CABA™ Continental Automated Buildings Association

Creating a New Deal for Buildings

A white paper to facilitate the adoption of information technologies enabling a more productive indoor environment

A CABA WHITE PAPER

Anto Budiardjo (Main Author)
Cimetrics, Inc.

David Katz
Sustainable Resources Management Inc.

Harsha Chandrashekar
Honeywell International Inc.

John Petze
SkyFoundry, LLC

Mike Welch
Fulham Co., Inc.

Ron Bernstein
LonMark International

Therese Sullivan
Buildingcontext.me

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Authors

Anto Budiardjo (Main Author)
Cimetrics, Inc.

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Fulham Co., Inc.

Ron Bernstein
LonMark International

Therese Sullivan
Buildingcontext.me

Working Group

Anto Budiardjo
Cimetrics, Inc.

David Katz
Sustainable Resources Management Inc.

Gerry Cellucci
Yorkland Controls Limited

Harsha Chandrashekar
Honeywell International Inc.

John Petze
SkyFoundry, LLC

Mike Welch
Fulham Co., Inc.

Ron Bernstein
LonMark International

Therese Sullivan
Buildingcontext.me

Working Group: Individuals who either contributed ideas and input into the direction of paper or reviewed the final draft.

Sub-Committee

Dr. Kenneth Wacks (Chair)
Ken Wacks Associates

Brittany Hack
Consultant

David Katz
Sustainable Resources Management

Dilip Sarangan
Frost & Sullivan

Heather Knudsen
National Research Council

Marek Dziedzic
Public Services and Procurement Canada

Nikiforos Panorios
Synergy Companies

Raphael Imhof
Siemens Industry, Inc.

Sub-Committee: Under the direction of the Sub-Committee Chair, this formal committee reviewed and approved both the initial white paper proposal and final draft.

Published: January 2018

ABOUT CABA

The Continental Automated Buildings Association (CABA) is an international not-for-profit industry association, founded in 1988, and dedicated to the advancement of intelligent home and intelligent building technologies. The organization is supported by an international membership of over 365 organizations involved in the design, manufacture, installation and retailing of products relating to "Internet of Things, M2M, home automation and intelligent buildings". Public organizations, including utilities and government are also members. CABA's mandate includes providing its members with networking and market research opportunities. CABA also encourages the development of industry standards and protocols, and leads cross-industry initiatives. CABA's collaborative research scope evolved and expanded into the CABA Research Program, which is directed by the CABA Board of Directors. The CABA Research Program's scope includes white papers and multi-client market research in both the Intelligent Buildings and Connected Home sectors. www.caba.org

ABOUT CABA'S INTELLIGENT BUILDINGS COUNCIL (IBC)

The CABA Intelligent Buildings Council works to strengthen the large building automation industry through innovative technology-driven research projects. The Council was established in 2001 by CABA to specifically review opportunities, take strategic action and monitor initiatives that relate to integrated systems and automation in the large building sector. The Council's projects promote the next generation of intelligent building technologies and incorporate a holistic approach that optimizes building performance and savings. www.caba.org/ibc

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PUBLISHED
January 2018

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FOREWORD

The Building Automation System (BAS) industry is made up of many passionate individuals working for large multinational companies as well as technology start-ups. These manufacturers are supported by local providers and technology-focused groups, committees, systems integrators, consultants, specialists, media, and bloggers. The past decades have brought about dramatic developments in technology, business practices, and approaches. Today, the industry is grappling with impending disruption brought about by information technology, specifically the "digitalization of everything" under the moniker of the Internet of Things (IoT).

In mid-2017, some industry thought leaders saw the need to initiate a conversation about how best the industry should adapt to the age of data. It started as an online blog "A New Deal for Buildings" (www.newdeal.blog). This blog became the inspiration for this white paper created under the auspices and guidance of Continental Automated Buildings Association (CABA), the industry body that lies at the center of BAS discussion, education, and advancement.

The New Deal is not promoting any specific technology or company, nor is it a new association or other entity. The New Deal is designed to encourage dialogue on how the BAS industry can advance and deliver significantly better value to customers including building owners, facility managers, and society at large. All will benefit from the best possible indoor environment and energy performance of their buildings.

Discussing disruptive forces can be both invigorating and uncomfortable. Many CABA members will be excited by the New Deal, while others will see it as unnecessary and counter to their current business priorities. A better way to view disruption is that it is inescapable. Acknowledging and discussing responses to disruption is much better than the inevitable external disruption from entities less able to fulfill the needs of building owners, operators, and managers.

The authors hope that this paper lays out the background, issues, tenets, driving forces, and possible responses for the industry. The authors know that they are not omniscient and seek input from all in the industry to further the mission of the New Deal.

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1. EXECUTIVE SUMMARY

Buildings today are much more than the shelter they provided in the 20th century. Buildings have become centers of productivity, places of learning, art and entertainment, and gathering places for our increasingly urban life. Innovation in architecture, construction techniques, and building materials are changing how we create and operate these physical structures.

The occupants of these buildings–we humans–are evolving our use of digital technology. Internet-delivered products and services are making our lives easier, more productive, and more enjoyable. Enterprises are also profiting from the increase in productivity through online tools such as Enterprise Resource Planning (ERP), Building Information Modeling (BIM), and Customer Relationship Management (CRM), as well as innovations such as supply chain, social media, and e-Commerce.

The focus on creating a "New Deal" is a key missing part of this picture. We believe that the relationship between building owners and building vendors is currently broken, especially in the area of how building automation systems and rapidly multiplying IoT devices are used to improve the value and utility of facilities. We believe that by enhancing this relationship, both enterprises and people who occupy buildings will reap significant benefits.

We are not naive about the complexities of building a modern facility. The approaches we propose accept the realities of the new construction and retrofit processes, and provide a path to improve them, especially in the area of operating the building from construction until demolition.

We believe that it's time for vendors and owners to take action, and demand that the design and construction process enable owners and occupants to benefit from the type of technology, products, and services that can unlock the full potential of buildings for the 21st century and beyond.

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2. INTRODUCTIONS

2.1 Building Automation - From DDC to IoT

From the late 1980s, building owners, the building controls industry and futurists have espoused the dream of intelligent buildings, anticipating "Jetson-like" buildings. When buildings are smart enough to adapt dynamically to the desires of occupants–providing them with an environment good for their health, productivity, and enjoyment–while simultaneously meeting the regulatory community and business needs of the owners, we will have arrived.

The first wave of information technology in the late 20th century helped propel the industry toward the goal of an intelligent building. Digital controllers started to be attached to mechanical equipment that had predominantly remained unchanged for decades. Data networks began to connect devices together, enabling the earliest inkling of a system-engineered approach to buildings, made up of a vast array of sensors, logic controllers, mechanical equipment, user interfaces, actuators, and other ancillary products. Early adopters saw benefits of these fledgling solutions, while innovators pushed the envelope. Technology groups started to discuss open specifications and standards, and major equipment vendors grappled with the challenge of staying ahead.

The dramatic explosion of technology in the recent decade, driven by the consumer Internet, is providing a wake-up call for the buildings industry. In our daily lives, we carry smartphones that allow us to talk to anyone on the planet via voice or video! We can summon any music we desire, watch any TV channel, purchase any item we want, keep track of our health, and communicate with our social networks in ways that were unforeseen just a few years ago. Perhaps most relevant, we can also control the equipment and systems in our homes. On the supply side, businesses have an unprecedented view of their consumers through the massive trove of big data we leave as bread crumbs along our daily digital journey. The Internet of Things (IoT) is taking us further into this digitally-enabled world; the number of smart devices is predicted to overtake the number of humans in short order. Smart refrigerators, toasters, toothbrushes, transportation, and other innovative devices are starting to make the Jetsons look quite real, at home anyway!

2.2 Hot and cold calls!

And yet, when we look at buildings, we see a different picture. If you ask facility managers what issue they have to deal with on a daily basis, many would say "hot and cold calls," occupants uncomfortable with the temperature of their indoor environment. Such calls are like a consumer needing to call Spotify or Pandora when their music is too loud or too soft; it's clearly absurd. And similarly, businesses that spend a significant portion of their Operating Expenditures (OPEX) on facilities have little visibility on the comfort and productivity of employees occupying their buildings, nor on how the performance of their retail properties is contributing to or is a detriment to sales, nor on the waste of energy and other valuable resources, nor the risks of exposure to regulatory noncompliance.

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So, the question is why? Since the same technology used by the consumer tech market is also available to buildings, why is it so hard to make buildings truly intelligent and realize the immense value to owners and occupants? To try to answer this question, we need to understand how buildings are built, and the relationship between building owners and the building system vendors.

