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ABOUT IFMA IFMA is the world's largest and most widely recognized international association for facility management professionals, supporting 24,000 members in 100 countries. This diverse membership participates in focused component groups equipped to address their unique situations by region (136 chapters), industry (16 councils) and areas of interest (six communities). Together they manage more than 78 billion square feet of property and annually purchase more than US$526 billion in products and services. Formed in 1980, IFMA certifies professionals in facility management, conducts research, provides educational programs, content and resources, and produces World Workplace, the world's largest series of facility management conferences and expositions. To join and follow IFMA's social media outlets online, visit the association's LinkedIn, Twitter, Facebook, YouTube and Flickr pages. For more information, visit the IFMA press room or www.ifma.org.

FMJ (ISSN 1059-3667) is published six times a year (January/February, March/April, May/June, July/August, September/October, November/December) by the International Facility Management Association, 800 Gessner Road, Ste. 900; Houston, Texas 77024-4257 USA. Periodicals postage paid at Houston, Texas and at additional mailing offices. One electronic copy of each issue is supplied to IFMA members. Printed copies are available to members at an additional US$48 per year. Nonmembers can purchase a subscription for US$84 per year. To receive a subscription, mail a check to FMJ, attn: Subscriptions; 800 Gessner Road, Ste. 900; Houston, Texas 77024-4257 USA or visit www.ifma.org/fmj/subscribe. For advertising rates call +1-281-974-5674 or email diana.maldonado@ifma.org. FMJ is printed in the United States. FMJ reserves the right to edit any articles received or solicited for publication. This right includes the discretion to select titles, artwork and layout. Opinions expressed in articles are those of the authors, not necessarily those of FMJ staff.

POSTMASTER Send address changes to: FMJ, 800 Gessner Road, Ste. 900; Houston, TX 77024-4257 USA.

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Online

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FMJ Extras

The online version of FMJ features extra resources like videos, podcasts, white papers and more to enhance your reading experience. Click on the FMJ Extra icons that appear in the digital magazine to link to additional sources of information to learn more about topics covered by articles in this issue.

FMJ Extended

Check out the online issue of FMJ for a special section that follows the end of the print magazine and includes additional articles not available in the print edition. Read the extra articles listed below for contributions from councils and communities, and other supplementary content.

FROM LAST ISSUE

The **March/April 2018 issue** of FMJ had a theme of **Financing FM**. Our most-read article was on preventative asphalt maintenance, **It Saves to Pave**. Read it now at **http://bit.ly/0218pave**.

READER FEEDBACK

"FMJ—I've always considered it a great resource for best practices, next practices and things that are going on in the facility management industry."

– Steven Early

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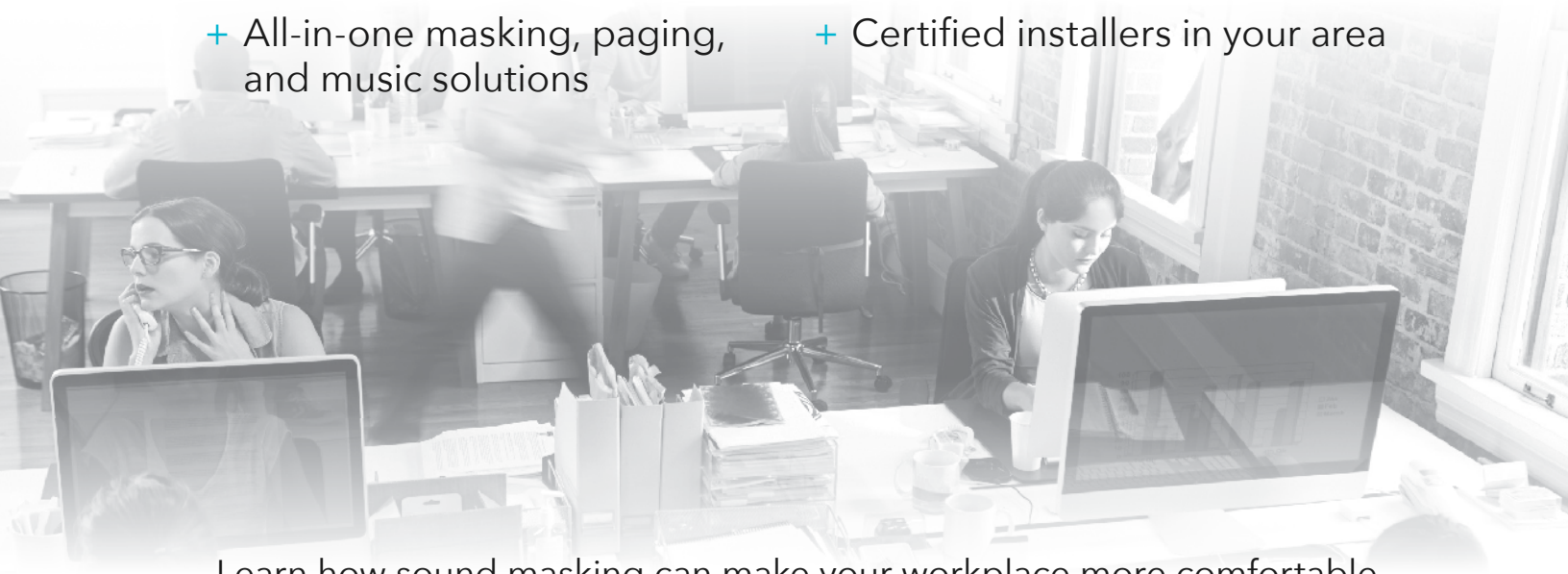

Learn how sound masking can make your workplace more comfortable, private, and productive at **cambridgesound.com/MayFMJ**

Editor's Note Jocelyn Kerr

I don't think I'm alone in saying the weather this spring has been anything but spring-like. Still, as the seasons turn, it is a good time to think about back-to-basics operations and maintenance.

The U.S. Department of Energy's Federal Energy Management Program released a set of best practices to improve efficiencies and reduce energy consumption in buildings. While the guidelines were originally intended as best practices for government buildings, the DOE estimates implementing their best practices could save a facility between five and 20 percent on energy costs without requiring any significant capital investments. It may surprise you how small changes can add up to sometimes significant savings over time.

This issue of FMJ is all about "Owning O&M." Alternative power sources, such as solar, have gained in popularity over the last few years, but installing solar in small- to mid-sized facilities has been a challenge when it comes to implementing solar on-site. On Page 28, find out how solar is finally being made available for mid-sized companies, so they can realize the same savings as larger facilities.

Another issue facing FMs is the growing concern about vapor intrusion and potential liabilities from occupant exposures. "Vapor Intrusion: EPA and Potential Liabilities" on Page 56 provides an overview of how vapor intrusion occurs, where you're more likely to find it and how to address it.

Cyber-security may not immediately come to mind when it comes to O&M, but with so many IoT devices and sensors being installed in facilities around the world, cyber-safety has become an issue FMs need to be proactively aware of. "Cyber-Security Guardians of the Built Environment" on Page 60 looks into how an HVAC vendor may have played a part in the Target data breach a few years ago and how FMs can build digital protections into their systems.

Finally, on the global front, "Reduce, Reuse, Responsible Recycling" on Page 73 digs into the 2018 China ban on some types of recyclables. Is your facility affected? Do you know where your recycling goes? The article provides an overview of the new ban and how new technologies and reframing the "reduce" conversation can lower the amount of waste produced in a facility.

From using maintenance history to optimize workflows to using life-cycle cost analysis in your next flooring procurement, this issue has a little something for each area of a facility (including enhancing your triple bottom line!).

We hope you find some ideas to inspire your O&M efforts in the coming year, and as always, we welcome your feedback!

Interested in writing for FMJ?
Email **jocelyn.kerr@ifma.org** article ideas to be considered for future issues of FMJ.

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From the **Chair**

WILLIAM M. O'NEILL
CFM

Chair, Board of Directors

Greetings, once again, IFMA members! As we reach the midpoint of the year, I want to give you an update on some of the major areas of change and progress that I first wrote to you about last September, when I began these columns. One of the initiatives I mentioned that would be at the forefront of our efforts was IFMA's continued involvement in the ongoing development of global standards. The release of three FM-related ISO standards occurred last year, and a fourth is finally set to be released. The previously released topics include:

- FM Vocabulary, ISO 41011:2017
- Guidance on Strategic Sourcing and the Development of Agreements, ISO 41012:2017
- Scope, Key Concepts and Benefits, ISO/TR 41013:2017

And now, Management Systems, ISO 41001 will soon be joining that list.

Another area of focus is IFMA's continued collaboration with the Royal Institute of Chartered Surveyors (RICS), which was signed in April 2016 and continues to extend the IFMA reach for credentials, knowledge sharing, networking opportunities for our members and co-sponsored events (such as the recent World Workplace Middle East conference in Dubai, where I was one of the speakers).

You might remember I issued a challenge at the beginning of this year to continue learning and advancing your career by enhancing your skills in the 11 core competencies. With the industry constantly changing, it becomes more important than ever to keep up with professional development and make good use of the resources and networking opportunities available to you as IFMA members.

Have you visited the Engage platform yet? I've been pleased to see the number of members sharing advice and exchanging information on both the website and the app that came out a few months ago. I recommend using these available tools to connect with other FMs and built up a network of career support and expertise.

The IFMA Board of Directors is continuing to focus on the mission laid out in our strategic plan. Built around the strategic themes of global community, membership, sustainability and knowledge/education, our actions and decisions are based around these themes and balanced between the different perspectives that make up the organization: stakeholders, governance and systems, learning, growth and financial health.

As always, it is an exciting time to be in facility management. I look forward to connecting with you at the next event!

Bill

Explore IFMA

Get the most out of your membership with the following resources:

IFMA Engage
engage.ifma.org

The 11 Core Competencies
ifma.org/about/what-is-facility-management

Learn more about the strategic plan
ifma.org/about/strategic-plan

The Knowledge Library
community.ifma.org/knowledge_library

The Research & Benchmark Institute
research.ifma.org

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International Facility Management Association

Empowering Facility Professionals Worldwide

From the **President**

TONY KEANE
CAE

President and Chief Executive Officer

As you're receiving this issue of FMJ, World FM Week is underway. World FM Day falls on May 16 this year, and IFMA has planned five days of FM gratitude, from May 14 through May 18, to celebrate your contributions to the industry.

The entire month of May is a time when the FM community gathers to celebrate facility management and the work you do. This year's theme, "Enabling Positive Experiences," serves as a reminder that facility management is a strategic, impactful and integral part of everyone's lives. I encourage you to participate by accessing free FM content online, attending in-person events and joining online conversations using the hashtag #IFMAWorldFMDay. This is all part of a larger recognition that FM practitioners on all levels work to create safe, productive and enjoyable built environments. Every day, around the globe, FM professionals make sure that all facilities are not only performing effi ciently, but also that they are pleasant and productive places for people to live, work and play.

Of course, there's more going on at IFMA beyond World FM Day. I had great visits with many of you at Facility Fusion Chicago in March, and the following month the World Workplace Forum Middle East featured global experts sharing their experiences on the future of FM.

The event in Dubai marked the launch of the Strategic FM Framework, authored by Dave Wilson, FRICS, IFMA Fellow with input from industry leaders. This guidance note sets out a coherent, consistent approach to planning the provision of FM. It combines experience from a range of sources consistent with ISO standards to outline best practices in the strategic delivery of facilities services to optimize value and contribution to the organizations that FM supports.

Speaking of standards, last month the International Organization for Standardization published ISO 41001 Facility management – Management systems – Requirements with guidance for use. We were proud to support this new management systems standard as administrator for the U.S. Technical Advisory Group and appreciate the involvement of all members who contributed to making it possible.

IFMA staff is hard at work on World Workplace, which we'll hold on Oct. 3-5 in Charlotte, North Carolina, USA (with plenty of input from the local chapter). Many chapters, councils and communities have already joined the Race to Charlotte, a friendly competition leading up to the main event. If your component hasn't signed up yet, learn more online and get started by declaring your commitment on the Engage discussion platform.

Educational and training opportunities, as well as events that facilitate connections in the FM community, are two of the things IFMA staff are most passionate about providing to members. We're committed to fulfilling the shared goals for IFMA's future that came out of the Appreciative Inquiry process started last August: sharpening your skills, providing an exceptional member experience, increasing visibility of FM and equipping the industry to lead innovation.

With global recognition of the FM profession in full swing this May, now is a perfect opportunity to invite a colleague to join you at IFMA.

Tony

Find free FM content related to "Enabling Positive Experiences" online at **www.ifma.org/wfmd18**

Download Dave Wilson's Strategic FM Framework for free from the Knowledge Library at **bit.ly/strategicfmframework**

Sign up for the Race to Charlotte for World Workplace 2018 in October at **bit.ly/racetocharlotte**

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IFMA APPROVES PETITION FOR NEW CHAPTER IN UNITED KINGDOM

IFMA's newly formed regional chapter, which joins 136 IFMA chapters across more than 100 countries, will provide a local community for professionals in the UK to grow their careers and expand their FM knowledge and skills though IFMA resources.

With a mission to "enhance, evolve and expand the knowledge of facility managers with a focus on the United Kingdom, while also providing pathways to career success for young professionals within the industry," the chapter will offer direct localized support that taps into the global industry in ways not currently available in the UK market. In addition, it will help ensure the UK continues its critical leadership role in the ongoing global evolution of the FM industry.

Mike Petrusky and his popular FM Innovator podcast join iOFFICE

Speaker, moderator, podcaster, entrepreneur and seasoned marketer Mike Petrusky has joined Silver-level Corporate Sustaining Partner iOFFICE as director of events and growth marketing. Leading the company's efforts to attract a broader audience via the web and live events, Petrusky will continue to host his FM Innovator podcast and take an active role in speaking engagements around the country.

"Bringing Mike on board means taking our live events platform to a new level," said Elizabeth Dukes, co-founder and CMO of iOFFICE. "Having deep conversations with the movers and shakers in our industry via the podcast and a great presence at more events means we'll be able to connect really important content and ideas with a global audience."

With a growing audience of 5,000 monthly listeners, Petrusky's FM Innovator podcast features discussions with industry leaders, including Workplace Evolutionary and HOK's director of workplace Kay Sargent; speaker, author and futurist Jacob Morgan; and IFMA Fellow and FM Transitions president Teena Shouse. Mike will continue to tap industry visionaries alongside iOFFICE experts and customers for practical approaches to tackling the digital workplace and elevating the employee experience.

ISO 41001: A standard to assess and measure FM organizations

In April, the new management system standard (MSS) ISO 41001, Facilities management – Management systems – Requirements with guidance for use, was published by the International Organization for Standardization Technical Committee 267 (ISO/TC 267) for Facility Management. The MSS provides specific requirements for organizations to demonstrate that they have a robust process through which to design, manage and improve an integrated standard for the practice of facility management.

According to ISO, the MSS is about "recognizing the scope of responsibilities and creating a management structure appropriate to the needs of the organization. Its main focus is to provide a framework and criteria against which FM teams can be measured as being 'fit for purpose' for the organizations they serve."

In praise of the forthcoming standard, Stanley Mitchell, chair of ISO/TC 267, the technical committee developing the standard, said: "ISO 41001 will help to clarify the 'what' as well as the 'why' facilities management is a strategically important discipline to all organizations in the management, operation and maintenance of the workplace, its assets and operational efficiencies."

UPCOMING EVENTS

International Sustainable Asset Management Conference 2018
June 4-6
Atlanta, Georgia, USA
isamconference.org

IFMA Advocacy Day and Public Policy Forum 2018
Sept. 12-13
Washington, D.C., USA
ifma.org/events

World Workplace® 2018 Conference and Expo
Oct. 3-5
Charlotte, North Carolina, USA
worldworkplace.ifma.org

MILLENNIAL BOSSES PRIMARILY COMMUNICATE VIA ONLINE MESSAGING

As millennials increasingly move into management positions, a new Korn Ferry (NYSE:KFY) survey reveals that this generation favors communicating with their employees online.

In a February 2018 survey of more than 1,500 professionals, 55 percent said online messaging is the most common way for millennial bosses to communicate with their direct reports, followed by email at 28 percent and in-person communication at 14 percent. Twenty-nine percent of respondents wished that millennial bosses engaged in more face-to-face communication.

"The way bosses communicate with their staff has a huge impact on organizational culture," said Samantha Wallace, Korn Ferry Futurestep North American Market Leader, Technology. "Millennials grew up using screens as their primary form of interaction; and while online messaging and email are efficient tools, face-to-face communication is needed to create an inclusive culture."

The survey found that managers believe millennial bosses are qualified. Seventy-five percent of respondents said they think millennial managers have earned their role; and 65 percent believe that creating flexibility in the workplace is what millennial bosses do best.

"Members of the millennial generation are really coming into their own in the workplace," said Wallace. "They may not approach management the same way as bosses from different generations; but instead of fighting change, adapting to the dynamic culture that millennials bring will help companies succeed."

View the survey results at **kornferry.com/press/millennials-as-bosses**

Employers' innovations in health coverage improve outcomes and lower costs

Employers have long been at the forefront of health coverage innovation. Frustrated with paying for the volume of health services delivered rather than the value received, employers continue to take meaningful action to transform the health care system.

A new report from the American Benefits Council (ABC) and Mercer, "Leading the Way: Employer Innovations in Health Coverage," describes programs developed by a diverse collection of large employers that are designed to align payment with value; incentivize quality care; personalize the employee experience; and embrace disruption in the health care market.

"Employers' role in our health care system is often taken for granted; but the case studies in this report clearly illustrate that employers, in their capacity as plan sponsors, are saving lives and helping to restrain costs," ABC President James Klein said.

According to Tracy Watts, Mercer's U.S. Health Reform Leader and member of the council's board of directors, the stories highlighted in the report exemplify how successful employers can be in managing cost, driving better quality and outcomes, and improving workforce health and productivity. "Taken together," Watts said, "these efforts can have a positive impact on employer bottom lines and America's competitiveness in the global economy."

As "Leading the Way" shows that employers have been successful where the government has struggled, it will be shared with policymakers in Congress, the executive branch, state officials and other opinion leaders to underscore the importance of enabling employers to address the challenges of the current system.

Download a complimentary copy at **https://goo.gl/u1Ej6P**

Federal funding for WaterSense program a victory for many

As part of a US$1.3 trillion government spending bill passed by U.S. Congress and signed by President Donald Trump, the Environmental Protection Agency's (EPA) WaterSense program will be funded at fiscal year 2017 levels until Sept. 30, 2018.

Plumbing Manufacturers International (PMI), its members and partners worked for more than a year to preserve the program. In a March 2018 letter to the EPA, PMI encouraged the federal agency to maintain the widely supported WaterSense program, which provides valuable water- and cost-saving benefits to American households and businesses. Over the past 10 years, WaterSense-certified products have helped consumers save a cumulative 2.1 trillion gallons of water and more than US$14.2 billion in water and energy bills since 2006.

Reflecting a bipartisan approach to addressing the nation's water issues, the bill also contains significant increases for clean water infrastructure investment, including:

- US$600 million for EPA State Revolving Funds (SRFs), split equally between the Drinking Water SRF and the Clean Water SRF for a total of US$2.9 billion in funding. These federal-state partnerships provide low-cost financing for water quality infrastructure projects.
- US$63 million for the Water Infrastructure Finance and Innovation Act (WIFIA).

INTEL-SPONSORED STUDY: SMART CITY TECHNOLOGIES GIVE BACK 125 HOURS TO CITIZENS EVERY YEAR

The concept of the smart city – which employs IoT technologies such as connected sensors, meters and lights to collect and analyze data to improve public infrastructure and services – holds the promise to dramatically change the way citizens live, work and get around. But is there a way to tangibly measure these benefits?

A study by Juniper Research sponsored by Platinum-level IFMA Corporate Sustaining Partner Intel estimates that smart cities have the potential to "give back" a remarkable 125 hours to every resident every year. Ranking the top 20 smart cities worldwide across four key areas – mobility, health care, public safety and productivity – the study reveals how these cities deliver positive outcomes for increased time savings and productivity, increases in health and overall quality of life, and a safer environment.

» **Mobility.** The study determined that an integrated IoT-enabled infrastructure of intelligent traffic systems, safer roads, directed parking, frictionless toll and parking payments can give back up to 60 hours a year to drivers.

» **Health.** Smart cities with connected digital health services can play a significant role in creating efficiencies – saving citizens almost 10 hours a year – and even potential life-saving benefits for both patients and caregivers.

» **Public Safety.** Improvements in public safety – such as transforming street lights into connected digital infrastructure beacons – can deliver nearly 35 hours per year to smart city citizens.

The study found that Chicago, London, New York, San Francisco and Singapore, are the world's leading cities integrating IoT technologies and connected services. These cities stand out because of their cohesive efforts to connect city municipalities, businesses and their citizens to address a growing need to improve "livability" as they transition to a smarter, more connected environment.

"Analysts tend to focus on the technical underpinnings of building a data-centric world," said Windsor Holden, head of forecasting and consultancy at Juniper Research. "We can't overlook the importance of the real human benefits that smart cities have. Connected communities, municipal services and processes have a powerful impact on a citizen's quality of life."

Smart cities may be still in the early stages, but based on the activities the study highlights, which are being rapidly implemented worldwide, there's every reason to believe these examples are just the beginning of what's possible.

Access the report at **intel.ly/2J6hF4T**

Worldwide spending on mobile solutions projected to be more than US$1.6 trillion in 2018

According to a new Worldwide Semiannual Mobility Spending Guide from International Data Corporation (IDC), global spending on mobility-related hardware, software and services is forecast to grow 3.2 percent year-over-year in 2018, reaching more than US$1.6 trillion.

"As device capabilities continue to evolve with augmented reality and artificial intelligence, and with 5G networks on the near horizon, the choices for mobile technology buyers will become increasingly complex and critical to business success," said Phil Hochmuth, program director, Enterprise Mobility.

