



The State of IoT and Smart Buildings

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Introduction

More and more commercial and residential buildings, industrial factories, transportation systems, higher educational facilities, healthcare, smart cities, and communities will be connected and controlled through the Internet. Driving this shift are customers looking for cost savings, improved efficiency, real-time monitoring, predictive maintenance, and optimization of energy use. How will these goals be accomplished? Enter, the **Internet of Things** or **IoT**. Through connected networks, devices, and sensors that collect and analyze data, tools are available to provide better insight and new value to large electric power users, which is already changing the way they interact with the world.

The IoT concept is a disruptive force impacting just about every industry. According to several research studies, there will be approximately 20 billion connected devices in 2020 and by 2025, there will be 40.6 billion connected IoT devices worldwide.

Smart Energy Decisions' *State of IoT and Smart Buildings* presents a baseline look at where the industry is today and where it expects to go as energy management and control in buildings continues to evolve. We looked at who is using IoT, how they benefit, and the challenges ahead. The study surveyed respondents about their IoT deployments, drivers, barriers and the realized rewards— both intentional and unintentional—of smart connected facilities. We found that bridging the gap between legacy systems and new digital connectivity, lack of internal knowledge to achieve corporate buy-in, and cost are prohibiting factors. We also saw that organizations recognize value and cost savings with data-driven insights by better controlling their physical world through the ability to monitor & control equipment, fault detection and diagnostics (FD&D), and accurate forecasting. The survey identified the overlap between energy management and IoT tools. It is also clear that, as with any new technical strategy, the biggest challenge is raising awareness of the benefits. Read on to find out what state-of-the-art competitors are already discovering about the use of IoT applications for building asset management.

A note from Siemens

Tomorrow is closer than you think. The era of the smart building is here.

The first “thing” on the Internet was created in 1982: a soda machine at Carnegie Mellon University in Pittsburgh, Pennsylvania, that reported on the number and the temperature of the drinks it contained. It was unique back then, but by some point in 2008 or 2009, the number of things connected to the Internet came to exceed the world’s human population for the first time in history. Since then, the **“Internet of Things” (IoT)** has experienced a rapid expansion. Some 27 billion devices are now connected to the data network worldwide, including sensors, household appliances, machines, wind turbines, medical devices, and cars—with dramatic increases expected.

Digitalization is reaching into every aspect of our lives, changing the world faster than anyone could have imagined. It promises greater efficiency, lower costs, and more convenience. Building design and operation are no exception. Digitalization supports the goal of building owners—to create environments for people to work, to heal, to learn, and to succeed. Business leaders are implementing IoT solutions to not only improve the operational efficiency of buildings but also to improve occupant well-being, increase staff productivity and optimize space and asset utilization

With the onset of connected devices, buildings are generating more data than ever, leaving building owners and operators at a crossroads. Leaders realize they can keep up with the times and their competition by adopting digital strategies and technologies that leverage that data to increase the productivity, performance, savings, and adaptability of their buildings. Or they can risk being left behind. Failing to invest in smart building technologies comes with a cost. By implementing the right building technology, organizations can leverage data to make informed decisions and drive business outcomes. IoT infrastructure plays a key role, laying the foundation for your smart building.

- An electronic survey was conducted among readers of Smart Energy Decisions in December 2019 and January 2020.
- A total of 74 unique companies responded to the survey. Among these respondents, 11 have no experience and are not considering implementation of IoT, while 63 are considering or have implemented these systems.
- The survey defined IoT as follows:
IoT (Internet of Things) applications are a collection of device hardware that provides data to an analytical platform for interpretation. IoT-enabled building asset management allows systems to “talk” to each other utilizing smart connected sensors that provide data and analysis, which can be used to improve energy management, forecasting, fault detection, space utilization, safety and security.