2.3 Building a building

Unlike buying a consumer product like a phone or a car, planning and constructing a building is a major endeavor. The first thing to note is that buildings last a long time, typically decades. This fact alone makes the economics of buildings complex. There are financing entities, the owner's needs, tenants' demands, refurbishments, and equipment replacements over the years, and the many brokers and third parties involved during building's lifetime to consider. On the construction side, there are architects and consultants to design the building, contractors, and subcontractors to construct it, governments, safety, and other regulatory officials ensuring the building's adherence to codes. We also need to consider energy and utility suppliers, elevators, Heating Ventilation and Air Conditioning (HVAC), security, lighting, and specialized equipment for the business, such as laboratory or manufacturing plant assets.

The building automation system (BAS) is installed and overlaid atop the mechanical systems installed in buildings. The primary function of the automation system is to make these mechanical systems work individually and in concert to ensure that the building works effectively. The introduction of LED lighting and the digitalization of lighting control systems add additional optimization dimensions to the interoperability potential of the BAS.

The building system is typically installed when the building is built or undergoing major renovations and is usually paid for as part of the construction project. The cost of the automation system is not large compared to the total building cost, typically low single-digit percentage, though we would argue that automation punches above its weight when the full benefits are realized.

The question to ponder is the motivation of the owner and builder in their selection of the building system. Is this selection the best for them or the many occupants over the decades? This is further impacted by the time cycle of the process – many owners have not had the opportunity to learn how these technologies can benefit them by making their building more attractive, efficient, and of greater value. Historically they have looked to consulting engineers to assess and recommend technologies. But are those organizations equipped to assess this new wave of digital technologies?

There is a move by many in the industry, to bring the design of BAS much earlier in the building process, during the design phase. The argument is that doing so would enable the full value of BAS to be realized in a more holistic way, as a key part of the building. The "New Deal" welcomes this trend.

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3. VENDORS VS. OWNERS!

3.1 Partners or combatants?

It's easy to simply blame "the other side" when trying to uncover the problems in this buyer-seller relationship, but the truth is much more complicated. The dynamics behind this relationship have evolved on both sides for decades if not centuries.

On the building owner side, the issues have evolved significantly. Buildings a century ago were much simpler in purpose, construction, and financing. Steady technological advancements have changed the mechanical equipment used and how we humans control the indoor environment. Manually opening and closing windows, switching lights on and off, as well as manually adjusting any heating or cooling was the norm less than 40 years ago. Many buildings did not have air conditioning as they were built with a good thermal mass and had operable windows and fans. That sounds like a long time ago in technology terms, but in building terms it is only "yesterday", bearing in mind that most of the buildings from those days are still around today. Early building automation additions to these older buildings and the HVAC equipment were not well designed or installed. Also, many energy saving claims were not achieved for various reasons.

The longevity of buildings is a major factor in the current design-build cycle. The significant finances required to construct a building makes those who build them very risk averse. Builders focus a great deal of attention on the physical look in the construction of buildings, since that's the most obvious attribute that will remain the same for decades. To many owners, the automation systems within a building are not seen as critical to the success of the facility. These differences in focus are evidenced today in the differing roles on the building side; from owners to facility managers, operations, energy management, mechanical engineering, and information technology departments.

The BAS vendor community has challenges. It's an industry that started as predominantly providing mechanical services that, like buildings, have a typical life of many years, though not necessarily the decades-long life of buildings. In the 1970s and 1980s, the industry discovered electronics and digital technologies, which it slowly adopted as a way to control mechanical systems. The march to digitization continues today, while the mechanical skills remain just as important.

It could be argued that the combatants exist just as much *within* each of these two broad categories as *between* these two groups.

3.2 Split incentives

With multiple interested parties involved in owning, operating, and occupying buildings, it is not surprising that there are many areas of motivation that are not aligned with others. The most pervasive and talked about is the misalignment of interest between building owners and occupants of the building, especially when it comes to energy management.

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The nature of energy management systems is that they are specified and financed as capital expenditure during construction or refurbishment. The value of energy management, however, is enjoyed not by the building owner that pays these first costs, but by occupants; therein lies the disconnect. Why would owners invest Capital Expenditures (CAPEX) when they do not enjoy the Operating Expenditures (OPEX) efficiency benefits? Furthermore, it is challenging to use energy management enhancement as a basis for increased rents.

Another commonly debated disconnect is between the planning, construction and lifetime operation of the building. Automation systems in buildings cannot be seen as an add-on to the building, which is how most consider it today. Experience from successful facilities shows that considering automation at the earliest design phase is critical to making sure the building is designed to perform in concert with automation. And designing such systems for long-term operation is critically important to maximizing the full value of the facility throughout its life.

3.3 User-centricity

While the vendor-owner friction is evidenced as imperfect, there is a third and more important stakeholder that is worth noting, that is the users or occupants of buildings. These stakeholders have a very practical relationship with buildings: they are the consumers of the buildings with all of its flaws and imperfections. Users are office workers, retail shoppers, students attending school, and residence of multi-use properties.

While the broad relationship between users and their buildings differ according to the type of building, within a specific facility this relationship is typically very clear. For an office or work facility, the objectives of the occupants are to work and be productive to the benefit of the business enterprise that employs them. For retail, the objective is to provide shoppers with an experience and encouragement to transact with the retailers in the facility. In this era of pervasive mobile-enabling technologies, the biggest technological disruptor to workplaces and retail buildings may be that office workers can now opt to work somewhere else, like a home office, a café, or a shared-workspace location, and shoppers can transact online. With these convenient alternatives, buildings have to provide experiences that entice users to come there.

The “New Deal” is all about placing focus on this category of stakeholders above and beyond the needs of the building owners/managers and building automation system vendors.

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4. CHALLENGES

4.1 Decisions, decisions!

Should the building automation system be provided by the equipment vendor of the major plants or subsystems in the building? The argument for single-vendor can be compelling. They would provide a single point of contact to ensure that everything works at commissioning and at least for the duration of any warranties. This selection is often tied to a service contract with the same vendor. "Who else would be better able to maintain the facility?" the vendor would argue. This scenario leaves the owner little control or leverage to ensure that the building is performing as it should. The idiom of the "fox guarding the henhouse" comes to mind here. One of the other issues is that no single vendor has best-of-breed solutions in all areas of building technology and especially in the area of emerging digital and IoT technologies.

An alternative option to single-sourcing is to assemble a team of vendors from different disciplines: equipment, control system, maintenance, and other services. This approach has been appealing to building owners keen to encourage innovative solutions that might bolster the creative and "cool" aspects of the building, maybe increasing the value of the building to their target audience. There is risk involved however; some owners accept responsibility for managing this project team, while others hand it to a construction management consultant and a facility manager for building operations. The relationships among the various entities in this scenario can get complicated, contentious, and can result in finger-pointing when conventional construction contract scenarios are used, which ultimately will cost the building and its occupants in comfort, lost time, and money.

There are of course many other variables and business models for how buildings can be built. The point here is that the entities responsible for constructing and initially operating the building are mostly concerned about their responsibilities and risks, not necessarily the issues facing the long-term owner or occupants, who bear most of the cost of the facility for years or decades hence.

4.2 There has to be a better way

These and other issues are not new, and information technology is not necessarily going to resolve them. These questions reflect the realities of a major construction project such as a building. The "New Deal" acknowledges these realities and proposes a framework to ensure that buildings are built in a manner that enables the continuous efficient use of the building throughout its lifetime with potential to upgrade and improve as new technologies become available.

We believe that this vision improves the value of products and services that vendors provide since ultimately the building will provide more value to its owners and occupants. This proposal does, however, significantly undermine vendors that are not providing the

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best products and services–something all building owners, managers and tenants should celebrate.

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5. TENETS FOR THE "NEW DEAL"

The "New Deal" is built on three important tenets: *open standards, digital twins, and service transparency*.

Individually, these bring a great deal of value, but when delivered in combination, they provide a powerful and compelling roadmap for getting the most from today's and tomorrow's buildings. More importantly, these tenets are designed to improve the relationship between vendors and owners, as well as to contribute to improving their respective businesses.

5.1 Open Standards

Because a building is made up of many different types of equipment, functions, and systems, the best solution for a particular building will likely be sourced from multiple vendors. Also, by necessity, a critical element of building systems is how these devices communicate with each other. The answer to this interoperability problem is standards specified through an open and public process. Such standards would enable interconnecting building components into systems that are reliable and flexible enough to engineer the functions required by clients. The process of developing standards is done in a public committee, and the resulting standards are open for adoption by any company. Therefore, we use the phrase "open standards" to emphasize that standards are preferred over specifications maintained by private companies because standards help promote interoperability.