Mobility services will account for nearly 60 percent of overall mobility spending. Smartphones will account for 75 percent of all hardware spending as businesses equip their workforce with handheld devices that can run mobile apps and communicate in real time. Enterprise mobility services will be a significant spending category as these industries implement and execute their mobile strategies:

» Professional services (nearly US$45 billion)

» Banking (US$43 billion)

» Discrete manufacturing (US$38 billion)

» Retail (US$32 billion)

The two largest geographic markets are the United States and China, each accounting for around 20 percent of all mobility spending throughout the forecast. Western Europe and Asia/Pacific (excluding China and Japan) will be the next largest regions in terms of overall mobility spending. The Philippines, India and Peru will see the fastest growth in mobility spending over the five-year forecast period.

IDC's comprehensive spending guide can help IT decision makers clearly understand the industry-specific scope and direction of mobility spending today and over the next five years.

Download the guide at **bit.ly/2GZbMWv**

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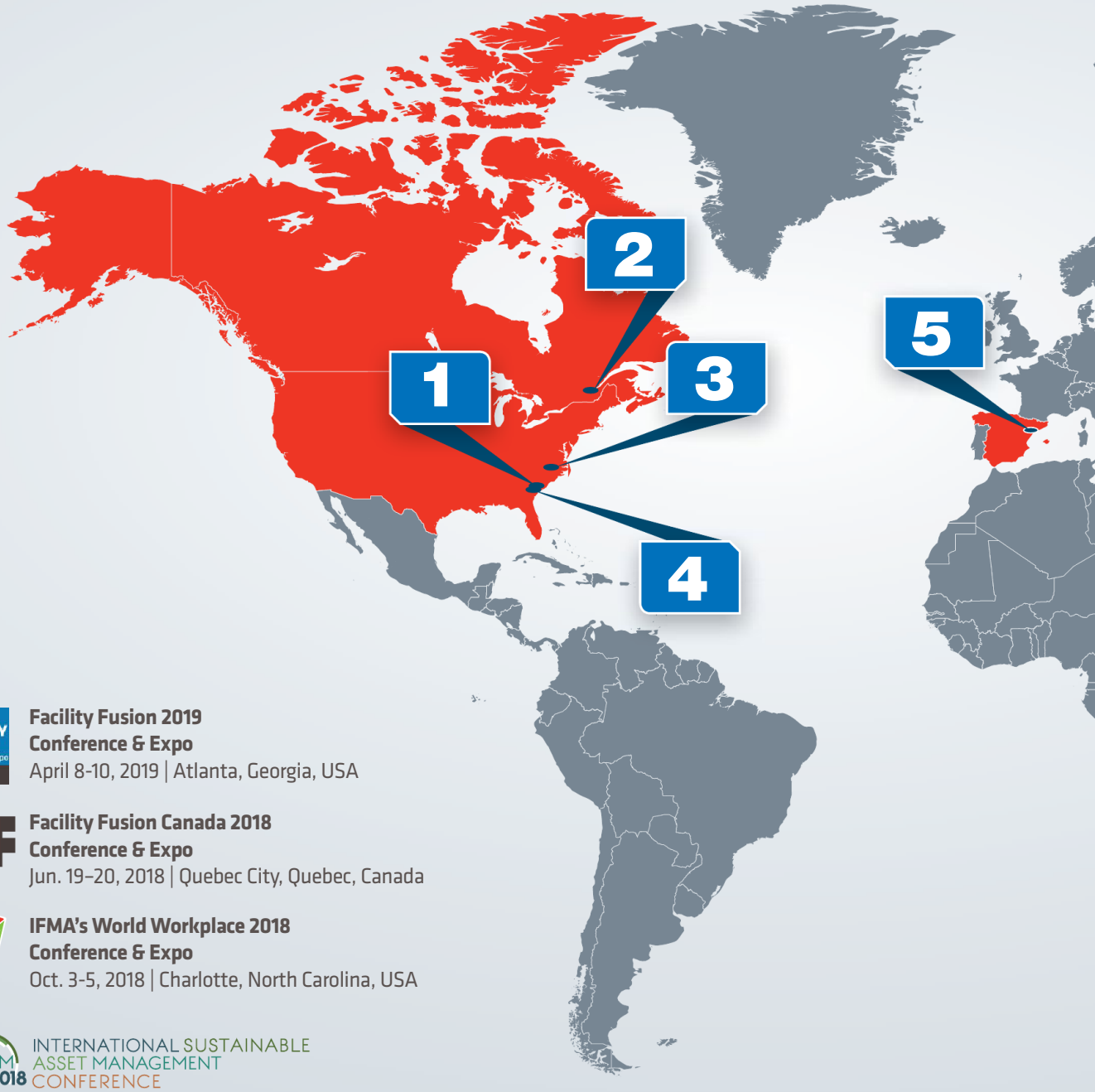


1 IFMA FACILITY FUSION Conference & Expo USA

Facility Fusion 2019 Conference & Expo
April 8-10, 2019 | Atlanta, Georgia, USA

2

Facility Fusion Canada 2018 Conference & Expo
Jun. 19–20, 2018 | Quebec City, Quebec, Canada

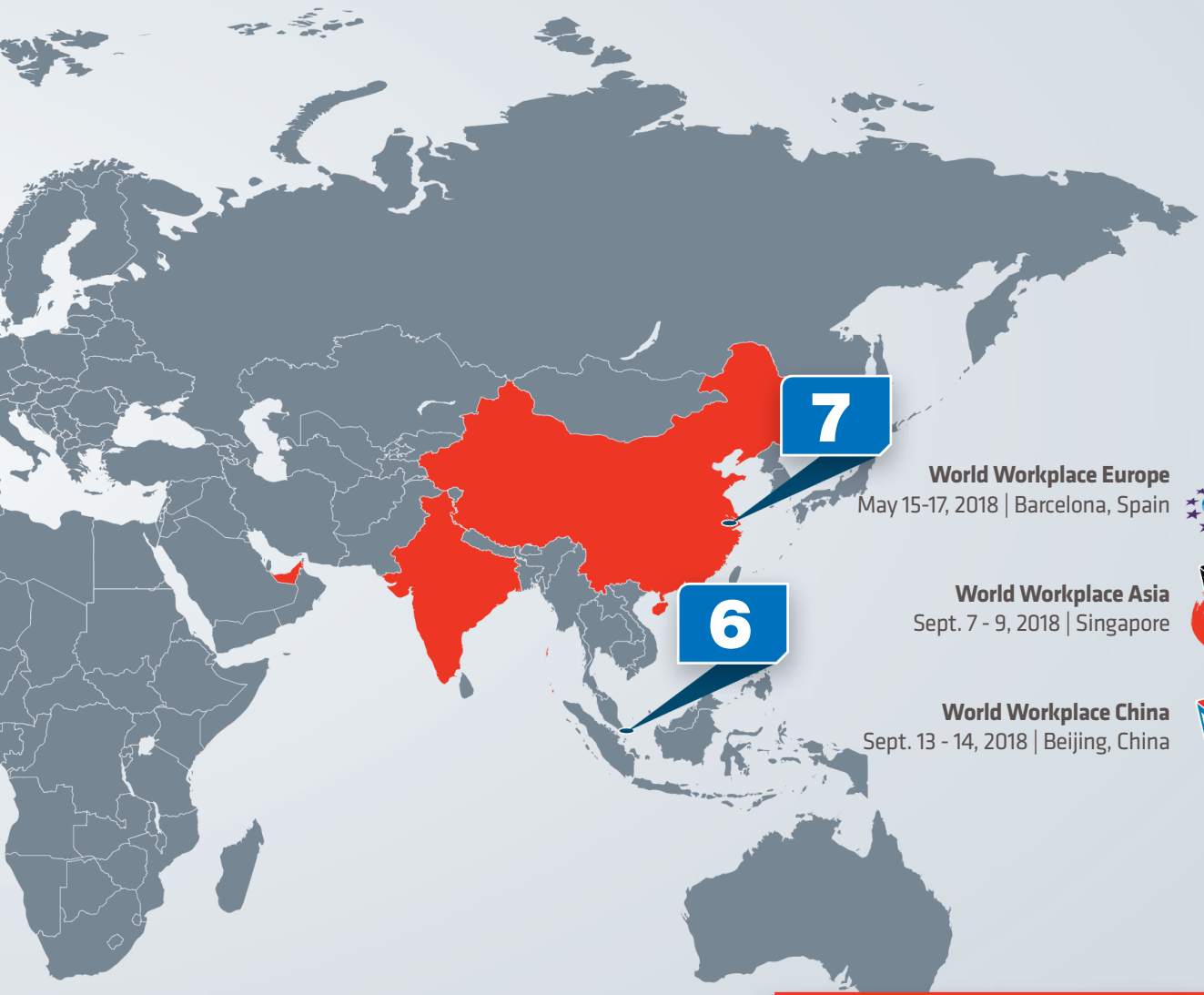
3

IFMA's World Workplace 2018 Conference & Expo
Oct. 3-5, 2018 | Charlotte, North Carolina, USA

4 ISAM 2018

INTERNATIONAL SUSTAINABLE ASSET MANAGEMENT CONFERENCE
June 4-6, 2018

At IFMA events held around the world, FMs from more than 100 countries, spread across six continents, find common ground to advance their careers and collaborate to identify and build the profession's best solutions.



World Workplace Europe
May 15-17, 2018 | Barcelona, Spain
5

World Workplace Asia
Sept. 7 - 9, 2018 | Singapore
6

World Workplace China
Sept. 13 - 14, 2018 | Beijing, China
7

Plan your FM event calendar at
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IFMA's Facility Fusion Chicago Influenced Change, Built Toward Future with Emerging Technologies

On March 20, 2018, IFMA's Facility Fusion officially kicked off in Chicago. Themed "Influencing Change, Building Toward Our Future," a variety of keynote speakers and power speakers gave presentations on leadership and technology topics, including digitization in the built environment, keys to unlocking leadership potential, creating winning workplaces and managing multiple generations.

While pre-conference sessions began on March 19 and served up CFM exam prep along with special sessions on BIM and sustainability, the majority of the more than 1,000 attendees arrived at the official start date to take part in three days of intensive education and networking opportunities.

"When you go to Facility Fusion, you may not have the breadth of session topics as World Workplace, but it isn't meant to be like World Workplace. Fusion is about education, it's about networking, [and] it's about how FMs can achieve operational excellence within their built environments," said Kim Coffey, IFMA Team Lead, CSP and Group Sales.

Coffey organized and launched the Emerging Technology Showcase on the expo floor this year. It gave attendees a hands-on opportunity to experience new and upcoming technologies, including sensor data and drone use, in the FM space. Mike Petrusky, host of The FM Innovator Podcast, was also on hand at the showcase to meet with attendees and answer questions.

The over-capacity expo floor contained more than just product demonstrations. It also featured fireside chats and FRED talks (Facility Related Education and Discussion — IFMA's version of TED Talks) on fixing gaps in emergency preparedness and how leaders can play to their strengths. As always, free headshot photos were available just inside the expo entrance, so attendees could update their website bios and social media profiles with a new, professional image.

Off the expo floor, IFMA Foundation Executive Director Jeff Tafel and IFMA Fellow and foundation chair Mike Schley met with attendees to talk about the Global Workforce Initiative and the foundation hosted a silent auction to support IFMA Foundation scholarships and programs.

Of course, the sessions are the real stars of Facility Fusion, and this year's focus on influencing change brought targeted sessions from Workplace Evolutionaries featuring the latest research on workplace design, strategy, the competitive advantage of sustainability and business resilience. Other learning tracks included leadership development, environmental stewardship and sustainability, emergency preparedness and business continuity, technology in the evolving workplace and sessions on human factors.

After a full day of learning, opportunities to connect with other FMs at offsite events were plentiful. The young professionals' happy hour and facility tours offered attendees a chance to enjoy Chicago's nightlife while getting to know other FMs. FMJ

In 2019, IFMA will host Facility Fusion in Atlanta, Georgia, USA from April 8-10. Watch for registration to open at **facilityfusion.ifma.org**.

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Visit facilityfusion.ifma.org for post-event photos & updates

IFMA
RICS

BY **JOHN RIMER**

THE fags ON cmms

How to find the right maintenance management system

FM technology has grown by leaps and bounds the past few decades. Maintenance management systems, such as Computerized Maintenance Management Systems (CMMS) and Integrated Work Management Systems (IWMS), are no exception. However, when it comes to these applications, many facility professionals are unsure whether they are ready for a CMMS or how to tackle implementing such an endeavor. In this article, we are going to address some of these questions and common hesitations, in hopes that FM professionals will take full advantage of these powerful tools within an organization.

CMMS, IWMS, CAFM: Which one should I get?

With a plethora of choices available, one should not be limited to any particular four-letter acronym.

Granted, some may draw distinct lines between these systems; however, their varying capabilities and array of modules quickly blur such delineations.

Rather than narrowing the selection to any single type, focus on the department's desired capabilities and organizational requirements. Then conduct the search for the best tool that meets the organization's objectives regardless of the flag it may fly under.

To mitigate repetitiveness, CMMS will be used in this article; but know that the principles discussed are applicable to any system.

Is our organization big enough for a CMMS?

Dare it be said that size does not matter.... Whether managing one facility or a worldwide portfolio, a CMMS will deliver value to any organization.

The difference lies in the magnitude and complexity. A small department will likely have a simple system. Larger entities may require a CMMS with more bells and whistles.

Regardless, all will benefit from improved customer satisfaction and communication, increased team efficiency, asset history and forecasting, comprehensive operations data and strategic information to drive informed business decisions.

Do we really need a CMMS?

Common refutes to this question include, "Excel works fine to schedule PMs" or "Everyone calls or e-mails us anyway." Some think IT's service request tool is sufficient or that a maintenance management system is only useful for managing and scheduling work orders.

Facility managers are accountable for the second-largest asset and expense for most organizations. Thus, it is imperative FMs operate as business managers, which requires a tool to help successfully perform as such. As the central nervous system of a facility organization, a CMMS is a necessary tool for today's facility managers.

Conversely, half of all organizations are reportedly reactive. In my experience, the departments enthralled in firefighting do not have a sufficiently functioning CMMS. Without leveraging a robust maintenance management system, costly firefighting will burn unabated.

In addition to scheduling and coordinating day-to-day operations, the data collected is invaluable for driving business decisions and justifying facility resources. In short, a facility management department will continue to struggle until they truly realize the benefit a CMMS can deliver to their organization.

What CMMS should we use?

This is one of the most common questions surrounding maintenance management systems. While seemingly straight-forward, the answer is not or should not be. Before shopping for a system, efforts should be made to determine what type of system is needed. A thorough needs analysis should be performed, which will result in a statement of requirements. Each candidate's capabilities should be quantitively evaluated against this benchmark to preliminarily identify the best fit. Once the pool of potential providers is narrowed, product demonstrations should identify how efficiently the required processes are navigated and if the user interface is intuitive. This user-friendliness is typically the deciding factor.

Will staff use it?

This is often the tallest hurdle that must be crested with any CMMS. The key to success is getting facility staff involved early in the selection process. They need to understand why a CMMS is needed and the benefit it can provide to the them and the department. This upfront buy-in will become especially critical when it comes time for them to capture work orders and where they spend their time. Plus, this will help head off the Orwellian, "1984" thought that the CMMS is "big brother." The value of operational and business data generated is dependent upon the completeness and reliability of the data entered by staff. Their full participation is crucial to success.

Streamlining the buying process The following roadmap can help simplify the system shopping process:

Conduct a thorough needs analysis to decide what information must be managed.

Create a statement of requirements that will be discussed with potential providers.

Use the requirements to create a benchmark to quantitatively evaluate each candidate.

Participate in product demonstrations to test navigation and user interface.

Can we afford it?

The better question is, "Can we afford not to?" The productivity and efficiencies gained by staff, coupled with the returned value of the data gathered, will quickly offset initial costs. That said, the advance of cloud-based systems and increased competition has minimized, if not eliminated, the affordability inhibitor. This leaves a strong choice of cost-effective solutions. The caveat, however, is while the software is relatively inexpensive, a reasonable budget and timeline should be set aside for implementation. Many organizations struggle with getting their systems off the ground as they attempt to set it up with their limited internal resources and knowledge. Thus, plan accordingly and solicit outside assistance as needed to expedite the process and ensure success.

How do we implement it?

Selecting a CMMS requires clear direction and understanding from the onset with involvement from all stakeholders. This upfront effort helps to ensure the organization drives system selection and not vice versa; additionally, it will help to establish expectations and relationships that can be leveraged during implementation. With respect to implementation, the proverbial approach to eating an elephant – one bite at a time – applies. A phased approach is strongly recommended. Once the locations and assets have been added and general configurations completed, facility staff can get their feet wet by internally capturing and completing corrective work orders. As the team's comfort level grows with the system, the preventive maintenance procedures and schedules can be established. This is followed by roll-out of the service requester module to the general populace. It may be a good idea to start with those occupants that have a more positive view of facilities and are more willing to accept the new process before opening it up to all customers.

What about mobile devices?

The efficiency gained in operations and communication with the advent of mobile technology cannot be overstated; not to mention the increase in responsiveness and data quality. That said, forcing such technology down the throats of unwilling staff can be extremely counterproductive. The value of engineers is in their expertise and "turning wrenches" – not painstakingly chicken-pecking at a tiny touchscreen. Thus, efforts should be made to identify the early adopters and get the technology into their hands. The success of the first few will quickly spill over to the abstainers, and position requirements and skill sets for new hires should include use of technology.

For most organizations, it is still unrealistic to expect 100 percent adoption of a mobile work order platform. As a compromise, perhaps an administrator would be more expeditious at entering data, dispatching work orders and coordinating schedules. This frees facility engineers to do what they do best. As the technology permeates throughout the department, the administrator can transition to a data analytics role, helping to proactively drive the organization.

While these answers to frequently asked questions are just a sampling, they will hopefully help many FMs breach the resistance to realizing the impact a CMMS can have on the department. Key to organizational success will be understanding the depth and breadth of CMMS capabilities and fully leveraging such in every aspect of day-to-day operations and strategic planning. The department will not be successful or operate efficiently until a robust CMMS is in place. So, stop the firefighting and take the leap. FMJ

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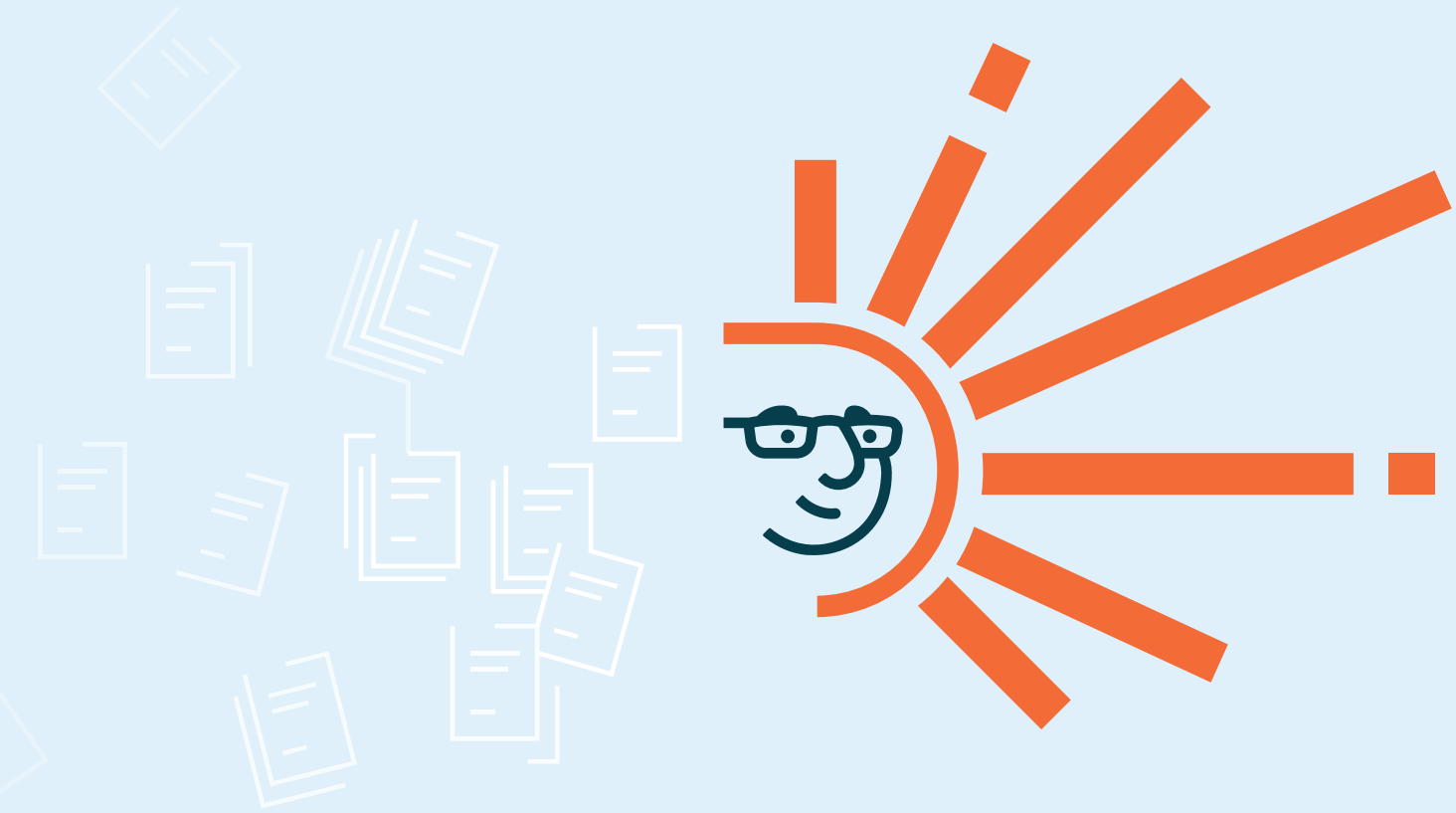