Survey respondents by company

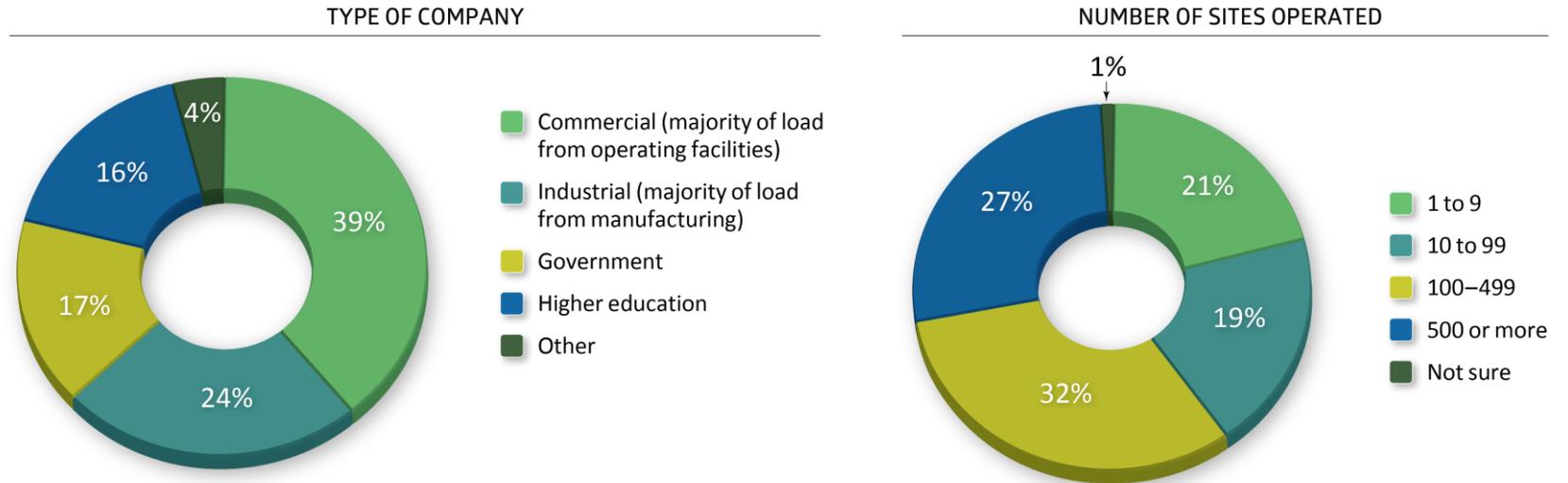
ACUA
AEG
AETOS
Albertsons Companies
Allergan
Amy's Kitchen
Aramark
Azusa Pacific University
BASF Corporation
Becton Dickinson
Borough of West Chester
Brevard Public Schools
Bucknell University
California Institute of Technology
California State University Dominguez Hills
CB Richard Ellis Group, Inc.
CBRE Group, Inc. (Canadian Division)
Chesapeake Public Schools, Virginia
Cisco
Citrix Systems, Inc.
City of Alexandria
City of Charlotte
City of Cincinnati
City of Philadelphia
City of Portland

City of Santa Clara
City of Vista
CSX Corporation
CU Boulder
Dal-Tile Corporation
Douglas County School District
Electrolux NA
FedEx Ground
FoodService Partners, LLC
Ford Motor Company
Genentech
General Dynamics Information
Technology
Georgia College & State University
Giant Eagle
Gilbane Building Company
Hartsfield-Jackson Atlanta
International Airport
Hexion Inc.
HP
IBM
Intel Corporation
IUPUI
Kohler Co.
The Kroger Company

Lockheed Martin
Merck
MGM Resorts International
Michigan State University
Nordstrom
Orange Silicon Valley
Orlando Utilities Commission
Park School of Baltimore
PepsiCo, Inc.
PGIM Real Estate
Rolls-Royce North America
Saulsbury Hill Financial
Sprint
Staples, Inc.
Steelcase Financial Services Inc.
Suffolk County Community College
Tetra Pak
Thomas Jefferson University
TJX Companies
U.S. Army Corps of Engineers
University of Wisconsin–Madison
Waffle House, Inc.
Walmart
Weis Markets
The Wine Group

Respondent profile: Company type and sites operated

By company type, commercial (including retail) at 39% and industrial at 24% were the largest segments represented, followed by government (17%) and higher education (16%). Nearly 60% operate more than 100 sites with 27% of respondents having 500 sites or more.