Standards are specifications developed by committees officially called "Standards Developing Organizations" (SDOs) authorized nationally and internationally. The American National Standards Institute (ANSI) and Standards Council of Canada (SCC) authorize North American SDOs and set requirements for a transparent process. SDOs establish committees that are open to any expert who may propose, debate, and vote on standards. International standards require multiple ballots by a super-majority of voting nations, where each country has one vote. National and international standards are published and available to all implementers without discriminatory fees.

To be effective in buildings, interoperability standards need to address three critical areas. The first is ubiquitous connectivity allowing easy mixing of products from different manufacturers on a single network. Secondly, because a building system is a living entity that can change over a decades-long lifetime, automatic discovery of devices on the network is necessary. Lastly, because building systems designed and installed by different engineers are increasingly complex, a common semantic lexicon is required. If the data from devices are to be made useful by any analytics tools, it's critical to have a markup language for describing the features, capabilities, and meaning of all of the components that is industry-standard and easy to understand.

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On ubiquitous connectivity, the future is clearly IP-centric since we have seen so much expertise and success of this technology in the broader Information Technology sector, specifically the Internet. IP is often the communication protocol of choice for the Internet of Things (IoT), with significant investment being made in wired and wireless technologies capable of solving all known network needs. IP network have challenges in meeting the timing requirements, relatively low-complexity, and cost targets of many BAS components.

Until IP networks become truly ubiquitous and applicable to IoT devices, many flavors of serial control networks that exist today will continue to dominate many of the devices installed for years to come. Standards specialized for BAS such as BACnet, Modbus, LON, oBIX, DALI, KNX, EnOcean, and others have significant momentum with available products, installations in many buildings, and support from a large pool of engineering expertise. Many of these systems have IP-centric routers (using IP networks to route serial data packets), use gateways that exist in the market today, or use IP to carry higher level building specific interoperable messages. Because building systems have a typically long life, these hybrid systems will likely be seen for many years, if not decades.

There will be many non-IP devices for the foreseeable future for applications where IP is not the best protocol for the job. In fact, the purpose-built protocols listed above predominate over IP. The challenge for IP is provide similar or improved features of these protocols practically and economically. The limitations of IP are discussed in an article from the spring 2016 CABA magazine *iHomes and Buildings* entitled "What is the Internet of Things?"

Auto-discovery of network nodes is of great importance to building systems. The reason is that building automation systems are specifically engineered for each building, where no two buildings have the same BAS configuration. This is unlike complex systems such as recently-designed automobiles that have dozens of microprocessors, where the topology and devices of one vehicle is identical to others of the same model. Buildings are custom-engineered systems, each designed, adjusted, and re-designed by engineers over its life. As a result, it is almost impossible to document accurately on paper updates to the equipment system architecture and resulting network topology. The ideal way to document reliably a building is for the system to self-document itself, which is typically implemented by some form of discovery process or a device and network management mechanism. This can only happen when the discovery software has some standard way to communicate information about devices, network topology, and relationships among devices.

The third part of the standards-based imperative revolves around metadata. A typical building system in a medium/large facility will have thousands of data points, from setpoints, status of mechanical devices, actual temperature, humidity, and other data in all parts of the building. To enable the creation of a Digital Twin (a computer-based simulation model) of the building (the next "New Deal" tenet, see below), there must be a clear understanding of every data point in the system. For the analysis tools and analytics systems to make use of a datapoint that may have a value of 86, the datapoint must describe the unit being used, the context of the value and relationship with other data

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points. The value of 86 in degrees F as a current room temperature being controlled by a setpoint that is set to 72 degrees F is clearly problematic, while a value of 86 in degrees F as an outside air temperature of a building in Florida is perfectly acceptable. Metadata gives meaning to data.

The importance of standardized metadata cannot be overstated. While some current standards provide a good starting point on this front, other metadata schemas are needed to allow data within building systems to be made more valuable for analysis. Of particular note is the work of Project-Haystack.org to create a framework of tags for BAS and beyond, as well as related and coordinated work being undertaken in the BACnet community. Also, the type of facility should be considered as each is likely to have a specific dictionary according to building functions (consider the differences among a library, a pharmaceutical laboratory, and a shopping mall) Appropriate standardized metadata dictionaries for these sectors can turn BAS, sensor, and IoT device data into meaningful business value.

Think of the collection of metadata as a profile where the device has self-documentation information that provides configuration, timing, and identification information available to any open network management tool, ready to reproduce the device in its Digital Twin in the cloud.

There is a great deal of work already codified or in the process of being specified in all these areas. While the reason for developing a profile might be cost-driven, for the "New Deal", the focus is to ensure that there is sufficient richness of data and meaning to be able to create an analytics-based Digital Twin.

5.2 Digital Twin

One of the attributes of building systems is that they are each unique, even though many of the devices that make up the system are common, standard, and available off-the-shelf. Each system in a building is engineered specifically for that building, with requirements that are unique to the circumstances and needs of that building, as specified by the building owner and design team.

Implementing analytics on such a system requires a thorough understanding of this dynamic. Many traditional analytical techniques such as pattern recognition, machine learning, and statistical analysis can provide value in analyzing building system operation, but to move to the next level of intelligence requires the inclusion of model-based techniques as well, which is a key part of the "New Deal".

Model-based analytics create a cloud-based Digital Twin of the building. Digital Twins are created automatically by examining the information from the building using the standards-based infrastructure in the first tenet, including topology, context, data models, and metadata. The Digital Twin models the structure of the system, which when combined with the continuous data flow from the building allows continuous dynamic modeling of the building in the cloud. These models can quickly identify issues where the physical system is

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not operating correctly. As an example, if we know that the gas to the heater is on, and the temperature after the heater is the same as the air before the heater, then something must be wrong.

Not only do model-based analytics identify issues and generate alarms, but they can also often determine the cause, and cost of problems, and can automatically determine when a problem is fixed following corrective action. In other words, this approach not only monitors the system, but also oversees the resolution of issues identified, and thus monitors and verifies the service performed by service providers.

Another critical value of this approach is that we can rewind the system to analyze the building as it was operating at some past date. This attribute is useful as a forensic tool, for example, to investigate why the energy cost a few months back was out of the normal range. The tool can help explore what-if scenarios as part of problem-solving complex systemic issues.

The value of this approach for building owners and managers is significant, as it brings accountability and transparency to the task of identifying and resolving issues. Equipment vendors are held accountable for their products, and service providers are held accountable for their services. Issues that were not caused by equipment or programming failures, such as a building occupants' behavior, floor plan changes, and other external issues can be identified in a similar manner. When the appropriate changes are made, the analytics engine should automatically re-adjust the status quo to the new circumstances, an example of applying machine learning techniques.

5.3 Service Transparency

We have already established that buildings are complex entities. Building owners (including managers and occupants) are the users of the building; they have their own issues to deal with and typically don't have the bandwidth of expertise to manage every aspect of how their facility is serving them. At the core of what building owners must demand under the New Deal is transparency that the products and services they receive are doing what they are intended to do–what the owners have paid for.

While the key components of the New Deal are the two technology approaches discussed above, to truly deliver value to building owners, these technologies must be viewed as enablers for vendors to deliver their products and services, and to do so with transparency.

This level of transparency was previously impossible to achieve, and much of the inefficiencies of buildings today are arguably the result of this problem. While it is easy to know when your HVAC equipment stops working, it's difficult to know that a piece of equipment was performing 10 percent below nominal, and it's not easy to prove that a fix was made to recover that lost 10 percent of performance. While 10 percent doesn't sound like much, multiple similar issues can compound into a substantial performance

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degradation of complex mechanical systems, costing the owner significantly, from energy usage and occupant productivity, to negative business impact.

Adherence to a standards-based building-wide control network, which is inherently open, minimizes a vendor's ability to hide behind proprietary products. It also removes the lock-in that vendors have traditionally used to secure additional projects and lucrative service contracts. The "New Deal" posits that when a quality-focused vendor offers open products and service transparency, they will receive an increased level of business, and the loyalty of the owners who appreciate the transparency.

Transparency also applies to the tools and information used by vendors to manage and diagnose the BAS. If the tools are proprietary and not available for the owner or alternate service provider, the vendor retains that lock on the building, forcing the owner to engage in costly a sole-sourced service contract. Open procurement of both the initial building BAS *and* the future service contracts is paramount. The "New Deal" transparency tenet specifically applies to the serviceability and maintainability of a facility. In other words, does the owner "own" the building or does the BAS vendor?

This transparency is beneficial both to the vendor and the owner. The vendors can use it to analyze the problem in the first place, and use any information gained to propose a solution. The owner can then see the rationale of the vendor's proposal and subsequently, the result of the service work. Should the problem persist, both vendor and owner can openly review the data and their decisions. If necessary, they can escalate the issue. Most importantly, with the data in hand, no finger-pointing is necessary.