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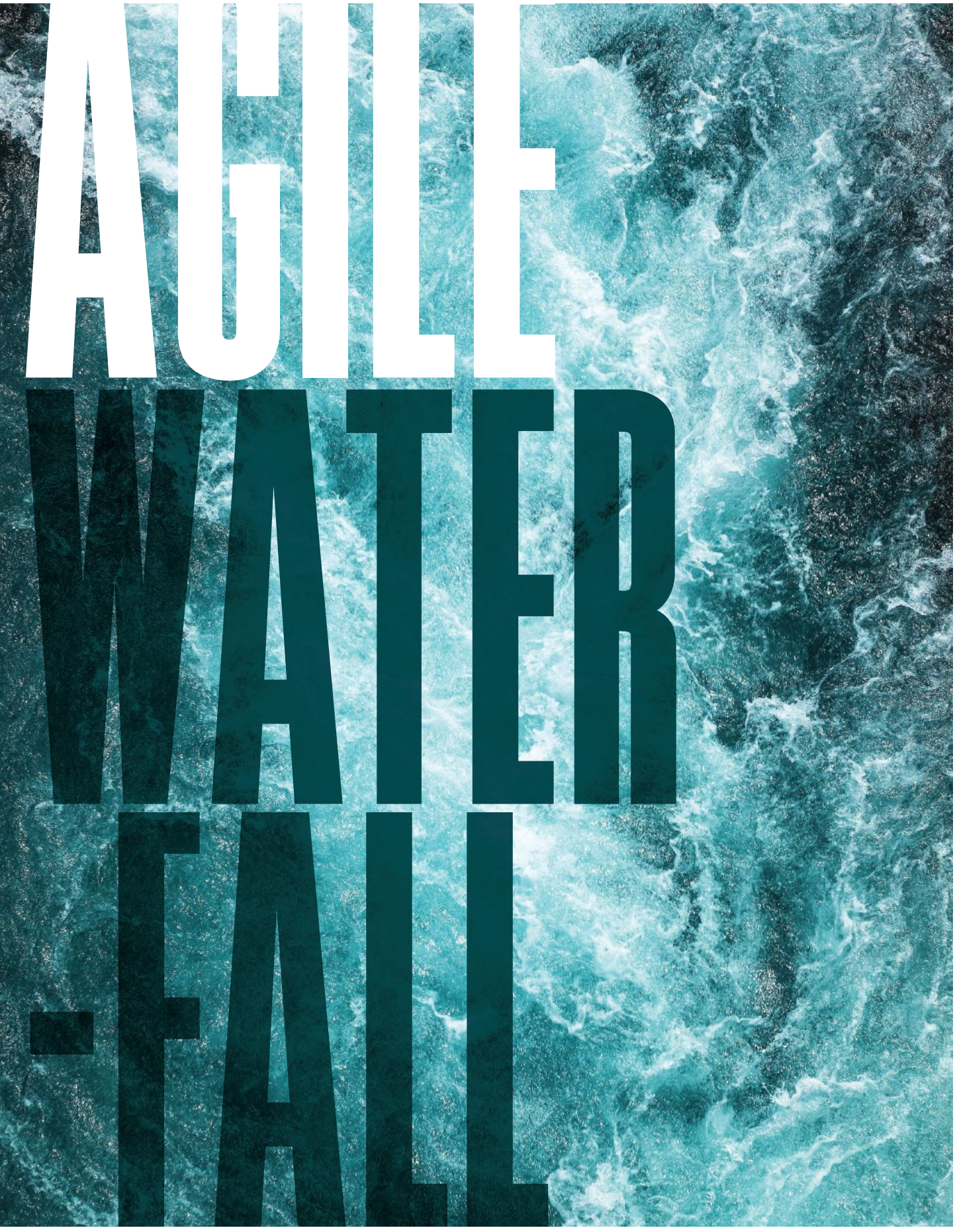
AGILE
WATER
-FALL

BY **CARLA HINSON**

Prevent implementation fatigue: understand roll-out techniques

A technology solution implementation kick-off can be time-consuming and heavily dependent on budget cycles and contract negotiations. When kick-off finally arrives, the business has already been discussing the new solution for months, sometimes more than a year, and is ready to get their hands on the solution. However, the excitement of a new solution soon gives way to a new set of implementation terminology, where words like "agile" and "waterfall" are often repeated but perhaps never fully explained.

How can FMs better understand implementation approaches so they ask the best questions about the approach and gain a better understanding to successfully manage expectations for their teams and clients?

During the technology solution kick-off, the implementation vendor will begin discussing the project schedule and deliverables in greater detail. Expect harsh reality to set in. While the business may feel that they have discussed requirements and the solution for years, they now realize that they have months until a solution implementation is complete.

This can be the start of a long cycle of implementation fatigue. On the upside, at this point, facility managers and other project team members can impact the project's direction by helping paint a very clear picture of what's needed to ensure a successful solution roll-out.

WATERFALL

While waterfall is possibly not a widely-known term, it is a known implementation process through which requirements are gathered and documented thoroughly before moving to solution design. Solution design is completed on paper with a lengthy design document produced for review and approval before moving on to the next stage of development and configuration. However, watch for red flags because this is where things can begin to veer off course. Design documentation typically contains mock-ups to depict the behavior of the solution. Facility managers and other project team members are expected to sign off on the document without having seen the solution in action.

Expecting a team to sign off on a lengthy design document produces several key issues. Solution behavior cannot be adequately depicted on paper without an extraneous amount of detail. The project team also will likely be told that once the document is approved any changes or deviations will require a "change request," which generally means more time and money. Once the product is configured and live, the document is typically stored on a shared drive and never opened or touched again because "Quick Reference Guides" or "Delivery Guides," which document the final solution in the context of end user roles, are much more practical to navigate. Additionally, the extended period of time required to complete a full solution design can demotivate a team that feels they have already "over-discussed" the solution (e.g. a year or more).

MOVING TOWARD AGILE

The team typically defaults to what they know, and many projects have come to expect this prolonged, painful design cycle. The good news is it does not have to be this way. Taking a step back and understanding the deliverables required to make the project a success can help. What if the team can minimize the design process duration and get their hands on the solution? That could help them better understand solution behavior and any available out of the box

UNDERSTANDING WATERFALL & AGILE

To understand how to prevent implementation fatigue, and to help steer the project down a successful path and realize a return on investment (ROI) sooner, it is important to first define "waterfall" and "agile."

Waterfall. An implementation with project activities and deliverables flowing in a linear fashion through phases where one phase must first be deemed completed before moving to the next phase.

Agile. A collection of methodologies where requirements and solutions evolve together. While design of a particular component is discussed prior to development, it is not necessary to design the complete solution before starting development.

(OOTB) functionality. Asking about minimizing is the first step toward moving to a more agile implementation approach.

An agile implementation methodology will group and assess requirements based on their priority. The project team agrees on a group of requirements to deliver in a "sprint" or "iteration cycle." During the sprint/iteration cycle, requirements are discussed in the context of solution behavior and team members' roles.

For each requirement, the facility manager will have a basic understanding of how the solution works and the configuration or development that will be completed. As the configuration/development is worked on, "build review" meetings occur to demonstrate progress in the solution. Frequent build reviews allow for near real-time feedback and ensure that:

Facility managers and other project team members see that the requirements will be met, and they are comfortable with expected behavior of the solution.

Issues raised can be addressed within the sprint/iteration cycle rather than at project end when changes and re-work are more costly from a financial and schedule perspective.

WHY NOT AGILE ALL-THE-WAY?

Based on the issues listed with the waterfall approach, and the benefits of an agile approach, facility managers may be asking why all companies do not move to an agile approach immediately. Fundamentally, change is difficult. When a company moves from a waterfall approach to an agile one, they often attempt to keep the same deliverables. An agile goal is to get the project team into the solution quickly with demonstrations of configuration as it occurs. Requiring a full design document as a project artifact will not only slow the process down but also causes rework because the document must be updated for each change.

The result is a deliverable that is continuously updated versus an ongoing process of configuration, review and improvement during the sprint/iteration cycle. However, there are situations where a complex requirement should be documented to allow for the demonstration of a clear understanding of the requirement and clearer communication to the technical team to help ensure efficient configuration or development. Therefore, the answer may be more of a hybrid approach taking the best of each.

TAKING HYBRID TO CONCLUSION

The next logical step is to define what is meant by complex requirements. How does the team determine which requirements warrant a more thorough design? This is somewhat dependent upon the team's experience level and how well they communicate. Generally, however, a workflow or process that will touch multiple forms or be used by multiple users will require more configuration.

An example of a complex requirement is an integration with another application. Integrations have stringent data and format requirements which should be documented in a specification prior to the start of configuration/development. Starting the configuration/development of an integration without an approved specification guarantees rework. That is due to the data and format requirements being different for each client as it is based on how the target solution of the integration is configured.

Another example of a complex requirement is certain workflows. If an approval workflow is mandated by company policy, it is best to document the workflow, receive approval and then configure/develop. Notice that each of these examples has very specific, well-defined requirements that do not change and must be met.

In these situations, each of these requirements would be defined in its own specification for sign-off and then configured/developed. However, the expectation is that they would still be part of the sprint/iteration cycle build review to allow the project team to see the solution at work. It is essential that the project team agree early on which requirements are complex and which are not. This prevents a slip back into a complete waterfall methodology.

Best of waterfall. Clear toll gates after each phase, and sign off prior to start of work helps prevent re-work in most cases

Best of agile. Early notification of failure minimizes schedule impact, and earlier access to the application and demonstration of met requirements.

If the project team is given the flexibility to determine the best approach based on the requirement at hand, they will be empowered to seek the deliverable they require for a successful implementation. Taking the best of both approaches could mean:

- Specification of complex design components to prevent re-work
- Direct configuration/development of easily met requirements with frequent demonstrations to the project team to minimize risk of not meeting a requirement
- Clear toll gates at the end of each sprint/iteration cycle which includes a build review with acceptance sign off and a review and re-prioritization of the requirements list (or backlog).

FMS ARE DRIVERS

As stakeholders and end users of new solutions, facility managers play a key role in ensuring that their business needs are met. Gaining an understanding of the implementation approaches available will allow FMs and other project team members to ask questions and understand how to make their project participation as efficient and effective as possible.

Challenging existing up-front documentation requirements will help reduce wasted effort and time on project artifacts that are not useful in the long term. And, most importantly, it can help reduce the risk of change by engaging facility managers in understanding solution behavior, thus allowing them to better set end user and client expectations. FMJ

Carla Hinson, *chief operating officer at eBusiness Strategies, brings expertise in service delivery, project management, business process and consulting services. She has more than twenty years of experience in the real estate industry and has worked both on the software/services and client side of IWMS projects.*

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small -scale solar

BY **OLEG POPOVSKY**

Since 2017, the global solar industry has seen record-breaking growth[1] and rooftop solar installations have become an increasingly popular option for reducing facility energy costs. The growth has largely been enabled by new financing solutions, decreasing equipment costs[2] and strong federal subsidies[3] coupled with increasingly common municipal incentives[4], making solar solutions a more viable economic decision for many facilities. Today's solar energy options provide energy consumers with a more cost-effective and sustainable solution than utility-only energy supply.

While the solar boom cannot be refuted, not all energy consumers are being offered the same options to take advantage of the benefits. Solar service providers, or installation companies, have primarily targeted large corporations and residential homeowners because institutional investors are more comfortable with the energy consumer's financial risk profiles. These market segments have benefitted from streamlined financing options and few barriers, which has not been the case for most commercial customers. A large portion of energy consumers have been left without adequate options for financing solar energy systems, specifically small- and medium-sized businesses, or SMBs, and non-profits.

Regional energy service providers have the right tools to install solar panels. Now, providers can access tools to help deliver simple and straightforward solar financing options to SMBs and non-profits, in large part due to financial technology, or "fintech," start-ups offering innovative services. These emerging companies are leveraging technology and data analytics to address common commercial market barriers. They are streamlining the financing process to ensure SMBs and non-profits can achieve the same benefits from solar as their residential and large-commercial counterparts.

IMPLEMENTING SOLAR

SMBs and non-profits represent a significant, yet largely untapped market. While SMBs represent incredibly diverse sectors — including auto, retail, medical, food service and many other industries — nearly all stakeholders face similar challenges of rising operating costs. They must consider how to address operating expenses, such as energy and employee healthcare, while continuing to grow their businesses. Going solar can help SMBs reduce operating costs on day one, often with no out-of-pocket expense.

ROUGHLY **99.7 percent** OF ALL U.S. BUSINESSES ARE CONSIDERED SMALL- TO MEDIUM-SIZED BY THE SMALL BUSINESS ADMINISTRATION[5], WITH 500 EMPLOYEES OR FEWER.

U.S. SMALL BUSINESSES SPEND MORE THAN **US$60 billion** ANNUALLY ON ENERGY[6], ACCORDING TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA), FURTHER HIGHLIGHTING THE POTENTIAL FOR SOLAR TO BENEFIT THE BOTTOM LINE.

For example, the average restaurant spends US$2.90 per square foot on electricity each year. For a 4,000-square-foot restaurant, the average size of a fast food chain, that equates to energy costs of US$11,600. Small businesses that go solar frequently save as much as 40 percent on energy costs. For a hypothetical restaurant, that means savings of more than US$4,600 per year, savings that can be reinvested to make a more efficient and profitable business.

Recent tax reform legislation is also increasing SMB investment companies, and companies across sectors are working to understand the implications the law will have on their business operations. The long-standing Business Energy Investment Tax Credit further incentivizes an investment in on-site solar as a tax-efficient building improvement that can significantly enhance business and facility operations.

While cost-savings are often the main incentive for SMBs, there are other benefits to implementing on-site solar. These projects employ local people and keep money in the community, all while reducing emissions and strain on the grid. These perks can be more difficult to quantify than cost savings but are important to businesses aiming to set themselves apart by supporting the local economy and environment.

TRADITIONAL MARKET BARRIERS

While the SMB and non-profit market is large and can greatly benefit from on-site solar, the sector has been largely under-served by solar providers due to the incredible diversity and complexity of the market. This raises very real financing barriers, and SMBs have typically needed to seek the expertise of niche financing providers to even consider how to implement a solar project. SMB financing typically faces the following challenges:

Long and diverse project development stages

As commercial solar projects pass through several development and implementation stages, risks and complexities compound. SMB stakeholders are often uncertain about which third-parties they are dealing with, the value proposition and the timeline for project realization. Typically, multiple stakeholders are involved in a project, with different project context and objectives. This contrasts with the common solar customer experience for homeowners, where the project incentives and goals are easily aligned. Typically, a residential solar project includes a simple transaction between solar providers and a utility.

Slow and complicated vetting process

Solar installers are typically not financing entities and don't have a long-term view on the important factors for assessing project economic risks. These risks include: sizing systems for immediate and long-term energy needs, addressing commercial real estate arrangements and ensuring tax and accounting efficiencies. Energy providers are rarely asked to consider such complexities, but they are critical factors for the success of investors and commercial customers.

Disinterest from financing providers

Banks tend to shy away from financing on-site solar, especially for smaller commercial clients, because they also lack expertise for assessing the risk of adopting new energy improvements. Banks, just like solar installers and energy providers, often don't have the capabilities to align investments with the financing needs of onsite energy contracting and deployment cycles.

ADDRESSING BARRIERS

E-commerce start-up companies are beginning to identify solutions to these common market barriers for SMBs and non-profits. Increasingly, these companies help commercial facilities assess the potential of a solar solution by validating electricity cost savings and offering the same types of streamlined service platforms we've become accustomed to in our daily lives — from ride-sharing apps to food delivery services.

Validating solar project savings includes both determining how savings will be achieved and clarifying the full process for all contracting entities involved in the project. Crucially, these new providers are removing uncertainty from solar transactions. There are several key factors to consider for mitigating risk and achieving commercial project success.

It may seem as if the "streamlining" of the commercial solar process is quite complex. However, new fintech online platforms ensure all pertinent information is captured in a single interface to provide the best power purchase agreement (PPA) or loan solution for a project that will guarantee savings. Once the ap-

case study: SOUTHERN JERSEY FAMILY MEDICAL CENTER

Southern Jersey Family Medical Center (SJFMC) is a non-profit organization located in Burlington, New Jersey. Corporate CFO, Ronald Kaplan, sought a clean, onsite energy solution to lower the facility's electricity costs and reduce carbon emissions. For over two years, SJFMC struggled to access the financing crucial to bringing the project to life. Energy provider Energy Solutions of New Jersey (ESNJ) was already working with SJFMC to implement building electrical services and sought out a number of PPA providers to enable the rooftop solar project.

To facilitate the PPA vetting process, ESNJ used an online platform from Braggawatt to streamline the project through the underwriting, contracting and implementation stages. The platform's financing process, milestone payments and appealing PPA and loan rates made the project feasible.

The solar installation now powers 20 percent of SJFMC's total electrical load and lowers the facility's energy supply rate by 37 percent to incur 13 percent net energy cost savings in the first year of project implementation. Through the financing arrangement, the non-profit will not only incur immediate savings, it will also be protected from long-term energy price increases through the solar financing arrangement.

This example illustrates the significant potential of on-site solar to reduce a site's energy costs and environmental footprint, if and when traditional adoption barriers are removed. While cost savings will vary based on the existing energy use of a building, jurisdictional electricity tariffs, site location and other factors, a facility can expect at least 10 percent and up to 60 percent savings on electricity costs. In terms of ROI, if a business finances with zero dollars down, that translates into day-one savings.

SMBs considering solar can expect a process that includes:

- Assessing key data and inputs, such as previous electric bills, project design and engineering and customer financials
- Determining exact requirements to achieve savings, including contractual obligations, site availability, permits, incentive assumptions, timelines and more
- Identifying relevant counter-parties to ensure project success – a single point-of-contact must be selected – an individual with the appropriate incentives who is responsible for ensuring all project objectives are aligned

propriate data is captured from a potential solar customer, either via the provider or end-customer, it's smooth sailing towards finding the right solution with a quick implementation timeline.

SMBs and non-profits can turn to on-site solar as a feasible solution for reducing operating costs attributed to energy supply. While largely overlooked in the past, stakeholders from these sectors have arguably the most to gain, economically and environmentally, from solar solutions. Fortunately, an ecosystem of innovative start-ups and data-driven analytics are making financing for these projects more accessible than ever. FMJ

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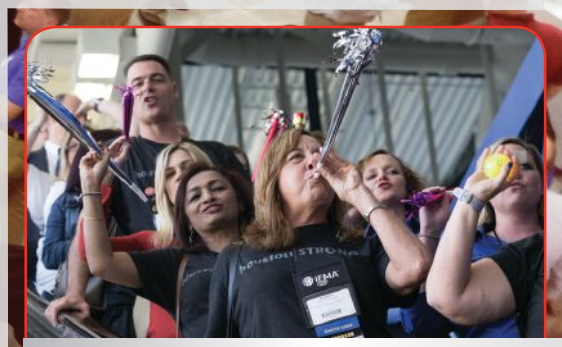

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BY GURRAM GOPAL AND JOSÉ LUIS MUÑOZ PÉREZ

Building Automation Systems

Building Automation Systems (BAS) are centralized, interlinked networks of hardware and software which monitor and control the environment in commercial, industrial and institutional facilities, ensuring the operational performance of the facility as well as the comfort and safety of building occupants. These systems are used to reduce utility costs while improving comfort. Building automation is normally used with the control of mechanical, electrical and plumbing systems including HVAC systems like chillers, boilers, roof-top units and heat pumps. Advanced BAS systems with complete automation may include other systems such as lighting, power monitoring, security and elevator management. Building automation for production or warehouse facilities (P/W) is significantly different from the systems deployed in "smart homes" or in "smart" office buildings. While those spaces are composed of several smaller rooms used by a few people, a P/W facility uses large rooms occupied by many workers, sometimes numbering in the hundreds.

These workers often share the space with machines that generate heat and increase the ambient temperature. This necessitates an occupancy control system, since the number of people is an important factor in maintaining proper temperature. A production facility might require different sensors and a larger number of them due to its size. Security is also more important with the colocation of workers and machines since the risk for injury is higher and there is a potential for harmful gases in some facilities. Hence, ventilation systems may also be included in the automation.

Another important factor in P/W facilities is energy consumption. Bigger rooms mean bigger and more complex HVAC and lighting systems. These factors drive greater energy use, hence the automation systems tend to be oriented towards energy savings. Also, the sensors and actuators need to be more precise since the temperature, humidity and lighting is important not only for the people but also for the machinery used in the facilities. Since these machines can cost several thousands of dollars each, the system has a greater focus on maintaining the right environment for the production system.

Elements of BAS

Although many building automation systems are customized, there are several generic systems in the market. These devices are often significantly cheaper as they do not depend on a specific building type or configuration. All BAS will control and manage HVAC systems. In addition, some manage other systems, including lighting, humidity, safety and security systems. It is important to determine the systems and parameters to be controlled before selecting the appropriate BAS for the facility.

It is important to determine the systems and parameters to be controlled before selecting the appropriate BAS for the facility.

ENERGY USE

Building automation systems draw a lot of energy. In P/W facilities, it is important to reduce this energy since the facility's equipment draws significant power and the devices used by the BAS add significant additional cost. HVAC systems draw most of the power consumed, since they work during production time and possibly all day. Radiant heat systems, although getting more efficient, consume significant energy in heating liquids to high temperatures to increase the temperature of a manufacturing or warehousing facility. Radiant systems can be installed in the walls or on the floor, but both options are expensive. Forced-air systems consume less energy, and they can deliver heat and air conditioning, but temperature management and dust and allergen control is more challenging.

LIGHTING

While temperature regulation is always needed in P/W buildings, complex lighting systems are not necessary if the lights can be turned on and off. However, proper lighting control is needed to reduce energy consumption and provide comfort for workers. Proper lighting does not have to be only artificial lighting. To achieve energy savings, take maximum advantage of natural light by installing windows that receive proper lighting during the day. Once windows are properly installed, alternative systems can regulate natural light through curtains that are managed manually or automatically. There are several companies offering automatic curtains at different prices. For residential use, a remote control is used to get the desired light. This is usually not feasible for P/W facilities, and the newer systems take advantage of sensors to move the curtains automatically.