Q. Which of the following is the best classification of your company?

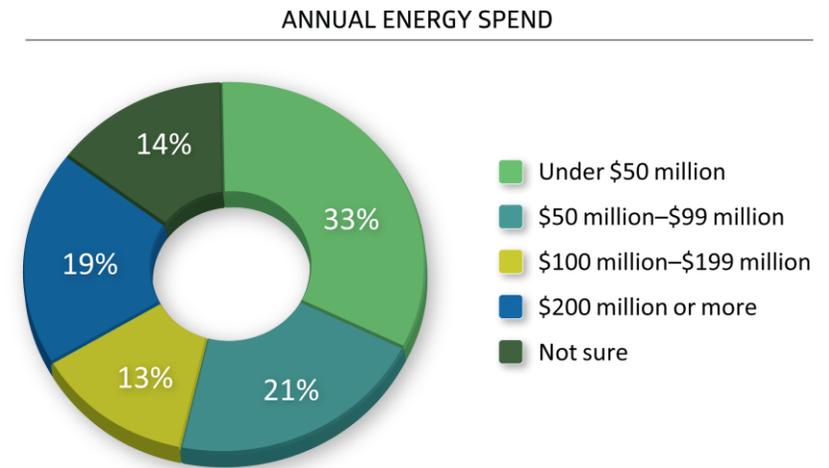
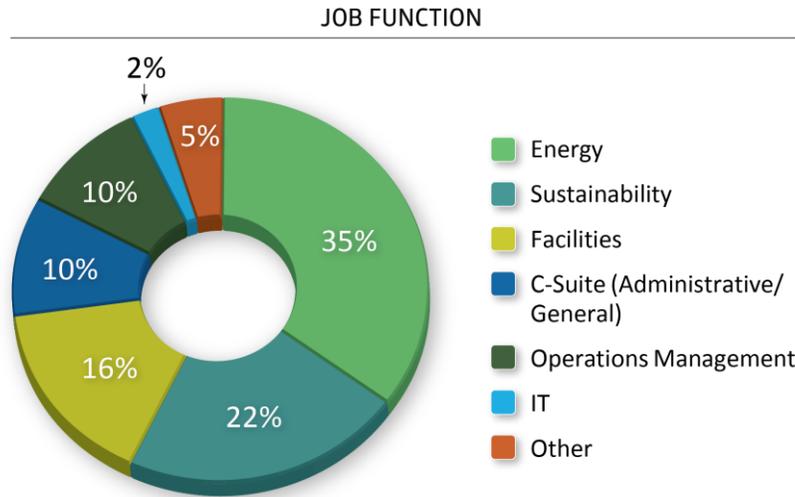
Q. How many sites does your company operate?

Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

Respondent profile: Job function and energy budgets

The role of survey respondents breaks down with 35% involved in energy management, 22% in sustainability and 16% in facilities. C-suite & operations functions each represent 10%.

Looking at energy budgets, more than half (54%) spend under \$100 million and 32% report \$100 million or more on an annual basis.