Service transparency is not a nice-to-have business model or a marketing slogan. One of the reasons for the success of the consumer Internet is leveraging information technology to enable transparency. When you think of Yelp, Airbnb, TripAdvisor, Amazon, or any of the many other online services, it is transparency that contributes to the quality of products and services that customers receive. In the New Deal, providing service transparency is a core attribute of the successful relationship between vendors and owners.

5.4 Interlocking tenets

The three building blocks of the "New Deal" are interconnected by design, each magnifying the contribution of the others. They collectively provide a huge boost to the value of buildings for their owners and improve the ability of vendors to increase the value of their products and services.

Open Standards: The three attributes of standards identified in the "New Deal" (*ubiquitous communications, open discovery, and a common semantic lexicon*) are keys to enabling buildings to reap the full benefit of today's and tomorrow's technologies. This combination makes device selection from multiple vendors easier, as many of the common types of devices are now plug-and-play commodities. The richness of information from these devices uniquely enables the model-based analytics to create Digital Twins that are at the

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heart of the “New Deal”. The widespread acceptance of these standards has created, and will continue to create, a large base of industry professionals globally, providing owners the flexibility to choose based on attributes such as transparency of their offerings.

Digital twin: There is a great deal of hype today about Big Data and analytics from the technology sector. The “New Deal” focus on model-based analytics (digital twin) is based on a deep understanding of the needs and value for building systems. Model-based analytics can only be achieved at scale using standards criteria identified in the New Deal, where the richness of their data and metadata is critical for the creation of the digital twin, a core feature of the “New Deal”. This form of analytics also enables the transparency we view as essential. By seeing and troubleshooting the system in their digital twin, insights that were invisible are now made visible, so that owner and vendor engineers can analyze and take corrective action collaboratively and openly.

Service transparency: Transparency is a cornerstone of the Internet-enabled services we now take for granted in the consumer world, from Yelp, TripAdvisor, Angie’s List, and many others. With the complexity of buildings, transparency is also a compelling proposition for buildings, but it is not possible without standards, combined with the transparency provided by model-based analytics monitoring of building operations. Service transparency turns the standards-based devices, coupled with the digital twin created by the model-based analytics, into a powerful accountability tool, holding vendors accountable for their products and services.

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6. A DAY IN THE LIFE OF A BUILDING

The "New Deal" believes that a user-centric perspective of buildings is illustrative of how we should be examining building systems. The following is a simplified (and hypothetical) narrative of the user-centric view.

Acme Corp. is a successful 120-person strong marketing company in a mid-sized city in the American heartland. Acme has recently moved from their 80s-built office into a five-year old facility in a hipster part of town hoping to attract new millennial talent. Susie is a talented graphics designer that founder Linda hired when she started Acme 10 years ago. CFO Jarred is looking forward to a better office for the team to flourish. He brought in Robert as a facility manager a year back to help maximize the value of their new office, built in line with "New Deal" ideals.

Creativity comes at any time for Susie, in the dead of night and weekends. In the new office, Susie is able to use her smartphone to notify the office system that she plans to go in to do some work. When she arrives, her studio will be at the right temperature and ready for her regardless of outside weather conditions. This compares to the old office where she would need to spend time preparing the old studio with floor heater in the winter, or using fans and opening windows in the summer. Susie also feels much more productive, and her recent successes are something that CEO Linda has noticed.

Increased creativity isn't the only thing Linda has noticed. Many of her team now often are at their desk when she arrives each morning, a far cry from her old role of unlocking the office each morning. The new office has cleaner air, better lighting, less CO_2, and other issues that impaired productivity she saw before. Acme's recruitment efforts has resulted in a number of new team members, who indicated the office environment as a key attribute to their decision to join the team. The company's Glassdoor reviews have shot up, with many mentioning the work environment as a key factor.

CFO Jarred was originally concerned about the cost of the move to a space 50 percent larger than they need, until he saw the numbers. Acme's utility bills are 20 percent less than before despite the larger space. Jarred proposed to the whole company that the money saved should be used to further improve the workspace. A big success with the team, they are now discussing how the money should be spent. Jarred's enterprise dashboard includes high-level BAS information, which gives him an instant look at the performance of the office, from utility costs to the status of any issues that the building digital twin is identifying. Lower cost, increased productivity, and happy employees lets him focus on more demanding and important financial planning activities, like raising capital for expansion!

In the old office, facility manager Robert was forever managing hot/cold calls and manually addressing problems raised by the team. With the "New Deal" inspired office, he has full visibility of the systems running the office. Each morning he is presented with a list of

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issues, prioritized by their impact to operating cost and comfort of the facility. Issues requiring the services of a vendor are based on data that he can share with the vendor. The service vendor in turn is able to resolve the problem quickly, show Robert the actual work done, and verify this work with data. Robert noted that he can work collaboratively with outside vendors, a far cry from the blame game he used to deal with before.

And the best thing for Robert is that CEO Linda is happy with the business performance and CFO Jarred can now understand what he does. He can now spend much of his time working with Susie and other team members to figure out how to continually improve the quality of the environment they all share. Susie is campaigning to change Robert's title from Facility Manager to Wellness Manager.

The above narrative portrays a simple yet powerful example of the business and financial benefits of efficient, intelligent buildings as a result of "New Deal" thinking. This narrative is supported by a number of industry studies including:

- Improving Organizational Productivity with Building Automation Systems
- Savings and Operational Efficiencies for the Industrial/Warehouse Environment
- IoT Smart Building Solutions Transform the Workplace

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7. BENEFITS OF A NEW DEAL

7.1 Benefits to owners

Those who have been involved in owning or operating large commercial facilities know that the term "owner" can be misleading. We use this term loosely to denote the stakeholders on the buying side of the BAS vendor-owner relationship, namely the owning, construction, leasing, management, operation, and maintenance of commercial facilities. Below are a few roles we consider more prominent for understanding the "New Deal".

Corporate owners: Corporate owners are focused on getting the most from the investment they make in facilities and people. While the costs of the facility, energy, and other services are important, maximizing the productivity of their employees and other assets are their highest priority. Under the "New Deal", owners are informed about issues that impact their business and are able to manage them with full transparency so they can plan their business accordingly. The "New Deal" is also an ideal way to assist on regulatory compliance, especially in health, pharmaceutical, oil & gas and other highly regulated industries.

REIT (Real Estate Investment Trust): For REITs, the capital and lease value of their buildings are their core focus. REITs are motivated by the "New Deal" to ensure that their properties are well maintained and that tenants get the promised value from their lease. REITs with a large and geographically diverse portfolio will benefit from the "New Deal" as a way to create consistency across their facilities, and to aggregate service and maintenance to increase the profitability of their assets. The "New Deal" also helps with environmental impacts and securing Green and High Performance building accreditations such as LEED, Green Globes, BOMA Best, ASHRAE SP189.1, which enhance the value of their properties.

Tenants: Commercial tenants are focused on getting the most from their lease for their business. Similar to corporate owners, tenants are keen to increase the productivity of their operations, and especially contentment and effectiveness of their employees and, in retail situations, the happiness and patronage of their customers. The "New Deal" tenets also provide transparency on issues like service and maintenance, and can significantly reduce energy and other utility costs.

Institutional owners (government, schools, religious groups, etc.): Institutional owners are typically focused on their purpose and mission. They desire facilities that work as specified, and that any issues are addressed as rapidly as possible. On the economic front, they need to show restraint and cost-consciousness to the community they serve. Open and standard-based products provide these owners a solid base of flexibility to choose future vendors, and transparency gives them visibility and accountability to their stakeholders.

Facility Managers: Facility Managers (FM) are responsible for the day-to-day operation of buildings. The purchase of systems conforming to standards provides FMs the flexibility to

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choose and combine products and services that suit their needs without being locked into a specific vendor. Model-based analytics provide FMs a powerful tool to identify and track issues to their satisfactory resolution, while transparency affords them visibility into the vendors' products and hold them accountable for their services. The openness of the "New Deal" allows for the use of innovative products and services as they come to market.

On-site Engineers: Engineers have the task of monitoring and resolving issues with their buildings on a day-to-day basis. Their work is typically underappreciated, few people understand what they do, and most of the interaction with occupants is fixing problems. The "New Deal" provides tools for engineers to transparently identify issues, work with vendors, and hold them accountable to resolve problems and to demonstrate results to building occupants and business managers relying on the facility.

7.2 Benefits to vendors

The "New Deal" for buildings affects many vendor types involved with the production, installation, and maintenance of building systems. While this is a broad industry, for the New Deal we focus on the following categories of vendors, each heavily involved in the building automation system at the core of our vision.