In most P/W facilities, natural lighting is not enough for a working environment. Artificial lighting is needed during the hours where natural light is not enough. Moreover, facilities may not have access to natural light throughout the work day depending on the climate zone, or the facility operation may not be compatible with windows. There are three main types of automatic lighting systems in the market.

The most common system is based on an ultrasonic sensor at the entrance of the factory. When the system detects the presence of at least one person, the light automatically turns on. This type of system is common in many public buildings like universities, libraries and government buildings. The second system is based on a light sensor (photo resistor or similar), which detects how much light is in the room and will regulate the artificial lighting system by controlling the voltage. Some natural lighting is required for these systems, since a non-windowed room will always require artificial illumination.

HUMIDITY

Usually there are no actuators to react to the humidity in the air in P/W facilities. The commonly used systems have a sensor (which can be the included in the temperature sensor) which measures the relative humidity in the air and sends the reading to the main controller, but no ac-

tion is taken as a response to that value. In certain industries, like chip-making, textiles and food and beverages, the manufacturing needs very specific weather conditions (humidity and temperature). In this case, industrial humidifiers and dehumidifiers are used to regulate the humidity in the air.

SECURITY AND SAFETY

Security and safety are not usually included in common BAS, but they may be included to get all the electronic systems of a building into one management system. In the case of P/W facilities, safety and security covers not only the workers but also the raw materials, the final products and the equipment. This is especially important for warehousing where the products need to be secured to prevent pilferage or shrinkage.

Workers' security is addressed by detection sensors set up to ensure only those workers with permission are in the facility at a given time. Camera systems are also used, but to implement them in a BAS, high-end devices need to be used. They are usually installed only in high security environments. Ensuring safety of the materials and the workers in the facility is quite complex and most of the P/W facilities do not have an active safety system dealing with the two main problems in a facility environment: improper ambience and electrostatic discharge. The solution is to use a combination of passive (non-conductive materials and special clothing) and active systems to avoid undesirable charges. The active systems are composed of a basic controller attached to the floor and walls which ensure that they are grounded. Fire is another safety concern. Advanced fire safety systems are included in a BAS. These are composed of a number of sensors, buttons on the wall for manual alarm mode, actuators for an alarm system to indicate that an evacuation is needed and a water system composed of sprinkler nozzles in the ceiling to extinguish the fire. Fire extinguishers and hoses are usually not included in a BAS.

SOFTWARE COMMUNICATION

Two protocols, ONVIF (Open Network Video Interface Forum) and PSIA (Physical Security Interoperability Alliance), are commonly used to communicate across different devices used in a BAS. Other protocols, like Wi-Fi and Bluetooth, are used in residential automation but not for P/W facilities due to technical limitations and limits on distance. ZigBee, a wireless communication protocol similar to Bluetooth, is being developed for BAS. It is a specification based on the protocol IEEE 802.15.4 for high-level communication. Its main advantages are low bandwidth usage, the ability to create complicated Personal Area Networks with less interference, a long range for sending information and low power required.

CONTROLS

All-or-nothing control is the simplest version of digital control. Its functioning is very basic: The sensor takes a measurement and sends it to the main controller, which converts the signal to a parametric value. If this value is in the desired range, an actuator will be put into work. Proportional-Integral-Derivative (PID) controls are the option to choose when there is a signal that needs to be regulated according to a reference scale. This will happen with HVAC, advanced lighting control or automatic curtain systems. Although PID controls are enough for most BAS, some newer systems are starting to use advanced techniques, including adaptive control and predictive control which allow for earlier and faster control.

WORKER COMFORT

Temperature, lighting, and humidity can significantly affect worker productivity. As an example, radiant heat systems are only capable of heating the facility and may not be an option for areas needing air conditioning in the summer. Forced-air systems can provide heating and air conditioning, but facilities using machines that generate heat make temperature management more difficult.

COSTS

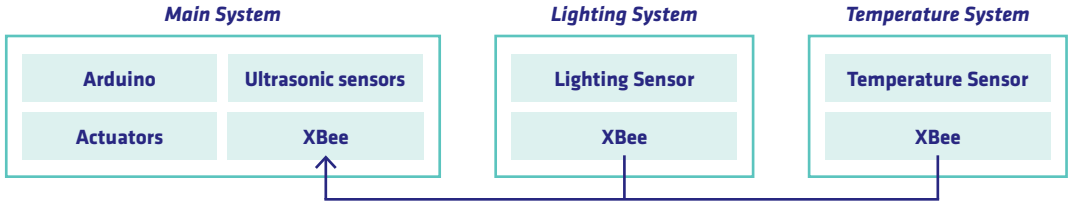
Various sensor types are needed in BAS. There are inexpensive sensors costing a few dollars (but have a high error range). There are also sophisticated sensors costing more than 30 dollars each that are very accurate. One solution is to use cheaper sensors and try to correct errors with the software. This is not feasible for P/W facilities where the cost of errors can be very high. However, there are some sensors that are reasonably priced and deliver high accuracy. For example, a DHT22 sensor for temperature costs ten dollars and delivers a ± 2 percent error, but it is also capable of measuring humidity, thus eliminating the need for another sensor.

The main processor in a BAS is a key component in system performance. The price of a processor ranges from about US$60 for an old AMD chip to $400 dollars for new Intel chip. Custom Programmable Logic Controllers are faster and more customizable, but at a higher cost.

COST COMPARISONS

The prototyped model illustrated is compared with two different systems built using technology available today for a local production facility in Chicago, IL, USA. One is a budget BAS composed of a forced-air system HVAC and automatic lighting systems (no regulation). The system uses a thermistor, wired components and an AMD fx 6300-based computer.

Communication design for a prototype BAS



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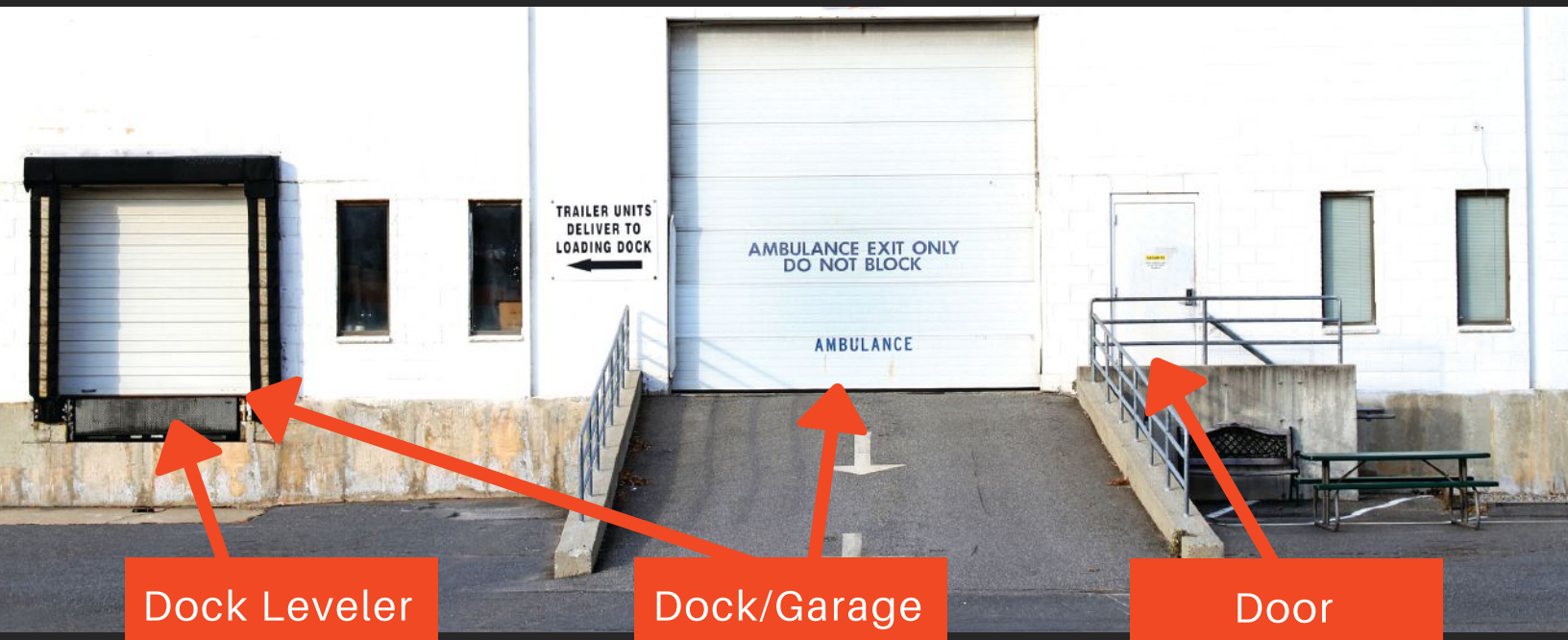

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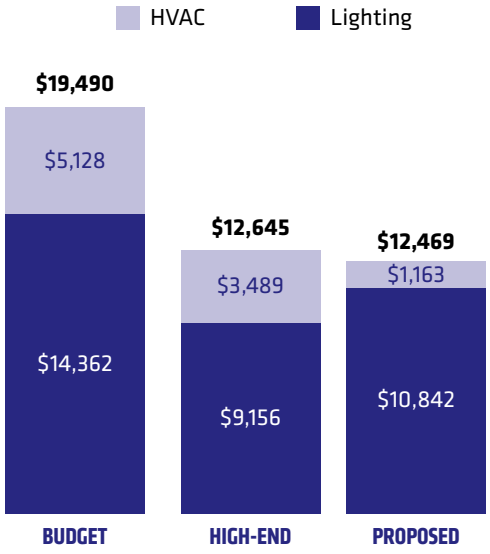
TABLE 1 *BAS Estimated Costs*

COMPONENT	BUDGET BAS	HIGH-END BAS	PROTOTYPED BAS
HVAC	$3,849	$12,685	$3,849
Lighting	$732	$1,139	$1,521
Ultrasonic sensor	$0	$34	$25
Lighting sensor	$0	$15	$0
Temperature sensor	$0	$10	$10
Communication	$148	$625	$1,352
Processor	$299	$1,985	$1,985
Coding	$400	$1,400	$1,400
Components price	$5,429	$17,893	$10,142
Installation	$5,639	$3,145	$3,145
Total Cost	**$11,068**	**$21,038**	**$13,287**

FIGURE 1 *Energy Consumption Estimates for the three BAS*



The second is a high-end BAS consisting of a radiant heating system, a separate air conditioning system and automatic and regulated lighting system based on occupancy. This system includes an advanced lighting sensor, DHT22 sensor, Wi-Fi communication, and a PLC Siemens S7-SIMATIC.

The prototype BAS consists of forced-air HVAC, and an automatic natural and artificial lighting system with no regulation. It includes a photo resistor, DHT22, ZigBee communication, and a PLC Siemens S7-SIMATIC.

Table 1 shows the estimated price of the different BAS setups, including the investment on the products and the installation costs (in U.S. dollars).

System repair costs are not included in the table. If the systems are wired and breaking the walls is required to detect where a failure has occurred, the repair costs will go up. A wired repair could cost between US$600 and US$2500 depending on the problem. For fully wireless systems, the modules are electronically coded, and the error can be detected on each module. Moreover, the parts in the modules can be replaced easily, thus repair costs are reduced to a range of US$150 to US$400 per repair. This makes the prototyped system the cheapest option if more than three repairs need to be made. Finally, the budget BAS option — which is wired — may require closing the facility if repair work is required, entailing losses for the company.

ENERGY ANALYSIS

To analyze energy use, assume the facility works 260 days a year, eight hours per day. Forced-air systems will be used all the time. In the case of the high-end BAS system, air conditioning will be used for six months, and the radiant heat system the other six months. The price for electricity is assumed to be 6.33 cents/KWh. It is assumed that natural lighting can be used in the prototyped system for an average of five hours per day.

Figure 1 shows energy consumption estimates for the three systems. The prototyped BAS has the lowest energy consumption, especially saving money in the lighting systems due to the use of natural lighting.

THE RIGHT BAS

As the tables illustrate, production or warehousing FMs should consider installing a BAS to lower costs. Custom solutions that have been tested commercially can significantly lower operating costs as well as initial costs when compared to high-end systems. High-end options will have better performance and efficiency in the HVAC area, but those systems are complex and expensive and may not be justifiable for some facilities.

As labor conditions tighten and companies need to attract and retain qualified employees while ensuring the safety and security of employees and assets, P/W facility owners and managers should actively consider a BAS system to power future growth in a sustainable way. FMJ

Dr. Gurram Gopal *is an industry professor in industrial technology and management at Illinois Institute of Technology with a keen interest in sustainability and corporate social responsibility. He has published more than 50 papers and articles and has presented extensively at academic conferences, including the Principles for Responsible Management Education conference in New Delhi, sponsored by the UN Global Compact. In 2011-12, he received a Fulbright Scholar Award to teach and conduct research at Galway Mayo Institute of Technology in Ireland, and is a Fulbright Specialist candidate from 2013 to 2018. During his career in industry and in academia, he has been actively involved in LEED projects and has worked with students to create innovative programs on sustainability using LEED-certified facilities.*

José Luis Muñoz Pérez *has a master's degree in industrial engineering from Universidad Pontificia Comillas and a master's in industrial technology and management from Illinois Institute of Technology. He is currently a firmware developer at Zennio, a global specialist in manufacturing building automation solutions.*

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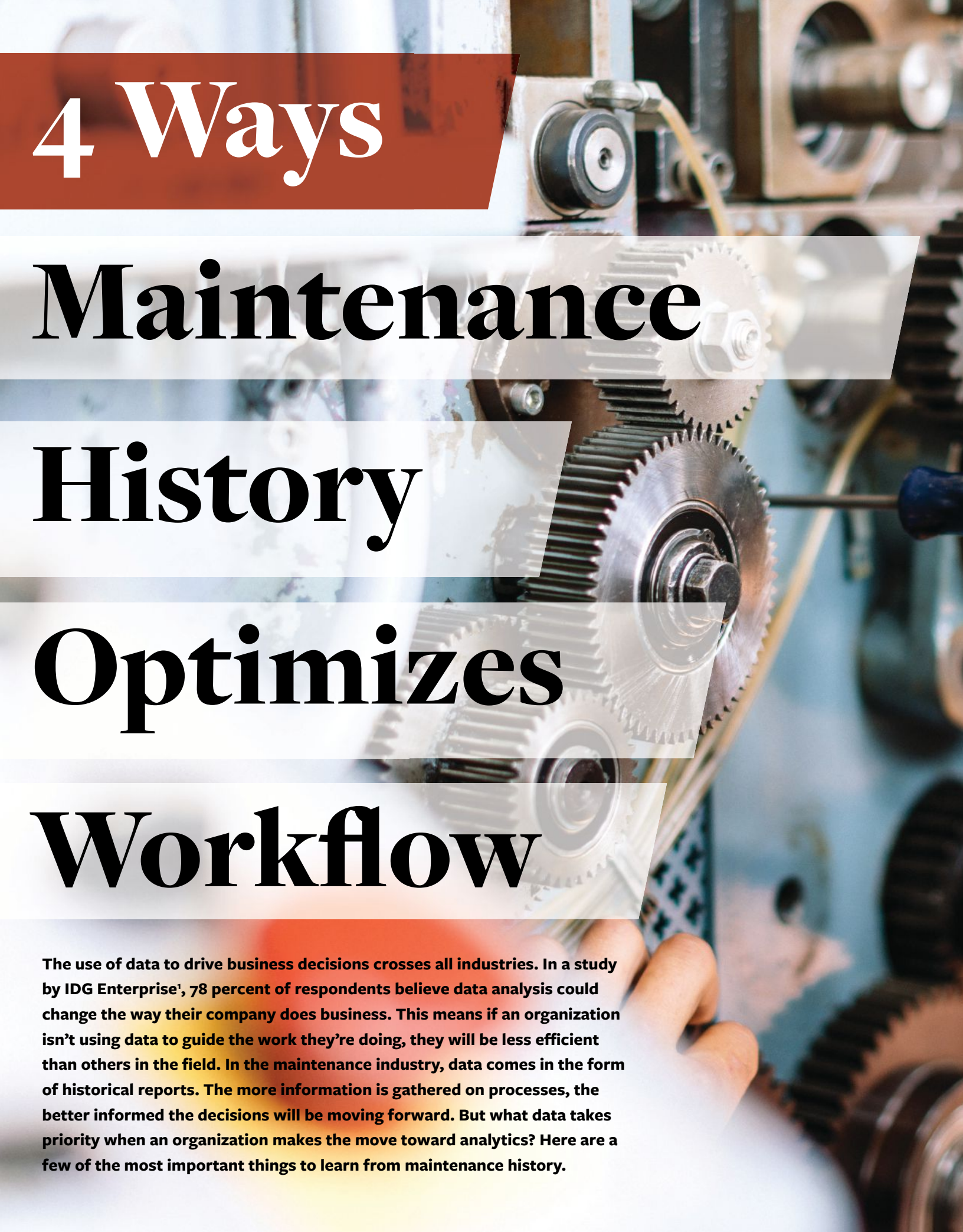


4 Ways Maintenance History Optimizes Workflow

The use of data to drive business decisions crosses all industries. In a study by IDG Enterprise[1], 78 percent of respondents believe data analysis could change the way their company does business. This means if an organization isn't using data to guide the work they're doing, they will be less efficient than others in the field. In the maintenance industry, data comes in the form of historical reports. The more information is gathered on processes, the better informed the decisions will be moving forward. But what data takes priority when an organization makes the move toward analytics? Here are a few of the most important things to learn from maintenance history.

BY **BRYAN CHRISTIANSEN**

1. How to Avoid Breakdowns

When a piece of equipment breaks down, it often comes at a high cost. Not only does a company lose valuable production time out of that equipment, but they also often find that the effects ripple out, interrupting numerous employees' ability to work.

In addition, repairing and replacing equipment is usually much more expensive than doing what it takes to prevent such a failure, meaning an investment in maintenance can make a big difference.

The best way to prevent breakdowns is to carefully monitor the equipment's maintenance history and performance. If that data has been collected for a period, there likely is enough information to analyze.

The only reliable way to track data on each piece of equipment, along with reports on work orders related to that equipment, is to implement a CMMS or similar maintenance software. As data analytics are refined, facility managers can learn more about what causes breakdowns, as well as monitor signs that will help predict potential breakdowns. Here are a few things to look out for during a review of the data:

— **PMs logged.** Is this machine getting enough preventive maintenance?

— **The time prior to the breakdown.** Can changes in productivity levels be measured in the days, weeks, or months leading up to the malfunction?

— **Employee feedback.** Try to collect employee complaints about the equipment prior to a breakdown. Were there signs that the equipment was going to fail, and could those signs be checked in the future PMs?

— **The mean time between breakdowns (MTBB).** In the months leading up to the failure, did breakdowns increase in frequency? Is this a recurring problem? If so, what is that cost and would it be wise to consider replacing the equipment, so production work doesn't get interrupted?

— **The mean time to recovery (MTTR) for this piece of equipment.** This can help identify the cost savings for any measures taken to avoid breakdowns.

— The **total estimated productivity loss** of each breakdown.

2. Identify Wasted Man Hours

Employer costs for employee compensation averaged US$35.64 per hour in September 2017[2], with another US$11.31 paid toward benefits like health insurance. While a team's hourly pay and benefits may vary, each man hour cuts into the operating budget.

Traditionally, to identify wasted man hours, managers merely looked around and identified employees who didn't seem to be working. But data today gives businesses a reason to go beyond that, finding areas where employees may be doing duplicate or unnecessary work.

Through analytics, FMs may find the weekly maintenance work they're performing on a piece of equipment could easily be scaled back to every two weeks, or even once a month, with no negative effects. Once that maintenance schedule is changed, they can monitor equipment behavior to make sure that less attention isn't causing more failures or a slowdown in performance.

Data can also show where repeated repairs on a piece of equipment are beginning to become cost prohibitive. Although replacement is always an expensive proposition, if there are repeat work orders for the same piece of equipment, the data can be used to calculate the cost of each hour the team puts into those repairs, then compare that cost to what would be spent to replace it. If this expense needs to be argued to the company owner, the necessary data exists to show that the added expense will actually bring cost savings over time.

When wasted man hours are identified and the cause of that waste is eliminated, FMs have the opportunity to channel those technicians into other areas of operations. For example, a technician who has previously only been asked to do routine maintenance and repairs may have the opportunity to learn the skills necessary to improve their effectiveness.

This skill growth-oriented approach often reflects in higher team morale as managers try to help the team personally improve. They'll also see a potential opportunity for advancement, giving them a reason to do a better job. Since high morale has been linked to[3] greater productivity, the business will benefit as a result.

3. Identify Potential Issues

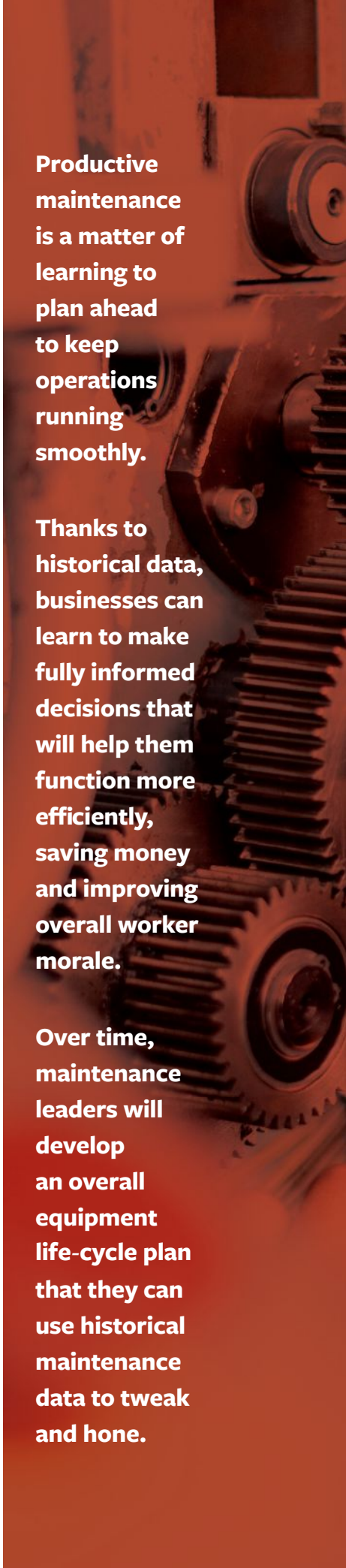
Risk management is an important part of maintenance work. Calculating those risks is the first step in keeping them under control, often saving money while also keeping employees safe. Maintenance history can be crucial in helping to prevent those risks, since past issues can speak volumes about the environment in which the equipment is operating.