Q. Which of the following best describes your role or function?

Q. What is your company's annual energy spend?

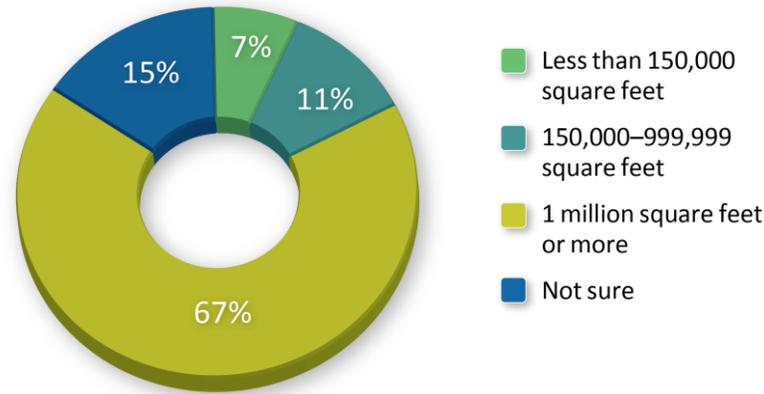
Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

Respondent profile: Footprint

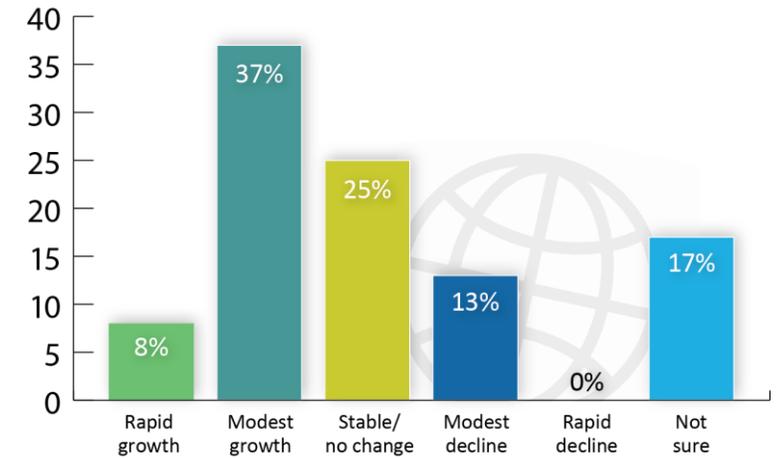
About two-thirds of respondents (67%) report total square footage for their operations of 1 million square feet or more.

Fully 45% of companies expect their footprint to grow in the coming year, either rapidly or modestly, while 25% believe growth will remain stable in the near future. While 13% anticipate a modest decline, no respondents are expecting to see a rapid decline in their company footprint.

FOOTPRINT



EXPECTED GROWTH RATE FOR FOOTPRINT



Q. What is your company's current footprint (square footage)?

Q. What is your company's planned growth rate in footprint (square footage)?

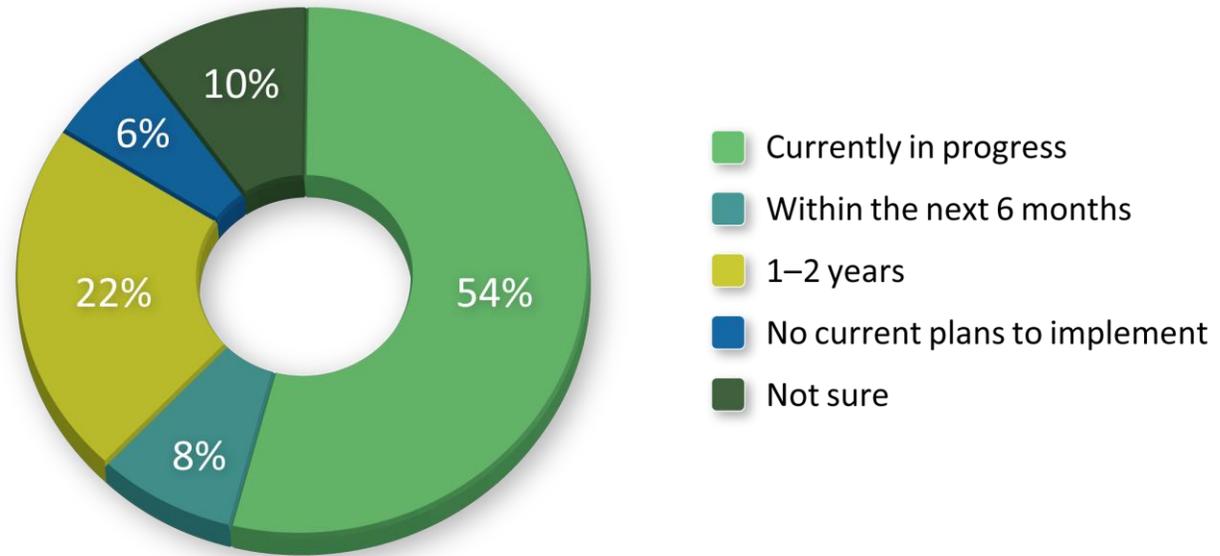
Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