Large multinational equipment vendors: Large vendors typically focus on scale and brand. These companies rely on the development, production, and service of a broad range of products across large market regions, where ensuring customer satisfaction is key. The principles in the New Deal provide these vendors with a tool to focus on the performance of their products over their lifetime while being proactive and transparent in their service offerings. These qualities, in turn, create a significant degree of loyalty among their customers. The transparency attribute also increases the value and relevance of their brand in a competitive market.

Independent control system vendors: Over the decades, small system vendors have been the innovative force of the building systems industry. These vendors easily adopt new technologies, and the adoption of standards is core to their beliefs. Partnering with model-based analytics companies can provide these system vendors significant leverage to gain business with ever demanding owners. Service transparency is normally a core competence, so adapting the New Deal principles is a natural fit.

Software and technology vendors: The significant growth of technology startups in the past decade has created opportunities in software and IT-based companies in the building space. It goes without saying that these companies fit right into the "New Deal" vision: *standards, analytics, and transparency*. Adopting the "New Deal" ideals will help these companies position themselves in the vendors' community, and present their valuable product and service offerings to owners who need innovative solutions for their buildings.

Consultants and engineering firms: There are many disciplines of consultants involved with buildings: architects, civil engineers, structural, HVAC, security, audio video, lighting,

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electrical, and others. The work of many of these consultants is impacted by the quality and effectiveness of building system in the facility. Therefore, the "New Deal" will become a valuable tool for them to ensure their discipline is well integrated into the broader building automation system that touches almost all corners of the facility they contribute to.

Control contractors and system integrators: Much of the work in installing building systems fall on these vendors. They are typically local and provide expertise in the design and installation of real-time systems at the core of building automation. Most already have expertise in the necessary standards as it provides them multi-vendor flexibility. Adapting model-based analytics will allow them to provide additional services throughout the life of the building. Service transparency is typically an important component of these vendors and their relationship with the building owner and managers.

Maintenance & service providers: Service providers are key to the continued functioning of facilities, and the "New Deal" holds a great deal of value for these companies. The adoption of standards reduces the variety of technologies they have to maintain, while the model-based analytics provides them with an important tool to be alerted of issues, and provide the owner with resolution in a very transparent manner. With the New Deal, service providers can be proactive and resolve issues before owners are aware of them.

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8. ADDITIONAL CONSIDERATIONS

8.1 Occupant productivity and health

A common and misleading understanding of BAS is that it is purely a discipline to control the actual building and its systems. Since energy is a prerequisite for any form of heating or cooling, another often-stated reason for BAS is to manage energy. In today's performance-focused organizations, a better view is that the purpose of BAS is to ensure the productivity and health of the occupants of the buildings.

This is best captured by a model created by JLL (Jones Lang LaSalle) commonly referred to as the "3-30-300 rule"™. JLL observed that as a rule-of-thumb, facilities face annual cost per square foot of $3 for utilities (energy), $30 for rent, and $300 for payroll. From this, a target 10 percent improvement in energy efficiency would yield a benefit of $0.30 per sq ft, while focusing on improving the productivity of the occupants by 10 percent would yield a benefit of $30 per sq ft, a better return than a pure focus on energy.

The methodology to improve productivity and health vary significantly by building type. In retail for example, tying the comfort of the environment to the buying habits of customers can directly impact the productivity of the business. In office environments employing millennials, there is commonly a desire to make the work environment "fun", to encourage the workers to remain in the office. There is also a great deal of research on the effectiveness of learning based on the color temperature of lighting, and the impact of CO_2 levels on productivity of employees is also well understood.

It is thus important that building owners not focus on energy consumption alone, nor on the cost of the building lease. There are many ways that a well-designed building automation system can improve the quality of the facility that will lead to productivity and health benefits of occupants. This should be the goal of introducing "New Deal" inspired buildings.

8.2 Cybersecurity

No paper about the future role of information technology in buildings is complete without a discussion on the risks from cybersecurity. The impact of breaches to businesses is unfortunately regular news these days, but "what is the risk associated with building automation systems," some ask, "Surely there isn't much value for a hacker breaching the BAS network?"

Back in the days where BAS networks were slow, proprietary and hidden, in other words before they were connected to the IT system, there was some truth to that. The worst that could happen is hackers changing thermostat setpoints so the building gets too warm or too cold. Maybe enough to cause discomfort, but it unlikely that a hacker would risk jail time for that. This was "security through obscurity".

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But today, especially under the "New Deal" vision, integrating the building Operation Technology (OT) with the IT network systems is practical, beneficial, and rapidly becoming the norm. Much of this issue falls under the relationship between IT and OT, a much-discussed issue by practitioners in smart buildings.

The first thing to understand is that OT, especially BAS, is mostly a discipline. It involves creating and ensuring a comfortable and safe environment for people to use buildings. Much of the work of OT is the expertise to heat, cool and move air around buildings, to ensure they are illuminated correctly and that people who shouldn't be in the building are prevented from doing so (physical security).

In today's enterprises and organizations, the IT department forms an important service to ensure that all of the organization's functions can utilize information technology according to their needs, be it HR, finance, sales or other departments, and that they conform to an agreed upon set of policies, requirements and standards. The "New Deal" proposes that same relationships should be applied for OT, namely that IT is a service being used by OT.

Of course, this isn't a simple arms-length relationship, especially when we consider the impact of cybersecurity issues. The best results can only be achieved by viewing the OT-IT relationship as a partnership. It is critical that OT departments understand enough IT issues, without needing to be experts. They need to understand that when they install or configure a controller device connected to some HVAC equipment, that they source the right products, that it is used in accordance to industry best practices, and that they abide by the policies defined by the building owner's IT department. This is an analog of the HR staff knowing that it's not a good idea to leave a USB memory stick of employee files on a cafeteria table.

On the other hand, IT departments need to understand that OT systems often have very specific needs that are typically different from other IT system users. OT networks often have specific bandwidth or latency requirements, and the availability of systems is often critical to the operation of the organization. Just like any other supplier of a service, it's a good idea for IT to know the needs of their customer.

This symbiotic relationship between OT and IT has to be at all levels of the system, from the edge devices in the corners of the plant room, to the control room of the facility, mobile devices, all the way up to the complex cloud based services that OT will start to utilize for analytics and other services. More and more, information from OT will find its way to enterprise dashboard destined for executives.

The relationship also needs to span across time, from the initial design of the building or BAS system, all the way through installation and commissioning of the equipment and networks, throughout the lifetime of the facility. Planning also needs to be in place for contingencies; from the typical mechanical problems that happen with HVAC, all the way to defining a clear course of action in event of a security breach.

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For this model to work, it is critical that the principles of this relationship is codified by the organization at the highest levels, we would argue this is very much a topic for the 'C' level executives to put into place and monitor as they would any other critical element of the organization.

8.3 Privacy

In today's social-media-centric, interconnected world, we as a society are grappling with the issue of privacy and data ownership. The building automation industry is not immune to this trend, so in many ways, how this subject will interact with the future of buildings is still up in the air. There are however, a number of topics that can be mentioned here to help us understand the direction of these issues.

On privacy, as a general principle, building automation systems do not collect or store personally identifiable data - the type of data covered by numerous regulations in the financial industry for example. The closest that BAS get to personalized data would be tracking the environment and information such as temperature set-points in an office that is occupied by a certain person, whose identity is typically not stored in the BAS database, which typically contains just the zone or room number designation.

However, with so much innovation happening to maximize the performance of occupants, it is likely that analytics systems will start to relate the delivery of building services (lighting, heating, cooling) to particular individuals, which will entail knowing that a certain office or workspace is occupied by a specific individual especially if the settings are activated by an access card outside normal business hours. This will likely be an issue as stricter regulations are enacted, such as the concerns many businesses are having inside the European Union over the GDPR (General Data Protection Regulation) that will become enforceable May 2018.

A full discussion of this subject is beyond the scope of this white paper at this time.

8.4 Data ownership

Data access and ownership of anonymous data, on the other hand, is a commercial matter. Consider a piece of data in a BAS system, say the status of a piece of mechanical equipment. While there can be a debate about who actually "owns" the data, what is more important is who controls and has access to that piece of data, and for what purpose.

The building owner would obviously have access and can benefit in knowing that piece of data since, with analytics, they would use the information to better their building. So could the maintenance company providing a service contract for the building; they could provide a better and more transparent service with access to the data. The manufacturer of the equipment can also benefit from knowing the data, in order to improve their product. Other entities could also argue a need to access the data, such as a regulatory body in regulated

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facilities like pharmaceutical laboratories, or insurance companies in an audit or forensic role.