As advanced as today's equipment is, often it contains sensitive electronic components that can be negatively affected by the environment around it. Dust and humidity can be particularly damaging, especially with prolonged exposure. Historical data may be the key to seeing exactly what's going on in the environment, especially when comparing one area of the building to another. If high rates of failure or multiple repeated breakdowns occur in one area of the building, it might be worth having a study conducted to determine if there are things that can be done to make the space safer.

Through the maintenance history, it's easier to quickly identify flaws in the methods of planning for repairs or replacement. The current plan may be to replace the equipment that generates the most work orders in a given year, for instance, or to get rid of the oldest equipment first. Historical data, though, could show that a certain type of equipment may need replacement more often than another type, helping to prevent a costly mistake moving forward.

Although it isn't maintenance data, worker safety is another area that can improve using historical data. Since the health and productivity of workers is an important part of maintenance work, predicting and preventing injuries can benefit the bottom line. It is not surprising that, in a survey from the last year, respondents said 81 percent of their personnel receives safety training[4].

If injury reports and workers compensation claims are tracked, they may be able to show where changes need to be made. If the organization chooses to make those changes by implementing a workplace safety training program, FMs can also track how doing this reduced the number of injuries. This will show whether the investment of time and training dollars paid off in the form of a safer work environment. Data can also be used to monitor the introduction of safety measures like back braces and dust masks to see if the investment saved money on worker absenteeism.



Productive maintenance is a matter of learning to plan ahead to keep operations running smoothly.

Thanks to historical data, businesses can learn to make fully informed decisions that will help them function more efficiently, saving money and improving overall worker morale.

Over time, maintenance leaders will develop an overall equipment life-cycle plan that they can use historical maintenance data to tweak and hone.

4. Develop Equipment Replacement Plans

Well-timed equipment replacement is essential to operations. If equipment is replaced when it still has years of productive use, the organization will spend money unnecessarily. However, waiting until the very end of an equipment's life could be just as bad for the budget. Historical data can show what to do to strike the right balance between getting the most use out of equipment and avoiding costly malfunctions.

For a fully effective replacement cycle, a formal document outlining an equipment replacement policy is a good idea. Without data, the temptation will likely be to use guesswork to set parameters for replacing each type of equipment. For example, there may be a policy to perform a replacement audit on each piece of equipment every year after five years of use. This audit will review the equipment and determine if it is time to replace it or not.

Historical maintenance data can help determine whether that was the right choice. Note equipment failures that illustrate the need to have equipment replaced the following year. If there aren't a large number of failures, delay replacement slightly and monitor the data to determine whether this was a cost-saving move.

Time isn't the only metric used to plan for equipment replacement, though. Based off of standard failure pattern curves[5], an FM can eventually learn their own equipment failure curves, which will help predict when a piece of equipment needs to be replaced. Work orders are key to this, especially if failure patterns illustrate an escalating series of failures as a piece of equipment nears its end of life. FMJ

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How Life-Cycle Cost Analysis Impacts Flooring Procurement

BY SANDRA SORACI

Facility managers and building owners who require a minimum of 15 years and up to 30, or more, years from their flooring investment will find the shift to life-cycle cost analysis to be an economic advantage.

Those tasked with flooring selection for new construction or renovation projects have an array of resilient flooring materials to choose from. The Resilient Floor Covering Institute (RFCI) defines resilient flooring as flooring that is firm, yet has give.[1] It occupies a middle ground between soft floors (carpeting) and hard floors (stone or ceramic) and includes rubber, vinyl composition tile (VCT), solid vinyl tile (SVT), sheet vinyl, linoleum, cork and luxury vinyl tile (LVT). The multitude of options can make choosing the right floor a daunting task, so it becomes important for a project team to align flooring selection and specification with the basis of design (BOD) to ensure the team makes informed decisions.

Several factors of the BOD can impact the purchase decision. Though important, aesthetics should not be the singular focus of the selection process. Performance characteristics such as ease of maintenance, slip, wear and stain resistance, durability, acoustics, underfoot comfort, infection control, health and wellness and indoor air quality (IAQ) are all key considerations. These features, coupled with appearance, shape the perception of a space and contribute to a floor's life-cycle cost. When facility and EVS managers begin to look at the purchase as an investment, they should also quantify the costs associated with cleaning and maintenance over the life of the product, in addition to performance characteristics. This comprehensive evaluation determines the return on investment (ROI) and is referred to as life-cycle cost analysis (LCCA).

Every floor looks great when it is first installed. But how it is cleaned and maintained determines its visual appeal after one year, five years and a minimum of 15 years determines whether the initial investment was a good one. The level of cleaning and maintenance a floor requires is often overlooked but must be considered during the selection process to support long-term operational optimization and efficiency.

A CLOSER LOOK

Flooring is a complex, integrated system consisting of a sub-floor for support, the floor covering and a surface finish that supports specific activities in a space. Flooring contributes to a building's structural integrity, occupying every square inch of measured facility space while impacting the life-cycle cost of the investment.[2] Because flooring contributes to the building's footprint, it must be durable and resilient enough to stand up to the ever-changing demands of the environment. Depending on the needs of the facility, flooring must also meet specific performance requirements. For example, healthcare

facilities mandate flooring with superior hygienic properties, while educational spaces may require flooring with exceptional acoustics.

Flooring can fall prey to the value-engineering process as administrators work to stay within budgets. Unfortunately, as this happens, decision makers often overlook the floor's accrued maintenance expenses and total cost of ownership over its useable life. A comprehensive analysis of both first-time and life-cycle costs is necessary to make an informed decision. LCCA can provide data to determine whether a floor is financially sustainable from a long-term maintenance perspective and, depending on the findings, support the decision for selection or de-selection. Using this model, credible product selection is now based on evidence as defined by the owner's cultural, operational and budgetary goals.

UNDERSTANDING LIFE-CYCLE COSTS

The economics of flooring decisions comprises many factors. Operational optimization, sustainable cost of maintenance and IAQ rise to the top. The Whole Building Design Guide from the National Institute of Building Sciences states, "Operations and maintenance costs over the typical 50-year life cycle of a hospital contributes up to 80 percent of the equation, so anything to facilitate maintenance and reduce total life-cycle cost will have tremendous returns on a relatively small up-front investment."[1]

The total cost of flooring extends far beyond the initial purchase price. LCCA provides a method for evaluating the economic impact of alternative materials with similar functional performance criteria but varying cost over the service life of a building or a building system[2]. This includes the cost to purchase, install the floor (including labor, material, adhesive and prep), and to clean and maintain it (including man-hours, labor rate, material, equipment size, cleaning frequency and cost of chemicals).

So how does LCCA impact flooring procurement? Does the resilient flooring material satisfy the qualitative standards for the building and the BOD? For example, a healthcare facility requires flooring that supports the patient experience and hygienic properties, while educational spaces are more concerned with flooring that lessens absenteeism by reducing the amount harsh chemicals needed for cleaning and enhances learning with exceptional acoustic qualities.

A mock-up is typically constructed for real-time evaluation as an integral part of the decision-making process. This method of transparency includes calculating the life-cycle cost for all flooring products under consideration, enabling the project team to generate a side-by-side comparison in the areas of first-cost, aesthetics, acoustics, cleanliness, comfort, maintenance, durability, installation and useful service life.

Taking total cost of ownership and dividing it by the number of years the flooring is expected to last results in the total cost per square foot/per year. Service life data from RFCI, manufacturer warranties and past performance metrics help determine the functional integrity and lifespan of various resilient products, dependent on the owner's requirements, size of the project, function of the space and traffic.

FACTORING IN MAINTENANCE

A study by Suzanne Barnes, Florida Hospital, Office of Design, showed the maintenance costs for coated VCT can be nine to 15 times the initial cost. It also showed premium rubber flooring had the lowest cost per square foot over the study's fifteen-year life cycle.[3] The maintenance required to uphold the perception of a clean floor and to sustain the functional performance characteristics is based on two factors: the product composition and the type and amount of use the floor receives.

Maintenance protocols vary among resilient flooring materials. Cost of maintenance includes cleaning tools, associated labor and the cost of chemicals based on real-time facility data. VCT requires a very labor-intensive maintenance process for the product's useable life.

Once a resilient floor needs to be coated, the maintenance regimen requires stripping, coating and refinishing throughout the balance of the product's useable life. In the case of premium rubber flooring, the floor's dense, nonporous surface reduces susceptibility to soiling, improves hygienic properties and provides a lower outlay for maintenance, resulting in better IAQ with little or no exposure to cleaning chemicals. By requiring little more than water for maintenance, premium rubber flooring can contribute to significantly reduced total cost of ownership.

Administrators at Nemours/Alfred I. duPont Hospital for Children in Wilmington, Delaware, realized a 75 percent labor efficiency increase, a reduction in overtime labor for floor care and maintenance and an 11 percent decrease in floor cleaning supplies when they replaced VCT with premium rubber flooring. Similarly, Reading Hospital, in West Reading, Pennsylvania, saw a 20 to 30 percent labor savings with premium rubber flooring. Slidell Memorial Hospital, in Slidell, Louisiana, USA, achieved a cost savings of 18 percent just by eliminating the purchase of floor finish and stripper after installing premium rubber.

It's also worth noting resilient floors that do not require the application and removal of finishes offer additional savings, because large areas of a facility do not need to be closed for extended periods of time, and IAQ is not compromised. This is especially important in a 24/7 environment such as healthcare facilities, where efficiency improves and room turnover can be accomplished quickly. It also positively impacts educational sites, where allergy and asthma are the leading cause of absenteeism, responsible for more than 14.4 million missed school days in the United States per year.[4]

SUSTAINABILITY AND MAINTENANCE

Sustainability is not simply a box that gets checked. Facility and EVS managers should not negate the impact that floor coating, stripping and waxing has on labor costs and health and wellness. Paul Byler, executive director of facilities and operations at Grand Valley School District in Orwell, Ohio, states his EVS team "feels better at the end of the day" noting that health and wellness has improved in the district with the elimination of chemical fumes.

The resilient flooring industry does not categorize resilient flooring materials in terms of initial and long-term costs based on the level of maintenance required. Many resilient products have a factory-applied coating that initially suggests a non-wax protocol. However, if the wear layer does not sustain, the long-term cost effectiveness of the material often negates first cost, leaving the facility at risk for significant, unplanned operational cost obligations over the useful life of the floor (Moussatche & Languel, 2002). And, if the coating is removed through normal wear and tear, the question becomes does the floor covering still meet IAQ requirements for low-emitting materials? Or is the only way they keep this status is through continuous or restorative maintenance which includes applying additional finish?

STRIKING A BALANCE

The key to LCCA is creating a bridge between operations and purchasing, so decision-making is not based solely on initial cost, but, rather, on long-term cost of ownership over the useable lifetime of the product. Making informed decisions about facility design and specifications may contribute to increased financial stability and resources that benefit the organization's long-term goals. When flooring requires a more robust maintenance regime, offers a shorter life span and/or fails to meet specific performance requirements, it can result in replacement or other costly modifications to a space. A floor's life-cycle costs, when carefully analyzed, can significantly impact the financial health of an institution in a positive way. FMJ

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BY **WESLEY ROBB**

VAPOR INTRUSION

DANGERS, THE EPA AND POTENTIAL LIABILITIES

AS MORE INFORMATION IS collected about the health effects of vapor intrusion, facility managers are beginning to take notice. Vapor intrusion is the potentially harmful migration of chemical vapors into a building from soil and groundwater that has been contaminated by volatile and semi-volatile organic compounds, and some inorganic analytes.

Dry cleaning solvents and industrial degreasers are examples of volatile organic chemicals. Naphthalene is an example of semi-volatile organic chemicals, and radon would be an example of an inorganic chemical. The vapor intrusion of these chemicals cannot be detected by sight or smell, making it even more critical to be aware of the issue. Facility managers need to be confident that those working and occupying the building are breathing safe, clean air, and they need to do their best to avoid any kind of financial responsibility attached to any deviation of this.

By allowing individuals to work and occupy space where vapor intrusion may be occurring, those in charge of operating the facility could be opening themselves up to lawsuits. Class action lawsuits have been settled for up to US$8 million in the United States. In 2008, residents and business owners in the state of New York filed a lawsuit against IBM claiming US$100 million in damages. The town's residents alleged the soil and groundwater were contaminated as a result of IBM's former mi-

croelectronics plant. Microelectronics manufacturing facilities are known to have used chlorinated solvents such as Trichloroethylene (TCE) in their circuit board and microprocessor chip wafer production processes. IBM went on to install vapor mitigation systems in more than 300 homes. The case was ultimately settled, but no details were disclosed.

In a very similar way to how radon gas can affect a building's inhabitable zone, so can vapor intrusion. In fact, indoor air radon gas contamination is a specialized form of vapor intrusion, since the radon gas enters a building by the same mechanisms that a contaminated solvent or petroleum vapor would. The only difference is the radon gas is a natural consequence of the type of granite rock in bedrock below a building.

Risk of vapor intrusion varies from one location to another due to their proximity to specific establishments which, currently or in the past, conducted operations that could have potentially contaminated the soil or groundwater. Other than Radon, the types of chemicals that are most associated with the phenomenon are volatile organic compounds, petroleum hydrocarbons and semi-volatile organic compounds. Hence, any existing development, or any development of property being considered near establishments that have used these chemicals should be assessed for the potential of vapor intrusion.

News and information regarding the effects of vapor intrusion continue to be released. These public statements and action taken by the Environmental Protection Agency (EPA) to mitigate the issue have served to heighten awareness of vapor intrusion as an issue to real estate transfer and development.

Recently, the EPA included vapor intrusion as a potential pathway in its Superfund Program. This has led to even more people in the industry learning about vapor intrusion and its potentially harmful effects. Furthermore, the EPA added a subsurface intrusion component to the Hazard Ranking System (HRS) on December 7, 2016.

The HRS is the principal mechanism the EPA uses to place sites on the National Priorities List. The addition of the subsurface intrusion component to the HRS meets the congressional mandate in Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) to identify releases of hazardous substances at sites that warrant further investigation. The EPA defines subsurface intrusion as the migration of hazardous substances and pollutants from the unsaturated zone and/or the surficial ground water into overlying structures.

The EPA states[1] that Section 121 of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that remedial actions which result in any hazardous substances, pollutants or contaminants remaining at the site be re-evaluated every five years to determine if the remedy is, and will continue to be, protective of human health and the environment.

OSWER Directive 9200.2-84 provides the recommended framework for assessing vapor intrusion in the context of the Superfund five-year review process — Assessing Protectiveness at Sites for Vapor Intrusion.

According to the EPA, Trichloroethylene is a widely used industrial chemical frequently found at Superfund sites as a contaminant in soil and groundwater. Furthermore, the EPA goes on to say that scientific evidence indicates Trichloroethylene poses potential cancer and non-cancer human health hazards. This has led to the EPA asking for more community and stakeholder involvement concerning the issue. As one example of a health hazard, the EPA has identified the risk of heart malformations to developing fetuses of women only seven weeks pregnant who have been exposed even to very low levels of TCE in indoor air.

Consciousness of the issue is the first real barrier to overcome. By knowing that vapor intrusion is a potential concern for a facility, managers are able to take the necessary steps to mitigate the issue and do their best to avoid unnecessary future litigation. If the history of a facility's site or surrounding areas make it a candidate for potential vapor intrusion, or if a manager is unsure of a site's history and just wants to be safe, then the first step is to hire an environmental professional to conduct a Phase I Environmental Site Assessment and, if indicated, follow up

What is the difference between a vapor and a moisture barrier?

Vapor barriers are often confused with moisture barriers. They are two different types of products with two very different purposes.

A **moisture barrier** is designed to keep water in its liquid form from entering a building enclosure. It also keeps water from building up behind walls and under slabs to prevent the growth of mold.

Alternatively, a vapor barrier is part of a complete **vapor mitigation system** to prevent vapor intrusion. A vapor barrier blocks vapors from entering the breathing zone of a building.

with appropriate sampling and analysis.

When installing a vapor mitigation system before a structure is built, there are different options on the table. These are generally constructed in one of these three manners: a vapor barrier only installation, a passive or active sub-slab depressurization system (SSDS), similar to radon mitigation installation, or a combination system with a vapor barrier installed above an SSDS. These all allow the dangerous chemical vapors to be directed away from a building's habitable zone.

The system chosen will depend on a number of factors such as specified construction requirements, type of chemical contaminants of concern and the prevalence of them in the soil, groundwater or soil vapor below the proposed building. An increasing number of construction projects are occurring on properties which necessitate the consideration of one of these types of vapor mitigation systems. But what if a building was constructed on a potentially dangerous site before vapor intrusion risks were on anyone's mind?

Retrofitting a facility to mitigate the risk of vapor intrusion must be handled in a different way. If it's determined by an assessment that vapor intrusion is a risk for a facility after it has already been constructed, options are limited. One of the most effective approaches is to apply a specially engineered sealant product to the basement floor and walls of the structure. This sealant is specifically designed to repel the sub-slab vapor that is trying to make its way into the structure. This approach has proven to be very effective, significantly reducing the amount of dangerous chemical vapors from intruding into the structure. Facility managers are leaning toward this option more often because the barrier itself doubles as a finished floor surface. Furthermore, it is an applied sealant, so there is no turning it "on" and "off." It is always working.

If facility managers know vapor intrusion could be a potential issue for their facility, they should reach out to an environmental consulting company that is qualified to perform the necessary assessments, sampling and analysis, data interpretation and system design required to protect indoor air quality. FMJ

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CYBER SECURITY GUARDIANS OF THE BUILT ENVIRONMENT

BY **PAUL DJURIC**

“THE POTENTIAL FOR AN ADVERSARY TO DISRUPT, SHUT DOWN (POWER SYSTEMS), OR WORSE … IS REAL HERE,” WARNED SCOTT WHITE, A PROFESSOR OF HOMELAND SECURITY AND SECURITY MANAGEMENT, AND DIRECTOR OF THE DREXEL UNIVERSITY COMPUTING SECURITY AND TECHNOLOGY PROGRAM. WHITE WAS COMMENTING ON MORE THAN 150 SUCCESSFUL CYBER-ATTACKS ON THE DEPARTMENT OF ENERGY BETWEEN 2010 AND 2014. **“IT IS ABSOLUTELY REAL.”**

The evolution and adoption of the Internet of Things (IoT) as a useful tool in building management systems (BMS) has proved White correct countless times. The number and scale of security breaches over the past six years, particularly via an organization’s BMS, illustrates the necessity for the IT and FM divisions (not forgetting the C-Suite!) to work together to protect an organization from the ever-mounting cyber-threat.

As per recent news reports, hackers are increasingly targeting property and facilities-related devices which are connected to the internet. Take Google's Wharf 7 office in Sydney, for instance. It was hacked via its BMS by two security expert researchers who were able to access the building control panel, showing the layout of water pipes in the third floor at its Australian headquarters.

This isn't the first time such a breach involving the built environment has happened, of course. In fact, the first time was nearly two centuries ago in Europe. France was hit by the world's first cyber-attack in 1834. During that time, towers topped with a system of movable wooden arms, each designed to point to letters, numbers and other characters, served as mechanical telegraph systems. It was the operator's job to keep watch of the neighbouring tower via telescope in order to read the coded message displayed, and to recreate it by adjusting the movable arms on top of their own tower to mirror the arrangement of the characters. This technique enabled the same sequence of letters and numbers to flow from tower to tower, speedily sending messages from one side of the country to the other in a matter of minutes.

Despite the fact the towers were supposed to be for government use, two bankers decided to take advantage of the structure for their own means. Prior to successfully intercepting the towers, The Blanc brothers used to spend days, sometimes even weeks, waiting for news about market conditions in Paris in order to successfully trade bonds in Bordeaux. Discovering the market moved faster than their communications could, the brothers decided to explore a better alternative. That's when they spotted the towers. To access the network, they bribed the telegraph operators to be "playful" with the government messages; not to obscure the content, as such, but to include an additional secret symbol that would describe market conditions — but only to those involved with the scam.

This is a case in point that complacency can lead to network intrusion. It also offers a reminder that human beings play a key part in such breaches. It wasn't the tower that was insecure; the operators and processes were the weak link in the chain. Finally, it serves as an example that regardless of the invention in question — towers or technology — there will always be those that find a way to prosper from the efforts of others.

DATA WARFARE

The physical infrastructures and technical systems that facilitate the automation and maintenance of building controls are often responsible for the delivery of vital data to facility managers and their teams. This data could encompass everything from health, safety and compliance, to lift maintenance and space usage. In the same way, service requirements may also be tracked through sensors that connect washrooms to smartphones or tablets which remotely alert cleaning and facilities staff when maintenance is required. While this connectivity is highly useful, it brings with it substantial risk, as financially motivated (or simply meddlesome) cyber criminals will find a way in if there's a weakness within a network, or if there's a way to exploit the human element. Furthermore, the richer the data sets, the more appealing the target.

Of particular concern to FMs is the source of the cyber-attack on U.S. company Target, which exposed credit card and personal data of more than 110 million consumers. This was carried out via a malware (short for malicious software) email phishing attack sent to employees at a third-party HVAC firm that did business with the nationwide retailer.

Despite the fact that Target was the victim of a third-party breach, the retailer has paid a very high price. CEO Gregg Steinhafel left the company soon after the incident and earlier this year the company also learned it was going to be fined US$18.5 million.