IoT is a timely topic

Adoption of IoT for building asset management is moving swiftly with an overwhelming majority of respondents (84%) currently using or reporting near future plans for IoT connected energy management.

Specifically, more than half of respondents (54%) have IoT implementation in progress and an additional 30% are planning implementation in the next six months to two years. This indicates that the overlap between IoT and efficient energy management is being recognized and acted on rapidly.

TIMELINE FOR IMPLEMENTATION



Q. What is your organization's timeline for initial or continued implementation of IoT for building asset management?

Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

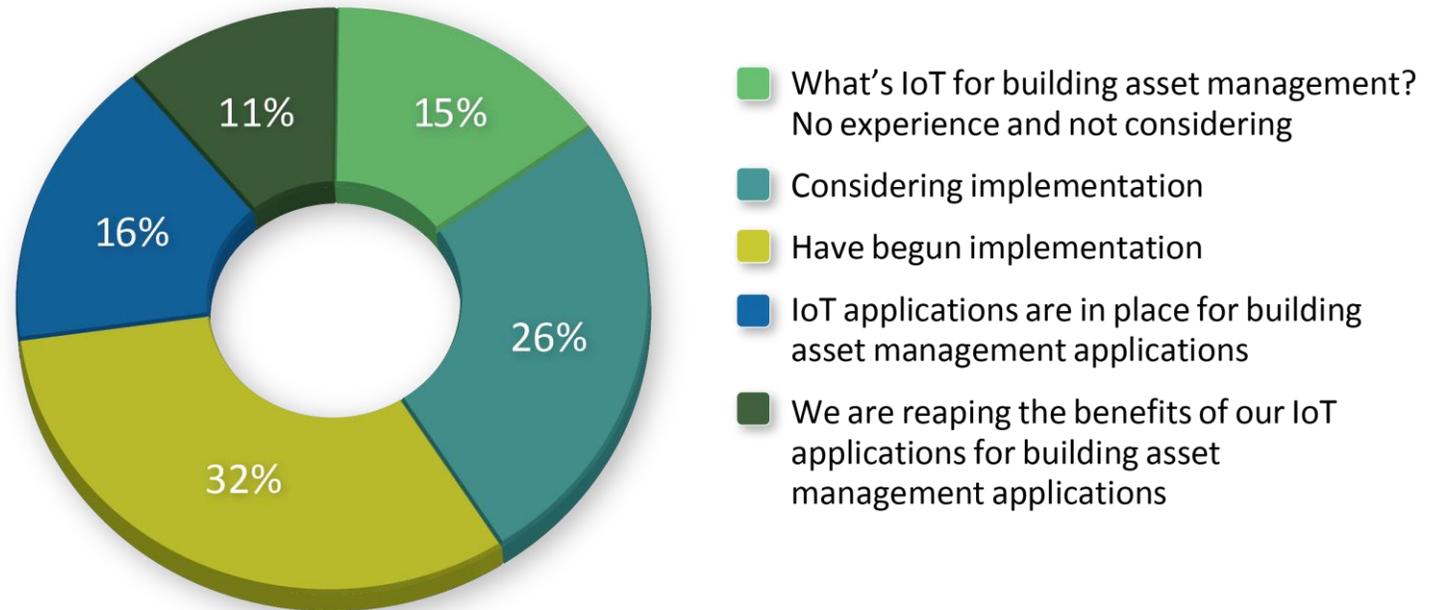
Everyone's doing it

Among total respondents, the majority (85%) have some level of experience with IoT applications for building asset management.