The control of access to the data is what is important, and likely to be at a granular basis. This control will likely be by the building owner or a designee such as the system integrator of facility management of the building. Technology models for this kind of control are all around us today. Think of how one uses a business accounting system and provides it access to their bank accounts. In keeping with the vision of the "New Deal", we believe that owners should have ownership of all data provided by all of the systems they have purchased and had installed in their building, even if that data are transferred to a cloud-based application or database as part of the manufacturer's service model. Owners should ensure they have full rights to access, utilize, and move these data to meet their needs subject to the privacy laws they operate under.

Without owners understanding this issue and directly involving themselves in procurement decisions that may affect their ownership of data, it is not clear that appropriate innovation of both technology and vendor business models will occur to address this issue.

8.5 Sustainability

The goal of a more sustainable built environment and the desire to meet public climate action commitments is driving many project teams to embrace "New Deal" thinking. Developers, architects, engineers, and builders have for decades recognized their responsibility as urban environmental leaders. They've launched and supported movements like the US Green Building Council's LEED and concepts like Zero Net Energy (ZNE) building design. However, it is only recently that a vanguard of new construction and retrofit teams have come to the realization that they need to procure controls expertise and tools early in the design phases of their projects. As Thomas Kaufman, Director of Corporate Real Estate for United Therapeutics, said about managing the largest ZNE project in the United States, "Once controls technology was not even on our radar. Now we know we live or die by controls."

For this Baltimore-based project team and other similar teams around the world, it is sinking in that analytics on top of a BAS platform is the only path to optimization at a whole-systems/whole-building-level. To deploy analytics at this level of abstraction, you need the three pillars of the "New Deal": *open standards, digital twins, and service transparency.*

Advocating that every corner of the buildings industry support standards and figure out how to talk to each other, the Alliance to Save Energy published "Going Beyond Zero: A Systems Efficiency Blueprint for Building Energy Optimization and Resilience." The SEI Blueprint recommends ways that manufacturers, associations, and policymakers can look for systems-level savings. One of the problems it documents is that popular green-building rating systems around design and construction and those around operations and

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maintenance don't connect, with the result that the feedback loop on design decisions is broken. One recommended answer is for standards organizations serving architects and engineers (BIM), smart grid (OpenADR), and BAS (BACnet, Project-Haystack) to work together to develop standards that promote unobstructed data flow.

Once you have data interoperability, the digital twin concept becomes possible. The visibility that systems-level analytics tools provide can enable a LEED or ZNE project team to work more closely and efficiently in an integrated design process. For example, an energy-usage-intensity (EUI) target established at the earliest phases of design can pull a team together. However, according to the "Old Deal," energy models were simply building code-based, taken from a specification with generalized parameters. Unlike a digital twin, these models were not conceived to be 'living models' that constantly update. Simulations with these models did not inspire confidence that the EUI target was real and achievable, and they didn't provide solid decision-support for mechanical, electrical, lighting and other systems designers striving to optimize for energy and environmental quality. "New Deal"-era models will contain rich, granular information, eventually including not only BIM documents, but real operational data from the building. LEED and ZNE project team members will be empowered to make better decisions together when digital twins can be consulted because the models will automatically evolve along with the design and construction process.

Keeping a LEED Platinum or ZNE buildings operating as designed over its lifetime is going to have to be affordable too. This is one of the reasons for the service transparency imperative. Building owners need to be able to put out competitive bids and allow market forces to determine up-front fair pricing and innovative submissions that allow evaluation on the life-cycle costs of ownership over the contract period.

These concepts are not just "nice-to-haves." In some cities and regions there is legislation, such as California's Executive Order, B-18-12, which sets all state agencies on the course of achieving net-zero energy building portfolios in a few decades. The authors of this law had the foresight to decree that all buildings over 5,000 square feet should deploy monitoring-based commissioning. Likewise, the City of Seattle has an alternative building code based on outcomes. This means project teams are asked to predict a certain level of performance and then to demonstrate that they've met the performance level once the property is built and occupied. These are just some of the ways that the Energy Efficiency and Sustainability movements are supporting the need for the tenets of the "New Deal".

8.6 Outcome and user-centric design

User-centric design establishes the processes, procedures, technologies, and usability aspects of the design with a focus on all users impacted by the design. In a building design the total set of users may include not only the full-time occupants, but transient occupants (patients, shoppers, guests) and should also take into account the role of the operations and maintenance staff, the vendors, integrators, service contractors, and other people that may come in and out of the building throughout the life of the building. A user-centric

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design ensures that the space is designed with the needs of the specific application of the facility in mind.

For example, a hospital design would, by necessity, be very different from a data center or a hotel. This may seem obvious, but sometimes a system for one purpose is shoehorned into a facility with a different intended purpose to reduce costs, shorten delivery time, or facilitate a vendor lock-in. All building systems that become part of the design must be designed, sized, and integrated for the desired use case. The flip side of user-centric design is the old school practice of designing building systems in silos, with little added thought to how those systems will interact with each other and the total array of potential users.

The "silo" approach is often a result of a specific vendor's product or solution being adopted verbatim rather than being based on an assessment of owner's needs. A user-centric design requires more upfront evaluation, simulation, and engineering. Owners will need to understand that these functions come with a cost, but pay for themselves eventually by not having to re-commission or retrofit a building due to poor or ineffective design and the eventual user complaints. The onus is put on the design team to ensure a more integrated environment, use of technology, and a strong enforcement process to ensure vendors and contractors don't undermine the intention.

8.7 The role of BAS Design Specifications

The development of good building specifications and the contracts that follow are key elements of any new or retrofit building construction plan. The two main contracting mechanisms Design/Build and Bid/Spec offer choices for owners according to their objectives. But generating a good design requires the team to be on the same page. When multiple engineers are responsible for various sections of an overall specification, coordination is key, but does not often happen. The concept of Whole Building Design enters as a new model to encourage the various engineering elements of a building to work together, to share information, and to allow the building to operate more efficiently.

The Construction Specification Institute (CSI) is an organization many engineers and contractors rely on to create a standard set of specification sections and project procurement documents commonly referred to as the CSI MasterFormat. One section in this is the Division 25 - Integrated Control and is an attempt to reduce "silo" designs and encourage greater system integration from the initial design basis. However, more industry adoption and education are required to ensure projects follow these objectives. Designing a control networking system from the top down, such that all of the required elements are available to each sub-system is required. This is a mindset change that engineers and contractors are only now starting to embrace.

Projects that implement a more integrated model often have as one of their key objectives long-term operational, maintenance, and ownership efficiencies leading to lower costs and more competitive solutions. For many years, there has been talk about open systems,

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interoperability, and vendor lock-in. Owners are now becoming smarter and realizing they have options.

Often the choice to do more upfront engineering, along with crafting more detailed job specifications, as well as contractor and vendor roles and project responsibilities, yields higher levels of satisfaction by the owner. Owners want to "own" their buildings, meaning they don't want to be locked into one vendor, service contractor, or product solution. Typically the longer the owner plans to own and operate the building, the greater the ROI on doing this upfront engineering design and specification work.

The contracting and construction markets are changing, due to the influence of IT. As more devices in the building are connected to IT backbones and to the cloud for providing application services, a requirement for a solid IT infrastructure is paramount. Applications such as fault detection and diagnostics, system analytics, Computer Maintenance and Management Systems (CMMS), and others require access to building data. The Digital Twin from the "New Deal" provide these applications with direct access to information, in near real-time.

8.8 Consulting Engineers taking the lead.

Changes are occurring in the consulting engineering world where LEED design practices are influencing good BAS design engineering practices. We're already seeing engineering companies retool themselves to add commissioning services in an effort to ensure that contractors are delivering solutions according to the design engineer's intent. This offers a good check-and-balance system, which sometimes can create debate, a best practice model, and an educational process required to ensure success. LEED has done a great job setting the bar for the architect, but sometimes falls short on the operational requirements of a building. Organizations like ASHRAE are stepping up to fill the gap by producing documents including "Specifying BAS Systems, Advanced Sequences of Operation," and tackling best practices for cybersecurity practices in building systems.

Other whole building design guidelines and industry trends and best practices referenced by CABA are influencing owners and vendors to be more engaged. Larger entities in healthcare, oil and gas, and government institutions are developing control requirements and system standards documents that guide all projects on a campus to ensure consistency, interoperability, and reduce project specific engineering time and costs. The "New Deal" embraces better integrated design and use of standards including design guides and specifications.

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9. REGIONAL ISSUES

9.1 The Americas

The opportunity size of the smart buildings IoT-enabled market for North America (Frost & Sullivan) was estimated at $19.22 billion in 2015 and projected to grow at a CAGR of 18.4% between 2015 and 2020. The market is projected to reach a size of $44.81 billion in 2020. BAS hardware and IoT enablement hardware accounted for 68.0% of the market revenues in 2015. This was followed by network communication services at 17.0% and IoT data services at 15.0%, respectively.