Often the points of entry that compromise a network are the devices and systems that leverage the power of data. When poorly secured devices are networked, they create links to critical systems through which data can be stolen or manipulated. Yet despite all these growing threats, there is evidence that organizations are still doing little to protect their systems from cyber-attacks, and the built environment appears to be particularly vulnerable.

A recent survey by the Electrical Contractor's' Association (ECA) in the UK found that almost 40 percent of smart buildings do not have adequate protection from cyber-threats, and there's no reason to suggest the situation is any different across the Atlantic or around the globe.

As information technology continues to evolve within the workplace, the responsibility for data security has been considered the remit of the IT department. However, the global economy has devoted huge levels of investment into the Internet of Things (IoT) over the last few years, with worldwide investment in hardware, software, services, and connectivity reaching approximately US$737 billion in 2016. The IoT is fast becoming firmly established in operations and the evolution of smart buildings.

Modern smart buildings are equipped with a range of IoT devices which automate much of the FM process, including lighting, HVAC, lifts, escalators and security. Connected technology enables building and facility managers to deliver higher levels of efficiency and gives occupiers unprecedented levels of control over their surroundings. But the FM department must also acknowledge that as a consequence of the new tech employed in the sector, they have an additional responsibility to contribute to organizational security.

Building Management Systems (BMS) have already begun to evolve into internet-enabled Building Automation Systems (BAS), making them a great deal more susceptible to po-

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Cyber Risk in an Internet of Things World

The VALUE of BELONGING

> **Belonging to IFMA is very rewarding to me because it allows me to network with other facility managers, who share many of the same issues I face. It also allows me to mentor young facility managers and students interested in becoming facility managers or enhancing their FM skills and experiences.**
>
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considered the remit of the IT department. However, the global economy has devoted huge levels of investment into the Internet of Things (IoT) over the last few years, with worldwide investment in hardware, software, services, and connectivity reaching approximately US$737 billion in 2016. The IoT is fast becoming firmly established in operations and the evolution of smart buildings.

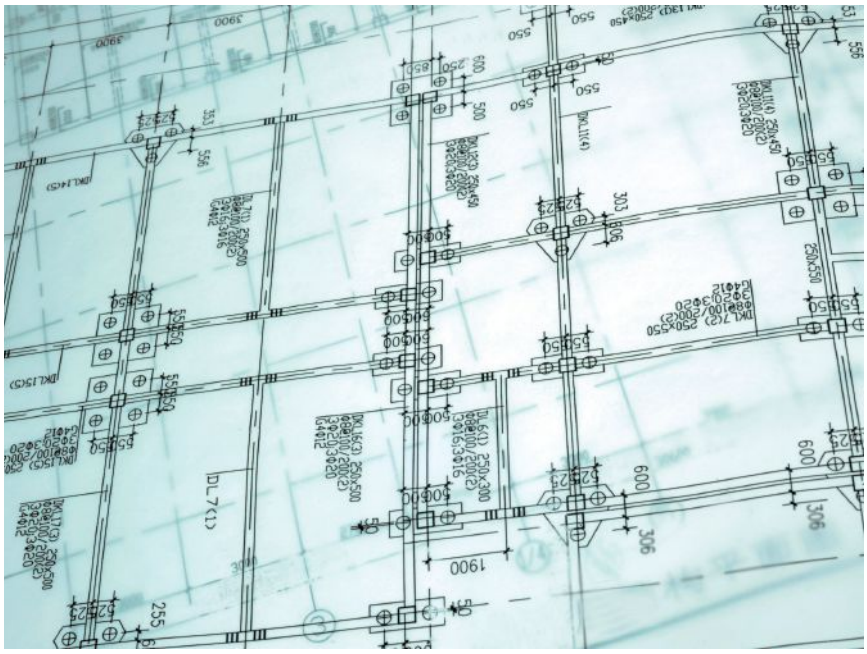
Modern smart buildings are equipped with a range of IoT devices which automate much of the FM process, including lighting, HVAC, lifts, escalators and security. Connected technology enables building and facility managers to deliver higher levels of efficiency and gives occupiers unprecedented levels of control over their surroundings. But the FM department must also acknowledge that as a consequence of the new tech employed in the sector, they have an additional responsibility to contribute to organizational security.

Building Management Systems (BMS) have already begun to evolve into internet-enabled Building Automation Systems (BAS), making them a great deal more susceptible to potential cyber-threats. The same technology which enables users to control all the elements of a building, including security equipment such as CCTV and door locks, may also be the access point for hackers to compromise systems and carry out a cyber-attack.

The IoT is, without doubt, an invaluable tool for innovation, but the associated increased risk to an organization cannot be ignored. With this in mind, it's critical to establish a best practice strategy to secure data in the cloud, protect data integrity while in transit over the public internet, and ensure all devices that are connected to a network are secure. This strategy should be developed and executed with the active participation of the various players involved with the conceptualization, development and deployment of a BMS.

ONCE MORE UNTO THE BREACH

In an effort to safeguard their systems, facility managers should begin the cyber-security process by lobbying those



who are responsible for protecting information to commission a data assessment. This will help an organization identify what critical information is stored, processed or transmitted, establish why the data might be an attractive target to potential hackers, and honor any regulatory compliance it must adhere to.

Once the value of data is understood, an efficient data risk assessment, that advocates the adoption of an information security standard and framework such as ISO 27001, should be conducted. Through this standard, organizations can measure and respond to data risk by establishing a platform for implementing, operating, monitoring, reviewing and improving information security.

Penetration tests on the network, both internal and external, should be performed. Although internal testing has proved to be a valuable tool, hiring an outside specialist to attempt to breach your network will identify weak points in your security that may have been missed by the in-house team. Consider establishing a group of "friendly hackers" that can assess aspects of cyber-security within an organization.

The facility management department should form an integral part of this process — particularly for pinpointing the built environment aspects of cyber-crime. For example, helping to identify physical items that could pose a risk, such as lighting sensors and other foreign devices connected to the network that could inadvertently offer an inroad. It's worth noting that some of the cheaper and disposable IoT devices may not have sufficient inbuilt network security.

Once penetration tests and a data risk assessment have been completed, the organization must address any vulnerable links within the system and ensure they are resolved and fortified. End users to any part of the network usually comprise the most vulnerable points of access. Using the same password for multiple work devices, applications and accounts is a typical culprit. And it's probably safe to assume that mobile and remote employees may log on to a public Wi-Fi network from time to time to complete work tasks. The majority of the workforce wouldn't know that these two habits could compromise organizational security. This is why employee security training should be a priority in educating staff on the behaviors that could enable hackers to exploit the BAS or networked systems. The requirements for work-related passwords, for example, should be made more complex and locked to a single user, and also managed via a password management tool.

Safeguarding an organization's data requires an assessment of the available entry points, from emails to external

memory devices like USBs, and ensuring steps are taken to sufficiently secure them. At the very least, scanning incoming and outgoing email attachments for viruses and other threats, and implementing a secure file transfer solution should be a fundamental consideration.

In 2017, international accountancy firm, Deloitte, suffered a cyber-attack that had admittedly gone unnoticed for months. Further investigation led to the theory that access to the global email server may have been gained through an administrator account that, in theory, provided a hacker with privileged, unrestricted access to the system. In 2012, Deloitte had been ranked the best cyber-security consultant in the world — which only proves the importance of keeping up to date on sophisticated security threats and evolving systems.

Due to sheer volume, much of the data on a modern BMS is cloud-based, meaning the cloud is another potential route for hackers to exploit. As BMS were primarily designed to offer functionality rather than security, there is a concern that the cyber-protection solutions relating to these systems are less mature. For this reason, it is increasingly important for FMs to evaluate their BMS vendors to ensure that the security protocols they have in place are adequately rigorous.

In addition, it's important to keep your BMS separate from the main corporate IT systems. Modern computer-aided facility management (CAFM) systems hosted in the cloud offer a greater opportunity to protect your data if the third-party center which manages the servers and storage systems have all the necessary security in place to make sure that vital data is never lost or destroyed.

As buildings and offices become ever more connected and digitized, cyber-threat has now become a prime concern for all facilities and building management teams and should be considered a major issue for every organization, regardless of the sector. Without correctly understanding this risk, FM teams could jeopardize both the physical and cyber-security of an organization. Through an in-depth understanding, however, the FM team has the opportunity to demonstrate its significance to the business and emerge as the guardian of an organization's security and data. FMJ

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BY **CAROLINA WEIDLER**

Process-Driven Spaces: Why Design Matters

Ask any facility owner, industrial engineer, facility manager or process improvement professional that is knee-deep in the day-to-day management of a process-driven space such as manufacturing facilities, laboratories, testing areas, R&D or research labs if their spaces are unique, and the answer will always be yes. They may say that their floor is not as intricate as a high-speed bottling plant or as large as an aircraft assembly line, but they will all say that their process-driven space has unique requirements, considerations and specifications.

This uniqueness translates into precise operations, which in turn renders profit for the company. Process-driven spaces are the hub of operations for the companies they support, so they should be treated with the utmost respect with a focus on efficiency, flexibility and accuracy.

So, how can facility managers ensure a facility is designed and operated in a way that promotes cost savings and improves efficiency? This is where Lean Manufacturing comes into play, as it has been an integral part of facility planning, operations and innovation since the 1990s when Toyota took the concept and ran with it on a global scale. Add the Six Sigma structure, and facility managers will find themselves immersed in what the current models of most operational companies are invested in.

For manufacturing facilities, the approach and implementation of these methodologies is a constant analysis of their flows, capabilities for expansion and flexibility along with optimization for new technologies and processes.

Growing markets, new technologies, changes in regulations, talent recruitment and retention are all triggers for a company's decision to assess their current operations and make tough decisions to improve productivity and flexibility.

When the need for efficiency improvement becomes the driving force behind a restructuring project, most companies choose to either tackle a relocation or a re-stack of their current operations. The goal is not only to remedy their current space needs, but also allow for future expansion and innovation. That's when the search begins for the "ideal" space and the right design partners.

Creating the right team

Process-driven spaces have very specific needs and criteria. Good manufacturing practice, or GMP, requirements, biomanufacturing facility design and engineering coordination and clean room classification and validation, among others, must be part of the lingo that the design team navigates on a daily basis in order to provide a comprehensive and holistic approach to the design process.

PROCESS-DRIVEN SPACES ARE THE HUB OF OPERATIONS FOR THE COMPANIES THEY SUPPORT, SO THEY SHOULD BE TREATED WITH THE UTMOST RESPECT WITH A FOCUS ON EFFICIENCY, FLEXIBILITY AND ACCURACY

PROCESS-DRIVEN

TERMINOLOGY

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When designing or managing a process-driven space, it's useful to understand these terms:

LEAN MANUFACTURING

A system that aims to eliminate waste from the manufacturing process in order to increase efficiency and profitability.

SIX SIGMA

A data-driven method of eliminating defects in production during the manufacturing process.

GMP OR CGMP

Refers to good manufacturing practice or current good manufacturing practice, respectively. These are regulations established by the U.S. Food and Drug Administration to govern proper design and monitoring of manufacturing processes and facilities.

Because of the complexity of these spaces and the amount of capital that goes into them, an accurate design that is done right the first time will not only save time and money, but also give the company opportunities for improvement and flexibility without compromising quality and results.

Knowing how to implement the appropriate materials and solutions will save the team time, it saves the organization capital expenditure and it aids in the new development of lean practices and growth implementation.

The team's inherent knowledge should correlate to the design professionals being tasked with planning and designing the space. The architect and engineering teams should be a conduit for improvement through their combined experiences, industry background and approach towards these kinds of projects. The value of having professionals that are seasoned and fluent with the values of Lean Six Sigma is immense, and can make the process of a relocation, reconfiguration or start-up faster and less costly.

Traditional space planning and architectural standards have, for the most part, pushed the "back-of-the-house" to the back of the drawing board, relying heavily on outside consultants to plan, optimize and dictate how specialized spaces need to be interpreted and optimized. Traditionally, the designer was expected to implement standard, one-size-fits-all requirements and then move on from the overall project, leaving the technical hardship to others.

This, of course, is a changing paradigm. Architects and space planners need to educate themselves more about the intricacies of process-driven facility spaces to serve as facilitators of solutions rather than just note takers. Facility managers who bring expertise in the day-to-day running of a process-driven facility should also have a seat at the table.

Coordination, communication and problem solving are expected, however facilities can also engage a design professional that can provide knowledge, bring value through expertise in the industry and furthermore aid the team in finding solutions from conception all the way through completion of the project.

The advantage of utilizing the resources of an expert team is easy to quantify: faster design and planning coupled with accuracy in design solutions. If the design partner happens to be a Lean Six Sigma professional, then the advantages grow exponentially because even the initial approach to the relocation project can be tailored towards efficiency, flexibility and cost optimization.

Pharmaceutical considerations

Pharmaceutical facilities are in a category of their own. The changing trends and technological and medical advances such as automation, remote monitoring and what these trends mean for the physical space need to be considered for correct operation. It is the job of the designer to put in

place the correct support for the company to be successful by providing technology integration, but also by using durable, safe materials that will increase flexibility in the space.

The rise of remote monitoring and technological integration with medications is something that may completely change the outlook of what pharma companies are looking to produce, innovate and spend their resources on. Pharma companies are finding unusual partners for development, such as tech companies, to develop products and medication that can track, diagnose and monitor.

Medical technology, or medtech, is changing the game by combining medicine and technology in new and innovative ways. In turn, this changes the conventional layouts of pharma manufacturing. There is a growing need for technology/IT labs to go alongside drug labs or complete technology integration for labs. In terms of constructability and space requirements, this means electrical and data connectivity, complete coordination of remote monitoring, spaces for different types of hardware, collaboration and overall flexibility at a minimum.

When looking to engage a design partner for a relocation project, the partner must bring value in addition to understanding the changing needs of process-driven spaces. The team should be a conduit for improvement, consider the root of the process and understand the technicality of pharmaceutical, biomedical, medical device and all other unique driven processes that allow them to look beyond the "fit-in-a-box" concept.

And whenever possible, secure a design partner early in the process so they can advise and guide the team on the correct location and identify issues early on, so that every aspect of the project can be considered and added into the budget and schedule. FMJ

Carolina Weidler *is an architect, Lean Six Sigma Black Belt and LEED AP professional with more than 15 years of domestic and international experience creating process-driven environments for high-tech corporations. As Project Director for Science and Technology at H. Hendy Associates, Weidler delivers an unmet need for businesses looking to maximize output and profitability. She has helped clients reimagine spaces — from pharmaceutical and food processing facilities to aircraft assembly lines — ranging from 2,000 to 470,000 square feet. Reach Weidler at cweidler@hhendy.com or 949-851-3080.*

IFMA FOUNDATION
MAKING FM A CAREER OF CHOICE

Building the Future of FM

The *dream* continues...

Pictured: Trina Lujano, President of IFMA's Chaffey College Student Chapter and Jeffrey J. Tafel, CAE, Executive Director, IFMA Foundation

Meet Trina Lujano, a student in the FM program at Chaffey College in Rancho Cucamonga, California, one of the top community colleges in the U.S. A process server for 18 years, Trina is now president of Chaffey's newly formed IFMA student chapter.

On Jan. 16, the IFMA Foundation's board of trustees attended a meeting of the student chapter. Students enrolled in the FM course taught by IFMA Fellow Phyllis Meng asked questions of the board regarding FM as a career of choice. Henry Shannon, Superintendent and President of Chaffey College and two of his deans stopped by to share how well the FM programs have been received.

Due to the numerous FM jobs available in Southern California at generous salaries, Chaffey's FM program piloted the foundation's Global Workforce Initiative (GWI). It was the first of what the foundation hopes are many more GWI programs, not only in Southern California, but across North America and around the world.

Global Workforce Initiatives are sprouting up in Texas, Maryland, Massachusetts, Tennessee, New York and Hong Kong. With the GWI, the foundation has gone from a non-profit concentrated on scholarships, to a major force behind creating opportunities at every stage of the FM career path.

The foundation's dream continues to evolve, exemplified at Chaffey College and by students such as Trina. The GWI endeavors to introduce the profession to students before they make career decisions, and increase the number of accredited FM degree programs worldwide. Want to be a part of it? Learn more at **foundation.ifma.org/global-workforce-initiative.**

In January, members of the IFMA Foundation Board of Trustees, the California Community College System and Chaffey College united to celebrate the realization of a dream launched three years ago.

Global Workforce Initiative Advisory Partners

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Foundation events at World Workplace are a critical part of our annual funding. We would like to recognize the IFMA chapters and councils, companies, organizations and individuals who were a part of our success last year.

Gold: New York City Chapter, East Bay Chapter, Silicon Valley Chapter, Interface

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The IFMA Foundation works for the public good in support of facility management higher education, students studying facility management and related fields, and increasing awareness of facility management and making FM a career of choice. The IFMA Foundation is a 501C nonprofit, charitable organization, and donations in the U.S. are tax deductible.

BY **CHRISTY HURLBURT**

FMJ EXTRA *Resource*

U.S. EPA: Recycling Basics

REDUCE REUSE RECYCLE RESPONSIBLE

How Facilities Can React Positively to the China Recycling Ban

"Reduce, Reuse, Recycle" is a mantra that most are familiar with. Facilities may even put these three R's into practice. But could there be too much emphasis on the last R, focusing on the sense of pride around a facility's recycling efforts?

Effective January 1, 2018, China banned the import of 24 recyclable materials due to receiving too many contaminated recyclables. Although U.S. congresspeople have called upon the government to repeal it, there are no signs that China will reverse this policy that has left parts of the world in a recycling panic.

At this time, facilities can no longer ship away their recyclables without having to think about their end destination. Beyond facilities, haulers, waste generators and everyone throughout the supply chain are forced to handle this issue at home. Meanwhile, waste materials are piling up, not only in the U.S., but also in other global markets.

There is now an opportunity for facility managers to approach their existing waste and recycling systems from a different, yet more positive, outlook. This ban provides facilities with an opportunity to avoid the landfill, prioritize reduction first and consider technology that will allow facility managers to understand where waste is coming from and how that volume can be decreased.

FMS & OVERFLOWING LANDFILLS

The U.S. has poured a lot of money into recycling efforts and built large facilities to process and sort these materials. But there is still a shortage of recycling centers in the U.S., and the existing facilities are reaching capacity. With nowhere else for waste materials to go, other than the landfill, the environmentally responsible act of recycling negates its purpose.

Although the waste industry can continue to bury waste because is it cheap, quick and easy, this approach is not sustainable. Facilities have a role in managing this waste. The more waste and recyclables facilities are producing, the greater they are contributing to the amount of materials that are going into landfills.

But, the situation isn't hopeless. There is still a way to achieve a feel-good, environmentally friendly response from facility recycling efforts. China's new policy is forcing everyone to take a deeper look at facility systems to better understand where waste is produced — both trash and recycling — and to use that information about waste streams to identify ways to reduce the materials eventually thrown away.

REDUCE FEAR, REDUCE WASTE

The word "reduction" often evokes something akin to a fear response as people feel they have a right to consume. Facility occupants may also express discomfort and inexperience when it comes to reducing because they associate it with loss of choice, status or convenience.

Facility managers and occupants most likely have never had to seriously consider these complex thoughts behind "reduction" because they have not yet been held accountable for the amount of waste they are generating or understood the impact of the entire life-cycle of their waste.

However, the China recycling ban has made two things clear: The U.S. is producing too much waste, and there aren't systems in place to manage that significant volume internally. Focusing on reduction of waste first may alleviate some of the issues associated with the recycling ban. Overcoming consumer fears and rethinking existing waste models offer positive, long term and localized solutions for facilities.

And this solution can be more easily achieved with the integration of technology.

DON'T REDUCE DATA

Some of these waste and recycling industry issues stem from how waste management on the local and facility level has been traditionally based on assumptions, relying on manual reporting. Facility managers in restaurant or retail facilities, for example, may manually check their dumpster once and base their collection needs on that, never putting much thought into their waste and recycling programs again — at least until an issue occurs.

Haulers use GPS geofencing to track route accuracy, but that doesn't ensure each dumpster has actually been collected. It only shows that the vehicle entered the area around the pickup location. When waste isn't collected as scheduled, that could lead to overflowing dumpsters and major issues for the fa-

NINE PERCENT OF SCHEDULED WASTE PICKUPS ARE MISSED, AND 21 PERCENT OF SITES NEED WASTE SERVICE LEVEL ADJUSTMENTS.

cility, such as health fines and violations. Nine percent of scheduled waste pickups are missed, and 21 percent of sites need waste service level adjustments. This means these facilities are paying for waste services that do not meet their actual needs, so they may be paying more than needed or their dumpsters may be picked up when only half full. Their collections need to be adjusted to align with their waste generation and volume.

Waste services providers can now use data from waste container sensor technology to help facilities understand their waste and recycling streams. This data is significant because visibility into waste management has never been this readily available to facility managers. Not only will the collected data help drive cost savings around waste management, but it will also help facilities ultimately reduce waste. This data originates at the dumpster.

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DUMPSTER DATA

Connected, smart technology, like waste container sensors, is increasingly being used across facility operations. Implementing Internet of Things (IoT) technology at the dumpster level allows facility managers to better understand volumes of materials that come in and out of a facility.

By monitoring around-the-clock sensor data, waste services providers can manage alerts, compare dumpster pickups against collection schedules and work with haulers to adjust service levels to meet actual needs. They can also use the data from container sensors to identify changes in volume, understand what is making up the garbage facilities produce, monitor if recycling programs are being properly implemented at the site level and employ recommendations for an easier-to-follow program. Waste services providers can make recommendations for waste reduction and lay out a plan that goes beyond just saying, "reduce."

Dumpster data can provide actionable insights and resources for facilities to improve operational efficiency while also reclaiming the accountability for their waste. Data collected can inform facility managers about what is making up their waste, how to reduce it throughout the supply chain and how purchasing multi-use items can help eliminate waste. Ultimately, waste services providers can help facilities understand their waste stream and drive toward the end goal of reduction.