About one-quarter (26%) are considering implementation, while almost one-third (32%) report having recently begun implementation. Just over one-quarter (27%) report applications in place with 11% of this group already reaping the rewards of these programs.

Buildings are rich in data; survey results show that those who have fully implemented systems are experiencing bottom-line benefits in energy savings, early fault detection, centralized decision making, and reduced operational costs.

LEVEL OF EXPERIENCE WITH IoT APPLICATIONS FOR BUILDING MANAGEMENT



Q. Which of the following best describes your company's level of experience in using IoT applications for building asset management?

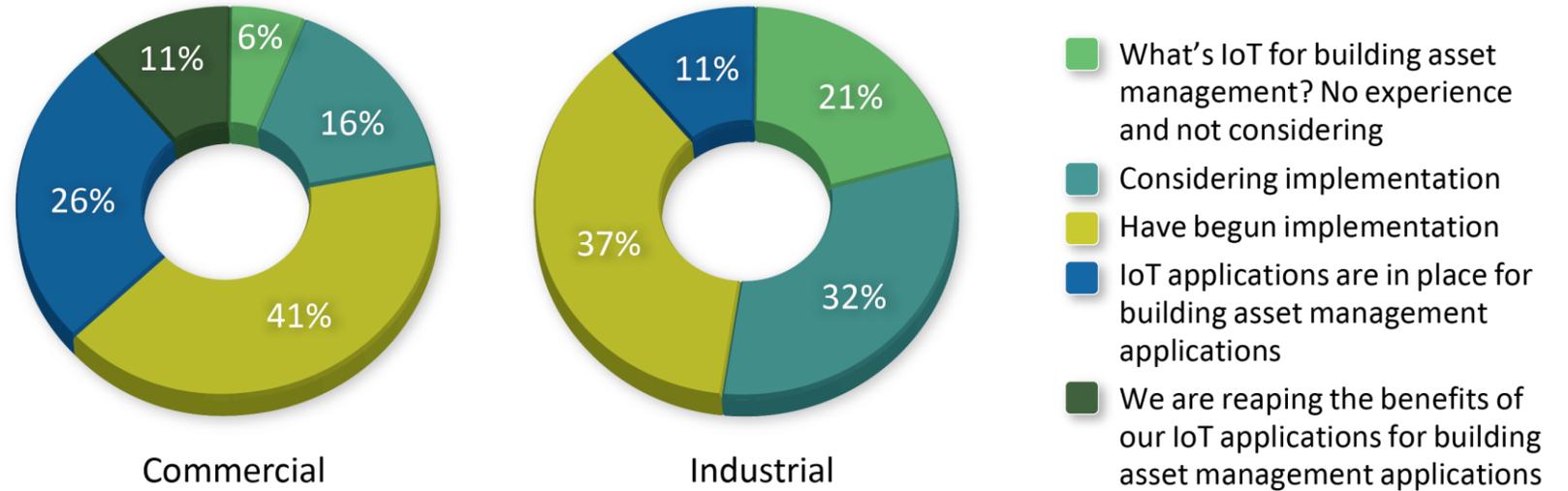
Base: Total respondents • Source: SED Research, 2020

Commercial operators are leading the way

Commercial operators appear to be the most advanced as 41% have begun the process and 37% have applications in place or are realizing the benefits compared to 11% of industrials. However, operators of industrial facilities are catching up as 69% are either considering or have already begun implementation.