In North America, the departure of the U.S. from the Paris Climate Accord is causing a number of challenges for building automation related to energy management. Programs like the Energy Star Portfolio Manager used for benchmarking buildings may be defunded. The Clean Energy Plan that included cleaner energy, renewable, and energy efficiency is also being cancelled. Green Building Programs like LEED, Green Globes, and the Living Building Challenge expanded the focus beyond the materials used to build the building, but also the energy and other environmental impacts of operating the buildings. Regardless of the US federal government positions on energy efficiency and renewable energy, many state regulators continue to encourage utilities to provide incentive for energy saving options to their customers. State and city administrations continue to seek companies to provide energy performance contracts that create and guarantee energy cost savings to pay for the equipment and upgrades. These types of contracts need real time controls, measurement and verification, and other forms of analytics anticipated by the “New Deal”.

Canada has implemented a National Carbon Pricing framework, and other levels of government are updating many energy audits to improve the payback from hard-to-prove direct energy savings and to lower costs. Consultants are being asked to provide retrofit options to reduce greenhouse gases even if fossil fuel is relatively cheap now. This leads to options that include various controls for new LED lighting systems, new boilers and chillers, and other variable speed equipment, which all require some form of building automation.

Latin America is seeing rapid growth and adoption of open systems due to modernize an aging infrastructure. Political, economic, and environmental factors are influencing designs because greater efficiency and lower costs are mandated. Open systems tend to require less onsite installation time, hence are being more broadly adopted. There is a growing number of system integration and design companies adopting best practices for open, interoperable BAS control networks in Latin America.

Five countries in southern Latin America have recently formed a consortium to help educate and promote these concepts to owners and engineers. The group LonMark Cono Sur has been offering training and educational awareness programs across the region.

Because few products used in this region are designed or manufactured locally, these regions source products from North America and Europe, with heavy influence from Spain due to language comfort. Two Spanish organizations have embarked on a regional effort to train system integrators to install systems with products based on control networking standards. When given a choice, local integrators are choosing open systems rather than proprietary systems.

The International Energy Agency reports state that sustainability and climate change considerations are prominent in Mexico's energy policy. Mexico was among the first nations to submit a climate pledge in the run-up to COP21, and was among the countries that pushed hardest for a climate change agreement in Paris. It has legislated to adopt a binding climate target: the second country in the world to do so. With institutional changes that help promote clean energy, Mexico is embarked on a course towards a considerably more sustainable and efficient energy system in the future. With high population growth and energy demand, the move from older fossil fuel equipment to clean renewables and higher efficiency will increase the growing building automation demand.

Tapping Mexico's efficiency potential in the buildings sector is becoming an important policy priority, as rising incomes and urbanization push up electricity consumption. Mexico has already implemented a variety of measures to foster efficiency in the buildings sector, such as efficiency standards for lighting, appliances, and insulation. However, limited resources and capabilities, weak coordination between different levels of government, and a lack of public awareness can result in indifferent enforcement of those measures. Energy efficiency standards for buildings, for example, have been developed at federal level, but local governments, which are responsible for incorporating them into local bylaws, enforcing, and updating them, have limited capacity to do so.

9.2 APAC

The Asia Pacific Building Management & Control System (BMCS) market has two main segments: BMCS Products and BMCS Maintenance & Services.

The APAC market over the past decade has witnessed increased adoption of Internet Protocol as a communication network and this has helped increase the attractiveness of BMCS offerings. The emergence of open protocols, facilitating communication between two or more systems, has enabled BMCS suppliers to broaden their functionality to other areas of building management (energy management, lift controls, fire alarms, access controls, CCTV, and public address).

Despite the move to more centralized building automation systems, most of the communication happens within closed systems. The closed systems may have a gateway connection to the Internet, but device-to-device communication is not happening through IP or the Internet. Such systems are not considered fully building-IoT systems

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APAC Key Drivers for New Deal:

IT Spending Rates: Today, the Asia-Pacific region accounts for more than 40 percent of worldwide IoT spending. The APAC region as a whole will need to prioritize building out backbone infrastructure to fully capture the IoT opportunity.

Strong IoT adoption rates: China and India have the highest global rates of IoT solution adoption, with 30 percent of firms already using the technology, and a further 45 percent planning to in the near future. A separate study by Vodafone found that a global average of 48 percent of companies interviewed are using IoT technologies to support large-scale business transformation, rising to 61 percent in the Asia-Pacific region.

Large volume of cellular M2M (Machine-to-Machine) connections: Despite a relatively low per capita number of connected devices, the Chinese market already boasts the largest number of M2M connections of any nation with 74 million connections (almost a third of the global base) by the end of 2014, in part due to its massive population. GSMA (GSM Association, representing the mobile communications industry) forecasts this figure will grow to 336 million by 2020, representing a compound annual growth rate (CAGR) of almost 29 percent.

APAC Barriers for Smart Buildings Market Growth:

Lack of Cybersecurity Provision: A recent study by The Software Alliance (BSA) and security market researcher Galexia, evaluated 10 countries in Asia-Pacific on five key aspects of cybersecurity. It found that China, South Korea, and Indonesia were hindered by local standards and testing requirements. South Korea, Malaysia, China, and Vietnam were still in the process of developing their cybersecurity infrastructures, and Indonesia had no cybersecurity plan to speak of.

9.3 EMEA

There is a view from outside the region that in terms of building and lighting controls the Europe, Middle East, and Africa (EMEA) are light years ahead of the rest of the world. In some cases that view is well founded. This is driven by higher energy costs, a more deregulated energy market, focus on CO_2 emissions, sustainability, health and wellness legislation, regulation, and public opinion.

Certainly, in terms of traditional Building Management Systems (BMS), the EMEA region has significantly understood the benefits of web IoT convergent platform technology and is probably one of the biggest and fastest growing adopters of such solutions in non-residential building stock both for retrofit and new build.

However, it is easy to overstate this apparent advance. Today the vast majority of retrofit and new builds are full of siloed subsystems where access to device level value data is somewhere between non-existent and limited. This is particularly noticeable in lighting,

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where despite the existence of open interoperable intelligent device communications standards such as IEC 62386, DALI lighting control systems, are still delivered as entirely separate solutions, with limited sharing of data and controls via other building control protocols already mentioned in this paper.

Sadly, the entire building and lighting controls model remains broken in the EMEA region as it is elsewhere. The “End Client” (building owner, developer, manager, and user) is delivered a “Value Engineered” building. Value engineering is widely understood in the “buildings industry” to euphemistically mean reduced price, and the very first casualty of this depressing approach are building controls. The impact of this “value engineering” process has disastrous consequences for End-Clients.

Despite all the good intentions in the EMEA region, lack of regulatory requirements to continually measure and report a building’s performance in order to confirm initial building certifications, for example green or energy-based, means that End-Clients and occupants of the vast majority of existing buildings are doomed to decades of very poor built “Old Deal” environment experiences. There is a clear need in EMEA for a “New Deal” vision.

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10. CALL TO ACTION

The “New Deal” for Buildings promises to improve the value of buildings if adopted by both the vendor and owner communities. Advocates for the “New Deal” are discussing their ideas at www.newdeal.blog. If the views presented in this paper resonate with you, we invite you to share this CABA white paper with others, consider joining CABA, and sign up for the CABA weekly NewsBrief. Other CABA White Papers can be viewed complimentary at: www.caba.org.

Published: January 2018

ADDENDUM

Provided below are a number of links to relevant articles that will help the reader further understand and research issues that are raised in this white paper.

The links are available on CABA and other websites. Please note that some of the CABA links are member-only, and thus require a currently active account on www.caba.org. Please contact Greg Walker, CABA Research Director, at walker@caba.org to join CABA for unrestricted access.

Links to related organizations

Standards organizations

- ANSI (American National Standards Institute)
- ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers)
- BOMA (Building Owners and Managers Association)
- CTA (Consumer Technology Association)
- IEC (International Electrotechnical Commission)
- ISO (International Organization for Standardization)
- SCC (Standards Council of Canada)

Trade Associations

- BACnet International (promotes the BACnet protocol, an ISO series of standards)
- DiiA – Digital Illumination Interface Alliance (promotes the Digital Addressable Lighting Interface (DALI), an IEC standard)
- EnOcean Alliance (promotes energy harvesting devices and a communications protocol, a series of ISO/IEC standards)
- IFMA (International Facility Management Association)
- KNX Association (promotes a building control protocol, a series of ISO/IEC standards)
- LonMark International (promotes the LonTalk protocol, a series of ISO/IEC standards)

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- Modbus Organization (promotes a communications protocol used in building automation systems)
- OpenADR Alliance (promotes a communications protocol for energy management of buildings)
- OSCRE (Open Standards Consortium for Real Estate) (promotes information exchange formats for real estate data)
- Project-Haystack (promotes a naming and taxonomy specification for building automation systems)

New Deal Blog Stories

Analytics is Only Half of the Story

Optimizing large and complex buildings is a challenge. The advent of big data analytics combined with professional services has created a winning combination to solve this dilemma. But how should building owners and managers decide to apply these powerful tools, given their particular circumstances?