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TECHNOLOGY AS AN ANSWER

In addition to container sensors, there has been a recent push of technology-enabled solutions in the waste industry that impact the waste management process. Technologies like robotic technology that sorts materials faster and more accurately as well as cameras installed on collection trucks to monitor routes and put more accountability on waste haulers. But why do we need technology in the first place? Can it really solve all waste problems?

Technology cannot replace behavior change. Furthermore, technology wouldn't be so necessary if waste producers like facility occupants were not tossing large amounts of waste materials in their dumpsters and, ultimately, in the landfill. Focusing on reduction first minimizes total waste. Once consumers and facilities consume less, we will all produce less waste.

The U.S. has started to hold producers more accountable for the waste they are generating. States like Massachusetts and California have implemented take-back rebates and the Bottle Bill to incentivize people to keep things out of landfills. Europe already has extended producer responsibility (EPR) market-based instruments, like deposit take-backs and advanced disposal fees, that have helped reduce waste management costs and incentivize package reduction and recycling overall.

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TAKING RESPONSIBILITY

China may have issued the recycling ban, but the waste we generate is ultimately our responsibility. A facility can use this new regulation as an opportunity to reevaluate its current waste management system and look for ways to implement positive changes and lasting, sustainable impact. It's up to the waste industry to offer alternative options to contributing to landfills, but it is in the hands of facilities to introduce new policies based on behavior change.

Is your facility ready to reduce its waste? FMJ

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The Triple Bottom Line

Enhancing Workplace Experiences

FMJ EXTRA *Research*

The Triple Bottom Line Concept in Theory and Practice

BY **BILL CONLEY**

Prioritization is part art and part logic. When a facility manager has multiple places to focus their efforts, deciding what comes first — the chicken or the egg; the cart or the horse — a number of considerations are taken into account. Most FMs learn, over time, that there are inter-relationships attached to almost any task. Decisions and actions have ramifications that could go far beyond their original intent and effects should be considered in managing the workplace. FMs must be able to perceive the subtleties and complexities of interconnected systems. They can take a lesson from the environment: When a single thing in nature is tugged, it is found to be attached to the rest of the world.

Sometimes, though, the rationale for taking an action can serve several positive outcomes. In the world of sustainability, the motivation behind programs or processes implemented, whether they be for people, the planet or profit, invariably end up benefitting all three of those criteria. Components of the "triple bottom line" form a symbiotic relationship that can be recognized given the right perspective.

Sustainability is becoming a business imperative regardless of whether the company operates in developed or emerging markets. The expectations of customers and investors are evolving as more attention is paid to issues such as environment, health and the social impacts of business operations. Sustainability approaches to operations and maintenance in a facility tend to help produce resilient and regenerative companies. It is in a facility manager's best interest to operate and maintain a building with those precepts in mind.

Given the premise that in business profit is king, consideration must be given to what makes a company successful. From a superficial level, it could be the right product, or the ability to meet a customer's needs or wants. It could be saturation marketing or top-notch advertising that comprise the elements of financial success. But digging deeper, it is the people that make a business run well and be profitable. Keeping personnel happy, comfortable and productive is a keystone to success as employee salaries are easily one of the highest costs in a building. An FM should understand that satisfying the needs of people through sustainable operations not only safeguards their well-being, but that of the company and the environment.

TOO HOT, TOO COLD. Thermal comfort is the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation (ANSI/ASHRAE Standard 55). Maintaining a standard of comfortable ambient temperatures for occupants is one of the most challenging tasks of facility managers. Satisfaction with the thermal environment is important for its own sake and because it influences productivity and health. Office workers who are satisfied with their thermal environment are more productive.

Thermal satisfaction consistently has the lowest rating in most buildings because of the high variability in thermal comfort. Occupant responses to the thermal environment are influenced by workplace stress, activity levels, gender, age and individual preferences. The most effective way to improve thermal comfort and satisfaction is by using controls for building and space temperature. Technology allows an FM to monitor systems and tweak them to provide better IEQ. Utilizing a building automation system (BAS) or an energy management system allows facility managers to adjust temperature by zone or geographic area in a building. The systems allow for control of variable air volume (VAV) to localize air flow and temperature ranges. This saves energy, as units are not competing, and it helps to minimize equipment runtimes when they are not needed. The responsiveness of the facility management team to complaints also improves comfort and satisfaction.

KEEPING IT CLEAN. Green cleaning has been a topic of discussion for years now. Even though it may be standard operating procedures in many facilities, it never hurts to revisit the practice. Cleaning for just appearance's

sake is not good maintenance. The keys to green cleaning revolve around maintaining optimum indoor environmental quality, minimizing negative impacts on the environment and saving money through smart cleaning techniques and the discretionary use of supplies.

Keeping entryways spotless is a facility manager's first line of cleaning defense. ISSA estimates 80 percent of the soil, dust and contaminants that create airborne particulates in a building come in through the door on the shoes of visitors and building occupants. Walk off mats are simple solutions for this issue. Ideally, a facility would have two mats at each entrance to the building. A 'Scraper' on the outside to remove heavy dirt, a 'Wiper' inside to brush the soles of the shoes.

Moreover, it costs at least US$500 to remove a pound of soil tracked into a facility. If dirt can be stopped at the door, it will improve air quality and minimize its spread throughout the entire building. These mats will help keep the facility clean and provide an appealing appearance for visitors and guests to create a positive perception of company while saving money in clean-up.

The primary reason for cleaning is to create a healthy environment. A green cleaning program promotes this effort as it minimizes odors, toxins and dust in the air. Using effective chemicals, equipment and methods, green cleaning is cost effective and improves worker and occupant safety. It is a combination of preventive maintenance, training and proper cleaning supplies. It can also help reduce absenteeism, increase morale, and improve retention and recruitment

Green cleaning can reduce the liability of claims of "sick building syndrome." There is a direct correlation between the level of cleanliness in an environment and the health and well-being of the people within it. Studies show that unhealthy indoor air is a leading contributor to decreased rates of worker productivity and morale. Absenteeism is irretrievably linked to health problems. Thus, a green cleaning program serves people's health and well-being while improving productivity, leading to a more successful company.

ENERGY DE-CONSUMPTION. De-consumption means making do with less. There are many aspects of energy conservation that can be implemented in a facility, but one of the easiest to address is lighting in a building. Lighting commercial buildings accounts for close to 71 percent of overall lighting electricity used in the United States. It is the largest cost component of a commercial property's electricity bill and a significant portion of the total energy bill. With good design, lighting energy use in most buildings can be cut at least in half while maintaining or improving lighting quality. Lighting electricity savings equates to an increase in net operating income (NOI) that drives favorable cap rates.

A lighting retrofit also has the best return on investment (ROI) of any energy efficient technology with typical payback periods between 14 to 18 months. Once the payback is realized, the savings will continue, creating a sound investment in the future.

Newer lighting technology leads to decreased demand on heating ventilating and air conditioning (HVAC) systems. Lighting is the largest source of waste heat, also called heat gain, inside commercial buildings. In fact, for every three watts of lighting load reduction, you reduce the air conditioning load by one watt.

There are several strategies available to minimize lighting energy requirements in any building. A study must be done to determine the illumination requirements for each use area within the building. This requires an analysis of lighting quality to ensure that glare and/or an incorrect color spectrum are not adversely affecting the occupants of the area. Space planning, interior architecture and paint palettes must be integrated with lighting design to ensure that competing factors are not evident and that the area and lighting solutions complement each other. Time of day scheduling should also be utilized to minimize energy usage. This can be accomplished automatically by using a real-time sensor as part of a BAS or can be performed manually.

Improved lighting enhances visual comfort, reduces eye fatigue and improves performance of visual tasks. Upgrading lighting systems with efficient light sources, fixtures and controls can provide several benefits, and most lighting upgrades are cost effective based on energy savings alone. However, the costs associated with a building's occupants greatly outweighs building operational costs, so any lighting change that improves indoor environmental quality is worth implementing.

EMPLOYEE PRODUCTIVITY. More and more data is being compiled proving that green building practices and the resultant improvement in the quality of the indoor environment leads to higher productivity in employees. Payroll and human resource costs are, by far, the largest expenditure in a company, so this is one area where a focus might be prudent. Negative impacts of poor environmental quality include illness, absenteeism, fatigue, discomfort, stress and other distractions. Reducing these problems through proper maintenance and attention to air quality, thermal conditioning, green cleaning and lighting will work toward improving employee's health and performance. Taking care of employees through proper indoor environmental quality is being proven to positively impact a company's business.

Sustainable actions improve morale and lead to highly motivated staff. When it is considered that a one percent increase in productivity across the board would pay for a building's utility bills and a two percent increase would pay for utilities and rent, any actions that help raise production in the company should be viable undertakings. A study by Greg Kats (2003) suggested present value benefits of US$37 to US$55 per square foot due to productivity increases derived from less sick time and higher employee motivation in green buildings.

VeriFone, a company located in Costa Mesa, California, realized a 42 percent decrease in absenteeism upon moving into a green building, and in a fairly recent study, a law firm in Australia found sick days reduced by 39 percent after a move to a green-rated building. As facility managers continue to operate and maintain these buildings in a sustainable

manner, they continue to support the triple bottom line by keeping employees comfortable, improving productivity and profitability and minimizing negative impacts on the environment.

From a corporate perspective, the sole purpose of a business is to maximize the wealth of its owners. However, to realize a profit, costs must be incurred. As the adage goes, you have to give to get. Indeed, the concepts of "profit," internal rate of return (IRR), or return on investment (ROI) are all predicated on the fact that investments are being made and money is output to generate income. The owners and operators of a business are tasked with generating a financial return in exchange for a service or product and the acceptance of risk. In this process, decisions must be made to determine how to allocate limited resources.

Sustainability is being proven as a good investment in a business and in its future. Sustainable operations increase the efficiency with which buildings and their sites use energy, water and materials. To the average business owner, this translates to cost savings; money that be profit or that can be re-invested into the company.

According to studies by the State of California, the U.S. Green Building Council (USGBC), the International Facility Management Association (IFMA), Lawrence Berkeley Labs and other similar entities, high performance (sustainable) buildings realize 30 percent energy savings, 30 to 50 percent water savings, 50 to 90 percent waste cost savings and 35 percent reduction in carbon emissions over conventional buildings.

Sustainability makes business sense. It affords owners and operators the ability to save money, improve productivity and create long term benefits for the company. It provides a competitive edge in marketing and its standing in the community. Operating a facility from a sustainable stance provides a company with an edge over the competition and benefits employees as well.

Profit may be king, but people do the work. Sustaining a company to long term success means paying attention to employees, and their well-being to generate profits. The triple bottom line is intertwined so that each aspect benefits from proper operations and maintenance.

Sound environmental practices satisfy the needs of people, profits and planet. However, no matter what the motivation for embracing sustainability, people are the ones who benefit the most. The fact that financial success and protecting the environment are also served well triples the impact. Not a bad deal, all things considered! FMJ

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Case study: Mermet USA shades are a well-crafted solution for brewery

Featuring a warehouse, bottling facility, taproom, restaurant, gift shop, amphitheater and an indoor music venue, Sierra Nevada Mills River Brewery in North Carolina, was designed as "a temple to craft beer in an area where beer has become a way of life."

Following completion of the 320,000-square-foot project, Sierra Nevada Mills River was the first production brewery in the U.S. to earn LEED® Platinum certification. The use of Mermet's M Screen Deco 5 percent shade fabric played a significant role in that achievement. Comfort, daylighting and solar heat gain control were integral to the design. The shades reduced the building's Solar Heat Gain Coefficient (SHGC) from .227 to .221 – a 20.2 percent SHGC improvement that glazing alone could not have achieved.

Manufactured with high-quality yarn comprised of fiberglass and vinyl, M Screen Deco is a designer fabric featuring a unique rib weave and bi-colored yarn that adds rustic elegance to the space through its texturized appearance. The shades, which were specified at 5 percent openness, block approximately 95 percent of U.V. rays and transmit only 7 percent of total solar energy.

– **VISIT** www.mermetusa.com

New portable combustible hydrocarbon gas detector

Model 7899 Gas Sniffer from E Instruments is a portable, rugged and easy-to-use leak-detection tool that can effectively pinpoint small leaks of combustible gas from piping, engines or appliances. It detects natural gas, town gas, propane, methane, butane, kerosene and gasoline in a variety of applications including HVAC, residential, commercial, engines, piping and industrial processes. The gas readings are shown on a large LCD display in either ppm, % vol, or % LEL, giving the user the actual amount of combustible gases present.

– **VISIT** www.e-inst.com

The 7899 portable gas detector allows the user to quickly and easily detect combustible gas leaks in most hard-to-reach places using the included 11" flexible probe.

Juice™ Mobile Power instantly makes facilities more mobile-device friendly

Powering classrooms and offices to meet modern technology demands is often the biggest challenge for facilities. Unless they were built in the last 10 years, schools and office buildings aren't typically designed to support present-day spikes in mobile-device charging; and the cost for electrical retrofits keeps many facilities from providing enough power to charge everyone's mobile devices simultaneously.

Enter Juice Mobile Power, an Active Charging™ solution from Bretford. This category-creating mobile power system changes the game for IT and facility managers by delivering a safe, effective, flexible way to turn a single outlet into a power source for the entire classroom or office, at a fraction of the cost of a retrofit.

Juice Mobile Power eliminates the tangled web of non-compliant, overloaded extension cords with a flexible solution that moves and adapts with you. Delivering safe DC power in a lightweight, portable track-and-pod system, it can be set up in any space that has a traditional three-pronged electrical outlet. Simply plug in the base, lay the track, place the pod on your desk and it's ready to go. Your team can get to work without worrying about battery life.

The Juice Mobile Power starter kit includes a compact base, a 12-foot track, two pods and a backpack carrying case. Additional tracks and pods can be added to the starter kit to accommodate larger groups and spaces.

– **VISIT** www.bretford.com

Rusoh® Eliminator® is a portable fire extinguisher you can service yourself

The Rusoh® Eliminator® fire extinguisher is designed for self-service, eliminating the need for specially trained and licensed technicians. Unlike traditional extinguishers, the Eliminator's contents are not stored under pressure – it's only pressurized when you need it: to fight a fire. The Eliminator provides major advantages over traditional extinguishers:

- **Self-service:** reduces costs by eliminating third-party service requirements, hydrostatic pressure testing and other periodic fire extinguisher inspections.
- **Non-pressurized:** safer and more reliable than stored pressure extinguishers – the source of the pressure is a CO2 cartridge you can check with ease and replace yourself.
- **Universal design:** easy for left- and right-handed people to operate, saving time when seconds count.
- **Engineered polymer construction:** resists corrosion, impacts and is 100 percent recyclable for sustainability.
- **High-efficiency valve assembly and nozzle:** improve agent discharge, knocking down fire faster and giving the user more protection.
- **Reloading kit:** everything you need to reload your Eliminator in minutes and put it back into service. (sold separately)

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Coffee Unlimited has been keeping Chicago offices caffeinated (and hydrated) since 1972

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Located in Chicago, Illinois, USA, Coffee Unlimited features more than 3,000 products to keep your office kitchen or breakroom on trend. The company specializes in all commercial coffee equipment, from single-cup, high-volume and specialty-drip brewers to espresso and bean-to-cup machines.

Purified, chilled, carbonated or flavored, Coffee Unlimited also offers water and ice solutions for a more sustainable alternative to bottled water, such as Bevi.

What is Bevi? Created by three friends with a passion for clean water and the environment, Bevi is a smarter water cooler that dispenses customizable drinks. An all-in-one hydration solution, Bevi hooks up to your existing water line, providing customizable pours of still,

sparkling and flavored water that will never run out. It is internet-connected and automatically notifies Bevi technicians when your machine needs servicing. Contact Bevi to request a free tasting box of flavors.

– **VISIT** www.bevi.co/try-a-free-tasting

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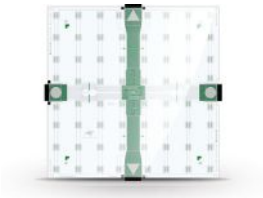
NEW TECHNOLOGIES

Big Data, IoT, AI, AR, sensors, drones, apps, biofeedback — emerging technologies, from the intelligible to the experimental, are disrupting and reshaping businesses, jobs and the built environment. Attendees at Facility Fusion Chicago in March were wowed by the following tech innovations demonstrated in the Emerging Technology Showcase on the expo floor.

Focus on work instead of back pain

Developed with guidance from a physical therapist, Muuv by Align1Solutions combines principles from engineering with the study of human movement to help workers sit smarter, work better and achieve more. **https://align1solutions.com**



It's like a touchscreen on the floor

Scanalytics measures human behavior insights through intelligent floor sensors. Connect the mats together and hide the array underneath a flexible floor covering. The advanced algorithms translate foot traffic into actionable data. **www.scanalyticsinc.com**

Imagine never receiving a hot/cold call again

With the Comfy app, employees can warm or cool a space on demand, change a room's light level, find and book meeting rooms on-the-go and submit work order requests. FMs can receive real-time feedback about employees' workplace experience to better meet their needs. **www.comfyapp.com**

Wearable 3D mapping

Combining the benefits of laser scanning, thermal and optical imagery into a mobile reality-capture solution, Indoor Reality's hardware and web-based software platform is a complete solution for fast, automated, 3D building documentation and mapping. **www.indoorreality.com**

Realize the promise of Industry 4.0

IoTium's Network as a Service solution is a secure approach to mass deployment of Industrial IoT. Connect legacy on-site systems to cloud-based applications to leverage new and predictive analytic applications at scale. The built-in firewall creates a secure perimeter that protects the asset on premise, making it invisible on the internet. **www.iotium.io**

Roof Intelligence connects FMs to the world of drones

Using drones to take hundreds of geo-referenced images that can be stitched together to evaluate a roof's condition, FMs can plan for maintenance and repairs, keeping inspectors safer in the process. **www.roofintelligence.com**

Cut energy costs with real-time occupancy data

Feedback Solutions' unique, thermal-imaging-based solution adjusts ventilation rates based on real-time occupancy data, reducing energy use and maintaining IAQ automatically. Advanced thermal imaging occupancy counters see people as yellow heat blobs – a non-intrusive way to track those entering and exiting a monitored space. **http://feedbacksolutions.ca**

The future of meetings in which everything works

AVaStar event technology software helps staff plan and provide audiovisual services, manage meeting needs, schedule resources and track financial performance. An inventory management module ensures "everything works" with a ticketing system and scheduled maintenance. **http://avastar-ets.com**

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Ask the Experts

In each issue of FMJ, IFMA's Facility Management Consultants Council shares some commonly asked FM-related questions accompanied by advice from top FM consultants. The questions and answers presented in this section align with IFMA's core competencies following the themes outlined for the given edition of the magazine. While the following answers are intended to be helpful, these responses should not be deemed complete and are limited in context by the space allocated. Please contact the individual consultants directly for further explanation of the opinions expressed.

CONTRIBUTED BY

IFMA™ FM Consultants Council
International Facility Management Association

The Facility Management Consultants Council (FMCC) represents more than 300 FM consultants from various countries around the globe. Its mission states, "The FMCC is the resource and voice for facility management consultants worldwide to leverage our collective expertise to benefit IFMA members, and the facility management profession.

Q: **A retail housewares company has embarked on an aggressive growth initiative. Currently they lease a 75,000-square-foot suburban corporate office building and three leased retail stores in the surrounding metro area. They plan to add five retail stores per year in locations across the U.S for the next seven years that they will build and own or build to suit and lease back. Their corporate headquarters will also need to expand accordingly as they grow. Up until now, they have not had a facility manager. To date, all maintenance has been the responsibility of the property owners and the facility operations have been overseen by an office manager. The company has just hired a full time FM. One of her first tasks is to develop an O&M plan for the organization. What advice would you give her?**

A: The management plan is achievable but very careful action and control needs to be put in place from day one and this will not happen overnight.

Have one project manager to manage the whole process from start to finish. Design, construction, implementation, move-in and then the management a new standardized facility management program.

Establish a set of "corporate standards" which is fully approved and agreed with the CEO and the Management team. Any deviation should only be for "extreme business needs" and should be referred to the CEO for approval or not. Establish communication with the various business units, set and agree on templates for the various types of space: HQ, retail, satellite office, etc.

Create a new facility management regime and tender and go to the market to get one FM provider who can manage your existing buildings and then take on the new space when they are available. Relying on the property owners to provide facility management services is expensive and usually results in random levels of service, and this service is too close to your core business which is retail sales.

Establish one design and project team for the design and installation of all the new retail stores and offices to ensure continuity and absolute adherence to the agreed corporate standards. Local tenders can be set up to do the actual fit out work, but control of the design is critical. This can be in or out of house but I would suggest out of house to deal with fluctuating workload and to keep internal head count down.

Set up a country-wide arrangement with Realtors to seek property, negotiate rents and contracts. They will report to the project manager. Similarly, set up an agreement for temporary staff and hiring new full-time staff for the various new locations.

For the implementation, look at renting office space from a serviced office provider who can operate throughout the country and understands your needs.

Setting standards across the U.S. is relatively easy as the culture is generally the same, unlike European, Middle East and Asia Pacific where cultures and norms are very different.

You will need significant external assistance with the process of setting corporate standards, setting up and tendering a new facility management contract and selecting the other professionals. You will need design, construction, facility management, Realtors, legal and local project management assistance.

Not an easy task, but having carried out a similar exercise for a client over 17 countries in Europe, Middle East and Africa, it works.

ANSWERED BY

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Visit FMCC online or join the conversation on the council's LinkedIn group | **fmcc.ifma.org** **http://linkd.in/1gAa8ae**

A: As an IFMA instructor and an FM consultant, I have found that the following five steps in preparing an O&M plan as described in the IFMA FMP program works well. They are*:

— **Determine physical assets as an inventory.** The inventory should include systems, structures, interiors, exterior elements and grounds.

— **Determine maintenance and repair cycle.** Decide when to apply predictive maintenance, preventive maintenance, and no maintenance. Influencing factors include safety considerations, overall cost, available resources, occupant satisfaction, and productivity.