Win-Win Strategies to Buy and Sell Building Solutions

Reflecting on a career that has included roles as an Energy Manager, Contractor, Entrepreneur and Technologist, I have had a unique opportunity to observe and participate in system deployment from a number of perspectives. My conclusion from all of that activity is that the traditional "design-bid-build" business approach is broken, meaning that "low bid procurement" is not a good model in today's building technology market.

Who You Gonna Call?—Digital Twins!

Every piece of infrastructure, sensor, personal mobile device, and business process in a building today is a potential source of valuable data for improving operations and user experience. Insightful facilities project teams are beginning to direct it towards the creation and maintenance of digital twins. A digital twin is a dynamic software model of a physical thing or system.

BACnet—A Foundation for Building Analytics

Since its approval as an ANSI/ASHRAE standard in 1995 and as an ISO standard in 2003, BACnet has become a common network protocol in modern building automation systems. Although BACnet was not originally designed to enable analytics, it has a number of features that have facilitated the implementation of analytics applications, not the least of which is that BACnet offers a standard method for third-party analytics applications to

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access data in building systems. However, this article focuses on other features of BACnet that help building owners to implement analytics in their facilities.

The Uberization of Buildings

We are moving to a world known as the sharing economy, collaborative consumption or peer economy, a common academic definition of a hybrid market model (in between owning and gift giving) of peer-to-peer exchange. Such transactions are facilitated via community-based online services. Uberization is an alternative name for the phenomenon.

CABA White Papers

(IS-2017-82) Improving Organizational Productivity with Building Automation Systems

Improving Organizational Productivity with Building Automation Systems is a $150,000 USD research project, undertaken by the National Research Council, involved the review and synthesis of a vast body of published work in the fields of business, engineering, and psychology. The results enable organizations to evaluate multiple organizational productivity metrics against benchmarks, and to compare the demonstrated benefits of better buildings strategies to other corporate investments designed to improve these metrics. This project is the first phase of a multi-phase approach to identifying specific mechanisms by which building systems can improve workplace environments and organizational productivity

(IS-2017-146) IoT 2020 Business Report - The future of the Internet of Things

From sensor to business sense this brochure from Schneider Electric describes a range of applications and benefits from incorporating Internet of Things (IoT) into products. Circuits within devices will enable connectivity locally and to the cloud for the "speedy delivery of meaningful information at the right time" with improved insights from the data gathered. IoT will benefit energy efficiency, asset optimization, profits, and risk mitigation. Best practices for IoT are presented.

(IS-2017-139) Internet of Things — Savings and Operational Efficiencies for the Industrial/Warehouse Environment

This paper reports on a survey of 213 professionals involved in warehouses and distribution centers about how they think the Internet of Things (IoT) will impact energy usage by their businesses. About 1/4 of those surveyed in medium and large businesses do not know their energy consumption. However, most want to reduce costs. Employee productivity is related to proper lighting and air conditioning. Most have heard of IoT, think it is coming, but are not planning to adopt.

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(IS-2017-135) IoT Enabled Smart Buildings Market

Smart buildings are increasingly being enabled by the Internet of Things (IoT) and made functional by the ongoing convergence of operational technology (OT) systems and information technology (IT) systems in buildings. With IoT, a host of new elements such as the cloud, remote access, data sharing and analytics, and connected and shared networks are becoming an intrinsic part of a smart building's operational dynamics, fundamentally changing how buildings are used and operated. This market insight takes a look at the specific trends, challenges and opportunities associated with IoT and Smart Buildings.

(IS-2017-107) Mastering Building Code Challenges

This paper was completed in 2016 by Owens Corning and Green Builder Media. It discusses how builders and manufacturers can work together to build high-performance, cost effective homes that exceed building codes. There are several case studies showcasing examples of manufacturers partnering with builders to build quick-selling, low-maintenance, high-performance homes.

(IS-2017-79) 2016 Smart Built Environment - Resource Guide

This is a 2016 *Smart Built Environment Resource Guide* published by Gabrielle Stoop. This guide provides readers with quick facts about European green and sustainable building and construction markets, compiled by the Commercial Specialist in U.S. Embassies and designed to help readers with international expansion responsibility.

(IS-2017-59) IoT 2020 Business Report - The future of the Internet of Things

From sensor to business sense this paper was completed in April 2016 by Schneider Electric and deals with five future predictions for the Internet of Things (IoT). The five predictions include use of mobile devices for IoT deployment, leveraging IoT for service improvement and tracking customer behavior, leveraging of site-to-cloud computing platforms, and systems integration. Immediate value of IoT and best practices are also discussed.

(IS-2017-29) Building Information Modeling and Intelligent Green Buildings

This white paper explores Building Information Modeling (BIM) and how its collaborative nature will allow efficiencies from concept through to operations in reducing capital costs and the carbon burden. According to the report, BIM demonstrations highlight that around 20% of costs can be saved during the construction phase. The report explores the different aspects of BIM and describes the relation between BIM and other information management standards. The report also assesses the adoption of BIM across different countries.

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(IS-2017-01) How Is the Federal Government Using the Internet of Things?

This report provides a summary of 22 expert interviews on the use of the Internet of Things in the federal government (including Smart Buildings with GSA Link) and identifies key challenges including a lack of leadership, skills, and funding, as well as cumbersome procurement policies and a risk-averse culture.

CABA White Paper on Project-Haystack

This white paper outlines the importance of metadata and tagging in building automation systems. The focus of the paper is the work being done in Project-Haystack, a community that develops standardized semantic data models and Web services, with the goal of making it easier to unlock value from the vast quantity of data being generated by the smart devices that permeate our homes, buildings, factories, and cities.

Research & Analysis

DOE: Utilizing Commercial Real Estate Owner and Investor Data to Analyze the Financial Performance of Energy Efficient, High Performance Office Buildings

Evidence has shown that owning and operating energy efficient, high performance, "green" properties results in multiple benefits including lower utility bills, higher rents, improved occupancy, and greater net operating income. However, it is difficult to isolate and control moderating factors to identify the specific drivers behind improved financial performance and value to investors that results from sustainability in real estate.

Life-Cycle Costing of Intelligent Buildings Report

The core objective of the "*Life-Cycle Costing of Intelligent Buildings*" research report is to identify what needs to be done, and by whom, to make life-cycle costing a mainstream criteria for building system evaluation in North America. Life-cycle costs analysis calculates the cost of a building system over its entire life span. The process allows commercial property owners and operators to analyze the long-term impact of construction processes and infrastructure costs on forecasted operational costs throughout the expected life of a building. CABA's research project identifies the barriers to adopting life cycle costing and determines what issues need to be rectified in order to make life cycle cost processes more understandable.

(IS-2017-180) Internet of Things Investment & Corporate Development Report

This report was prepared in August 2017 by Harbor Research and deals with the growth of Internet of Things (IoT) from a corporate perspective. Topics covered include mergers and acquisitions, investments, partnerships, new products, and private funding. The report is useful for owners of new and established technology companies, investors, and IT professionals responsible for deployment of IoT solutions.

Published: January 2018

(IS-2017-77) IoT Smart Building Solutions Transform the Workplace

This is a 2016 Forrester Research report by Michele Pelino and Andrew Hewitt. The report discusses IoT-enabled digital transformations as driver for business growth. The report focuses on Infrastructure and Operations executives role in supporting energy efficiency, enhanced employee productivity, and transformed work environments.

Case Studies

Data Analytics, From Cradle to Grave

The last few years have seen a rapid acceleration in the integration of analytics software into building energy management and other building systems. "Building analytics," "energy dashboards" and "smart buildings" have become popular industry catchphrases, but the practical utility of the underlying applications has yet to be fully explored.

Other Relevant Material

A Project-Haystack Primer on the New Deal Blog

So what's with all the talk about data semantics and tagging? Most likely if you are reading this you understand what data tagging is and why it's useful. Or you may be concerned that the concept is an attempt to force another communication protocol on the industry, or make you adhere to a rigid naming standard that will not fit your needs. If you are thinking of the latter, give me a few minutes of your time to try to bridge the gap.

Haystack Connections Magazine - Examples of Community Activity and Projects Around the World

This third issue of Haystack Connections came together naturally around the theme of "The Work Continues," i.e., how the community goes about developing a semantics methodology for device data that can be used to tag not only building data, but virtually any IoT or smart-and connected device application today.

Published: January 2018

Published: January 2018

888.798.CABA (2222)

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