— **Determine maintenance schedule.** Planned maintenance is any maintenance activity for which a predetermined job procedure has been documented and resources have been allocated. Unplanned or unscheduled maintenance generally addresses failed equipment or components or an unsatisfactory level of service.

— **Determine applicable regulations, codes and standards**. Regulations are laws or rules to regulate conduct. Codes are systems of regulations that define scoping requirements. Standards prescribe a minimum level of acceptability.

— **Determine agreed-upon occupant services and requirements, including:** Anything that facility occupants or visitors might need beyond the operational maintenance of the hard assets of the building and its systems; critical activities through which the facility manager directly affects the users of the building; everything should align with organizational values.

The new facility manager will be very busy with the development of the new FM department. It should be emphasized that although she has identified the development of the O&M plan as one of her first tasks, she should also be learning the organization's culture and overall business strategy. She will need to quickly build her staff and assign appropriate new staff members to the development of the O&M plan under her guidance and oversight while at the same time talking to senior management and FM's stakeholders in order to develop a facility management strategic plan that aligns with and supports the organization's overall strategy.

**Taken directly from the IFMA FMP instructional slides © IFMA 2014, All rights reserved www.ifma.org/fmp.*

ANSWERED BY

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Msekula1@wi.rr.com

A: Simply put, a programmatic approach to solving this challenge would be as follows:

The first step is to understand the current program to see what is working well and how changes will impact individual stakeholders.

Once this is determined, organize all data into a central location. Include current contracts, spend detail and work order history. This information will be valuable to ensuring you have a good baseline so you can measure the impact of the program

Create a detailed plan and get buy in from individual stakeholders and leadership as implementing a new O&M plan will impact everyone in an organization and involvement will improve the chances of individual adoption and overall success of the program.

Lastly, if you are unfamiliar with the details that should go into a world class O&M program, engage a subject matter expert.

Once the plan is completed, roll it out and measure progress.

ANSWERED BY

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Have a question about the Ask the Experts section?

Contact **Mark Sekula**, IFMA Fellow, CFM, FMP, LEED AP, president of Facility Futures, Inc., at **msekula1@wi.rr.com**.

Components in Focus

IFMA HONG KONG CHAPTER KICKS OFF WORLD FM DAY

The IFMA Hong Kong chapter was one of the first chapters in the world to kick off celebrations for World FM Day. Guests at the 2018 Asia-Pacific Facility Management Awards presentation ceremony on May 3 were among the first to congratulate fellow FM professionals on their achievements in the field. The awards ceremony honors area facility managers for their contributions to the field. The awards ceremony was held in advance of the IFMA Integrate 2018 FM Conference, which was held May 10 at the Hong Kong Convention and Exhibition Centre. The official date for World FM Day is May 16, 2018.

Houston Hug-a-Bear Campaign to Deliver Comfort for Kids

The IFMA Houston Chapter gathered and delivered 426 plush bears to the Houston Police Department through the "Hug-a-Bear Campaign." Bears were collected over the course of a month and presented to two Houston police officers at the Houston Chapter's March meeting.

Members of police and fire departments use the bears to help comfort children who are rescued from traumatic events or who are in crisis situations. The bears will be carried by first responders and crime investigators and given to the children they assist in the course of their duty.

UPCOMING EVENTS

May

22 Upstate South Carolina Chapter: *Annual Charity Golf Tournament*

23 Seattle Chapter: *Trade Show, Lynnwood Convention Center*

24 Austria Chapter: *Forum,*

24 Belgium Chapter: *Awards*

31 Greater Philadelphia Chapter: *Golf Tournament*

June

04 Kansas City Chapter: *Golf Tournament*

07 Long Island Chapter: *Monthly Meeting*

14 Greater Louisville Chapter: *Annual Event at Louisville Water Tower*

18 Northern Ohio (Cleveland) Chapter: *Golf Tournament*

19 East Tennessee (Knoxville) Chapter: *Monthly Meeting*

20 Nevada (Las Vegas) Chapter: *Monthly Meeting*

21 Denver Chapter: *Golf Tournament*

22 Dayton Chapter: *Golf Tournament*

26 Oregon & Southwest Washington (Portland) Chapter: *Golf Tournament*

Components in Focus

ABRAHAM FLORES

After 17 years in facility management, Houstonian Abraham Flores has spent most of his career working in higher education facilities. Although he didn't set out in his professional life intending to work in FM, he has worked his way into his current position as director of building maintenance at University of Houston Downtown.

ABRAHAM: [An FM career] just happened; it was not part of my plan. But I enjoy and love what I do.

ADAM LUJAN

Nevada member Adam Lujan started out in facility management more than four years ago. He said he wanted to take his years of knowledge and experience in the trades and apply it within an industry and company that values his background and experience. The FM industry fit the bill, and he now holds a position as a facility maintenance lead with a CAT dealership.

ADAM: One of my enjoyments in life is hanging out with my family and friends, listening to music and entertaining guests.

ANDRAS L. DANKO, PHD

Andras Danko came to FM after serving as CFO for central Europe for Monsanto and Unilever. Now serving as corporate services director for Europe for Monsanto, it was the desire to improve employee engagement that brought him to facility management. Based in Budapest, Hungary, Andras has spent his career in the agriculture and biotech fields.

ANDRAS: Whenever I have the chance I cycle to the office instead of using my car. Cycling through a city that's still waking up gives a great boost of energy for the day.

BILAL DA'AS

Qatar-based member Bilal Da'as has worked in the facility management field for six years. Prior to that he spent more than a decade in project management/construction management. The rapid growth of the FM industry drew him into the field and led him to his current position as a facility manager and Cx manager.

BILAL: I carry 13 different certificates in the construction & management fields. All are pieces in my maturity puzzle.

HOW HOSPITAL FLOORING FACTORS INTO LIFE OR DEATH SOLUTIONS

stopping infections

A blood pressure cuff slips from a doctor's hands as she places it on a patient's wrist. The side rails on a bed fall as someone with limited mobility tries to get out of bed. Everyday occurrences like these in health care facilities contribute to the most frequent health care problem worldwide: health care-associated infections (HAIs).

Until recently, research on HAIs largely focused on how frequently touched objects, like call buttons and blood pressure cuffs, can transmit pathogens to people. In March 2017, the American Journal of Infection Control published a study uncovering the important role that floors can play in spreading pathogens to these high-touch objects. Floors, in the past, weren't the focus of efforts to improve disinfection because researchers did not think they were often touched. But flooring, researchers realize now, grazes everything from nonslip socks, commonly worn by hospitalized patients, to blood pressure cuffs that fall on the floor only for a doctor to pick up again and strap around a patient's arm.

This new research offers hope in solving a problem that impacts an enormous amount of people around the world. The World Health Organization reports that the prevalence of patients with HAIs varies from 5.7 percent to 19.1 percent in low- and middle- income countries. Develop-

A few key points about this new research:

Five hospitals participated, and hospital personnel were not made aware of the study while in progress.

High-touch objects often came in direct contact with the floor.

Contact with objects on the floors frequently resulted in pathogens transferring to hands.

Floors in hospital rooms have been overlooked as a source for pathogen dissemination, with potentially dangerous results.

BY **PATRICK MEADE**

ing countries can suffer from up to 19 times higher rates of HAIs than those reported from Germany or the United States. And newborns are at an even higher risk of acquiring infection in developing countries, with infection rates three to 20 times higher than in industrialized nations.[1]

The research available on infection in resource-limited countries is minimal, but the studies that do exist all point to the alarming global burden of preventable infections.[2] In addition, these studies suggest that the impact of infection on patients and health care systems is greatly underestimated. This is largely because very few low- and middle-income countries have national surveillance systems for HAIs.

But even resource-rich countries like the United States are only beginning to learn the enormity of the problem. A February 2009 report from the U.S. Government Accountability Office (GAO) insisted on the need to collect data on HAIs, particularly in Ambulatory Surgical Centers (ASCs)[3]:

"The increasing volume of procedures and evidence of infection control lapses in [surgical centers] create a compelling need for current and nationally representative data on HAIs in [surgical centers] in order to reduce their risk. Because HAIs generally only occur after a patient has left an ASC, data on the occurrence of these infections — outcome data — are difficult to collect. But data on the implementation of CDC-recommended infection control practices — process data — in ASCs can be collected more easily and can provide critical information on why HAIs are occurring and what can be done to prevent them."

After the 2009 report, more than 11,000 healthcare facilities enrolled in the CDC's National Healthcare Safety Network (NHSN) to report HAI Action Plan data.[4]

Further knowledge on this issue is a step in the right direction to address a prevalent problem that hurts and kills so many. More knowledge on best practices provides a chance to rethink health care facility design.

HALTING INFECTIONS

Research has shown for some time that facility design and cleaning practices are vital in reducing and preventing the spread of HAIs. This remains critical. New research on the role of floors in transmitting pathogens simply refocuses our attention downward, to the floor everyone's feet touch as they walk into a health care facility.

Infection prevention has many critical components, including hard surface cleaning, sterilization of instruments, implementation of appropriate isolation precautions and proper hand hygiene. No single approach is the sole answer in reducing HAIs. But flooring is a central component within an overarching design and cleaning strategy.

While research is ongoing on what cleaning methods are best, here are some clear findings. Wipes like hydrogen peroxide have reduced infection rates from one of the most commonly transmitted pathogens, *Clostridium difficile*. No-touch methods, like ultraviolet light and hydrogen peroxide vapor, have also had positive results.[5]

And design matters too. In 2013, a group of doctors and medical professionals assessed expert knowledge, perceptions and experience on the role of design in the acquisition and transmission of HAIs. In terms of surface design, the experts emphasized "the importance of selecting non-porous hard surfaces, which are less likely to promote microbial contamination and are easier to clean, during design or renovation phases, and abandoning the use of pressboard in cabinetry, under-sink storage areas, and plastic laminate around sinks".[6] Seamless non-porous hard flooring is easy to clean because it does not end when it reaches the wall, but rather curves up the beginnings of where the floor meets the wall to eradicate any crevices.

Floor design, the participants emphasized, is especially important in emergency departments: "Given the 24/7 hospital operating schedule, flooring is a very difficult area in which to maintain cleanliness". Traffic flow and the nature of the patients who require emergency medical care means that infection risk can be quite high. When cleaning is possible in the hustle of a busy emergency department, the floor needs to be chemically resistant so that even harsh cleaning products do not damage or stain the floor.

Components of seamless, hard flooring that support the environment of care include:

Nonslip surfaces reduce the likelihood of recovery room falls. Falls are a huge problem that increase hospital stays. In the United States alone, one study found that patients stayed an additional 6.3 days on average due to a fall during their stay.[8]

UV stability in the floor surface allows for surfaces that maintain their color over the life of the floor even in exposed sunlight areas such as rooms with windows or skylights. Patients and physicians, when possible, need natural light and views of nature for a better quality of life.[9] One study found that patients with bipolar disorder who stayed in brighter, east-facing rooms with morning sunlight left the hospital four days earlier than patients with west-facing rooms.[10]

Non-porous hard flooring material can withstand heavy foot traffic and won't tear.

Low odor during the installation process allows facilities to remain open and operations largely undisturbed during renovations.

Chemically resistant floors allow facilities to use the cleaning products they need, even harsh cleaning agents like vaporized hydrogen peroxide (VHP), without degrading or staining the floor.

FLOORING FACTORS

There are largely two types of flooring for health care facilities:

Seamless hard flooring is non-porous. The seamless design eliminates cracks, so it won't harbor bacteria. Poured into place, these floors are usually composed of epoxy, urethane, and acrylic resin. Because the flooring does

not tear, even with heavy foot traffic, it does not need replacing as frequently as other flooring materials. Its seamless nature makes it easy to clean by eliminating areas where bacteria can harbor. Experts believe seamless hard flooring is helpful in preventing HAIs.

Soft flooring is typically carpet or rubber-based. It usually has a lower up-front cost than seamless hard flooring. And, aesthetically, carpet flooring can make a hospital look like home. Yet it can tear under the pressure of heavy equipment like hospital beds and is harder to clean.

The right floor for any given health care facility room depends on the goals for the room. But especially for specialty spaces, like operating rooms, a hard, non-porous floor can help prevent the spread of pathogens by supporting the goal of reducing HAIs.

DATA-DRIVEN DECISIONS

Facility managers are increasingly adopting predictive maintenance by studying and capturing real-time data to improve facility design and broader O&M decisions. While global datasets on HAIs are small, they point to the same thing: There is a need for facility design to holistically serve the entire environment of care.

Making decisions for the long term, however, can be costlier up front. There are many flooring options that offer a much smaller initial investment yet are not able to meet the aforementioned criteria. There are several studies that point to the long-term costs of designing a health care facility without considering the environment of care. Yet it's important that the environment of care be considered. In the United States, two million patients suffer from HAIs each year, and nearly 90,000 are expected to die. The direct cost of HAIs to hospitals in the United States range from US$28 to $45 billion per year.[7]

Because data is limited, especially in developing nations, there are only limited ways to measure HAI impact across the world. Yet it's clear that HAIs increase the duration of hospital stays and dramatically increase the costs, and even more so for developing countries. Even more importantly, we know that HAIs impact the health of an enormous amount of hospital patients. The crux of predictive maintenance is to make data-driven decisions and this new research offers hope. A central part of the solution in preventing HAIs is under the feet of the millions of people who stay and work within health care facilities each year. FMJ

Patrick J. Meade *is vice president of sales and technical support at Dur-A-Flex, Inc. Pat has over 25 years of sales and business development experience with strengths in strategic planning, team building and project negotiation. He manages a team of over 30 sales and technical reps across the United States, driving sales growth and focus in strategic vertical markets.*

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HVAC Optimization: The next step in cutting carbon footprints

HVAC systems typically account for 44 percent of a commercial building's energy consumption[1]. Commercial buildings also consume 47 billion gallons of water every day[2], with 28 to 48 percent consumed by the HVAC system. That makes these systems ripe for optimization — minimizing their energy and water use can make a major contribution to reaching sustainability goals and reducing operational costs.

BY **FRED WOO**

HVAC optimization is the natural next step, after lighting, in improving facility efficiency. It's also essential to creating truly intelligent buildings that maximize productivity while enabling effective resource management with minimum lifetime equipment and system costs.

Optimization means getting away from the philosophy of applying more energy to hide the symptoms of system deficiencies, and instead, finding a way to deliver the most system output with the least system input. It also means going beyond recommissioning or traditional static set points and PID-based controls. Optimized HVAC systems are controlled automatically to deliver needed heating and cooling with the highest efficiency.

There is a lot of talk in the HVAC industry about integrating HVAC systems into the industrial Internet of Things (IoT) as a way to boost operational efficiency. It's a process that involves connecting all kinds of devices — VFDs, pumps, chillers and so on — to enable data collection. That upgrade is necessary, but the real value lies in transforming the data into information and using that information for optimization.

Cases for optimization

Rising energy costs — due to either rising electricity rates or increased usage — signal a facility that is ripe for optimization. The more the organization pays for energy, the more it will benefit from optimization.

Many corporations have a sustainability mandate to save energy and meet sustainability goals. Johnson & Johnson, for example, has committed to reducing absolute carbon emissions 20 percent by 2020 and 80 percent by 2050. Part of that reduction is coming from renewable energy purchases, but the cheapest renewable kWh is the one that isn't used.

HVAC systems that have been built up over time often have a mix of equipment — some old, some new and often different brands. With mismatched equipment, the best run combination and the best set point for a subsystem are not always clear. HVAC optimization provides the information needed to control complex systems for the highest possible efficiency.

Top targets

In general, the larger, more highly utilized and more centralized the facility, the better suited it is for HVAC optimization. Centralized chiller plants and large air handlers present a concentrated target, which usually produces greater savings. These systems cost more to operate, generally have more sophisticated controls, and are more likely to have dedicated staff to operate and maintain them.

Facilities with high energy use are a great candidate for optimization — the more energy consumed, the greater the benefit. Optimization may not pencil out for facilities in locations with very low energy rates; all other considerations being equal, it makes sense to prioritize facilities with expensive energy.

Additionally, 24/7 (or close) operations would benefit from optimization. Facilities with limited operating hours (about eight hours per day or less) typically don't use enough energy to justify optimization.

Systems with years of life ahead — middle-aged HVAC systems (10 to 15 years old) often are prime targets because they offer good room for improvement and are worth upgrading. New HVAC systems that have not been optimized can also be good targets — controls do not equal optimization. Optimizing very old systems, however, is unlikely to deliver much benefit. A better approach is to retrofit and update old systems to enable optimization.

Sensitive environments

Facility operators are understandably hesitant about optimizing HVAC systems in environments where maintaining precise temperatures and other climate aspects is essential. Yet in many cases, facilities are using far more energy than necessary to meet such requirements.

Most existing facilities have dialed-in operational set points and procedures meant to fulfill worst-case conditioning and ventilation requirements. Many of these systems operate at these set points at all times, even when they do not need to. For example, a particular piece of equipment that requires cooling may cause a whole chiller plant to run, even when it is the only load in the facility that requires cooling at a given time. Optimization will address these causes of waste.

Project leaders can mitigate risk with proper modeling, a well-designed implementation and testing process and back-up plans in case of performance problems.

As part of the optimization process, it is critical to identify the facility's specific heating, cooling and ventilation requirements and ensure that an optimized system could operate within those requirements. An optimization provider should develop a plan for addressing all needs with the lowest possible energy input. The solution could be as simple as adding an occupancy schedule and night setback set points to an air handler, or installing a dedicated AC unit to provide cooling to a specific piece of equipment, and allowing the chiller plant to shut down when it's not needed.

In the case of a chiller plant with strict chilled water temperature requirements, it may not be possible to optimize the chilled water temperature; however, optimizing the cooling towers, condenser pumps, chiller staging, and chilled water pump operation could still produce significant energy and cost reductions.

Space temperature, humidity, and ventilation rate can also be important in sensitive environments, and ultimately an optimization project should give facility operators better control over these conditions.

Four keys to success

A significant number of energy conservation projects do not provide the projected energy or cost savings. To reduce that risk, optimization projects should include the following elements.

Defined goals

Is the goal to reduce energy costs as an absolute value, or energy cost per square foot, or energy input per unit output? When reducing energy costs, what is the baseline against which energy use will be compared? Answering these questions will ensure that the project has the right targets.

Measurement and verification (M&V)

The optimization product should include an M&V method that can report on the effectiveness of optimization versus the organization's goals. If the organization has a carbon footprint reduction goal, for example, the product should report mass of CO_2 reduced in an easy-to-retrieve format.

Road map

A robust road map will provide projected energy savings, an M&V plan and a detailed plan of the project retrofits and tasks required for optimization. The savings projections and retrofit plan should be developed in partnership with the contractors who will do the work. Many project managers instead go the traditional route of plan and spec, requesting multiple bids. But optimization is not yet a commoditized product that can be successfully purchased this way; typically, the bid winner is the one who provides the least optimization at the lowest price, which results in missed savings.

Training

As with HVAC controls, HVAC optimization can easily be overridden or bypassed by operators and thus fail to meet savings goals. Proper training will give operators an understanding of how the system is meant to work, what to expect the system to do and what to do in the event of a problem.

Ensuring payback

Certain facilities are more likely to meet ROI requirements than others. Consider a quick calculation of savings and ROI. If an HVAC optimization package reduces building energy use by 5 percent and the payback threshold for energy projects is three years, then the project budget for optimization is 15 percent of the building's annual energy expenditure.

Cost factors to consider

The condition and age of the HVAC system will affect both the cost and the savings potential of an optimization project. The older and less controlled the HVAC system, the larger the potential savings, but also the larger the potential cost to bring the system to optimization readiness. The newer and more modern the HVAC system, the lower the cost and potential savings.

The size of the facility and its HVAC system also affect costs. Larger and more centralized systems concentrate energy use in one place, where it's easier to measure and optimize. A distributed system, such as one with numerous split-systems or rooftop DX units, will require optimization and monitoring of each independent system and thus will cost more to optimize.

Timing for cost effectiveness

An HVAC system at the end of life provides another opportunity for optimization. If a system is ready for retirement, optimization along with equipment replacement provides a quantifiable financial payback that would not otherwise exist for the capital project. Replacing and optimizing a new chiller may have a 10- to 15-year payback, but replacing the chiller with no optimization may have a longer payback or none at all. This difference in payback could provide the impetus needed to secure funds to replace old equipment.

Depending on the size of the system, HVAC optimization can be a significant expenditure requiring up-the-ladder budget approvals. It's a good idea to time optimization feasibility studies to be completed in line with the budget planning cycle to avoid yearlong delays in procuring optimization.

If a large capital improvement is already planned, it may make sense to include HVAC optimization, especially if the HVAC system is part of the renovation. This may allow consolidation of construction costs. A design review from a qualified optimization provider may reduce project costs if they find unnecessary or redundant equipment. A common example is primary/secondary chilled water pumping. The HVAC optimization system may be able to achieve greater efficiency with a primary-only chilled water pumping arrangement, and converting the system to primary-only during the design phase eliminates the need to purchase and install a whole set of pumps. Another example: installing new flow meters and other sensors without hot taps during construction, which is much cheaper than retrofitting sensors onto a running system.

The path to savings

Facility managers often have concerns about accommodating sensitive environments and achieving ROI with an optimized HVAC plant, but current solutions enable a wide range of facilities to measure system input (electric, gas, water) and output (heating, cooling, airflow, water flow) and to use that data to optimize the system in real-time. To deliver consistent, reliable savings, HVAC optimization requires three elements: measurement, a system-level approach and automatic control.

Measuring both the energy input and the system output is essential for data-based optimization, because varying the energy input of any piece of equipment will vary the total system output.

A system-level approach is key to effective HVAC optimization because it prevents unintended side effects that can occur if you optimize components one by one. Without this holistic approach, reducing the output of one component may cause other components to increase their energy use.

A truly optimized system requires continuous, automatic control. Solutions that call for human intervention to implement optimization recommendations may provide some energy savings, but real-time, dynamic control is the only way to provide maximum savings without compromising operations.

With all these elements in place, an optimization project will result in excellent system performance and energy savings year after year. FMJ

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