It is likely that commercial operators have been early adopters of IoT platforms because high performance computing is required to collect and process data at lighting speed—crucial to data center and other technology operations, as well as to retailers who recognize the importance of an improved customer experience.

LEVEL OF EXPERIENCE BY COMPANY TYPE



Q. Which of the following best describes your company's level of experience in using IoT applications for building asset management?

Base: Total respondents • Source: SED Research, 2020

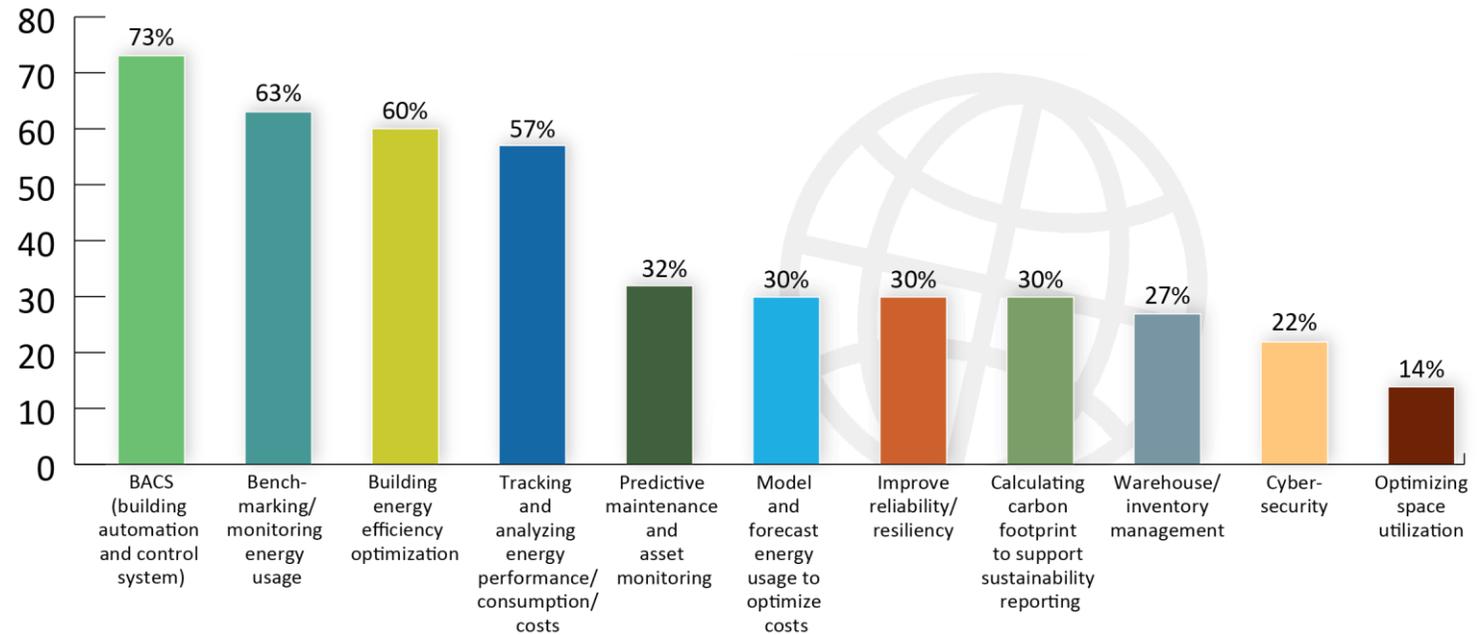
How IoT is being used

Building automation and control systems (BACS) is cited by the majority (73%) of respondents, making it the currently most used IoT application. Following are benchmarking/monitoring energy use and building energy efficiency optimization, each currently used by 60% or more of respondents. These applications target specific drivers of IoT implementation cited by users. (see page 14).

For example, BAC applications work to streamline business processes, reduce energy consumption, and enable better facilities management, while energy monitoring and energy efficiency optimization allows management to do more with less.



CURRENT USE OF IoT APPLICATIONS



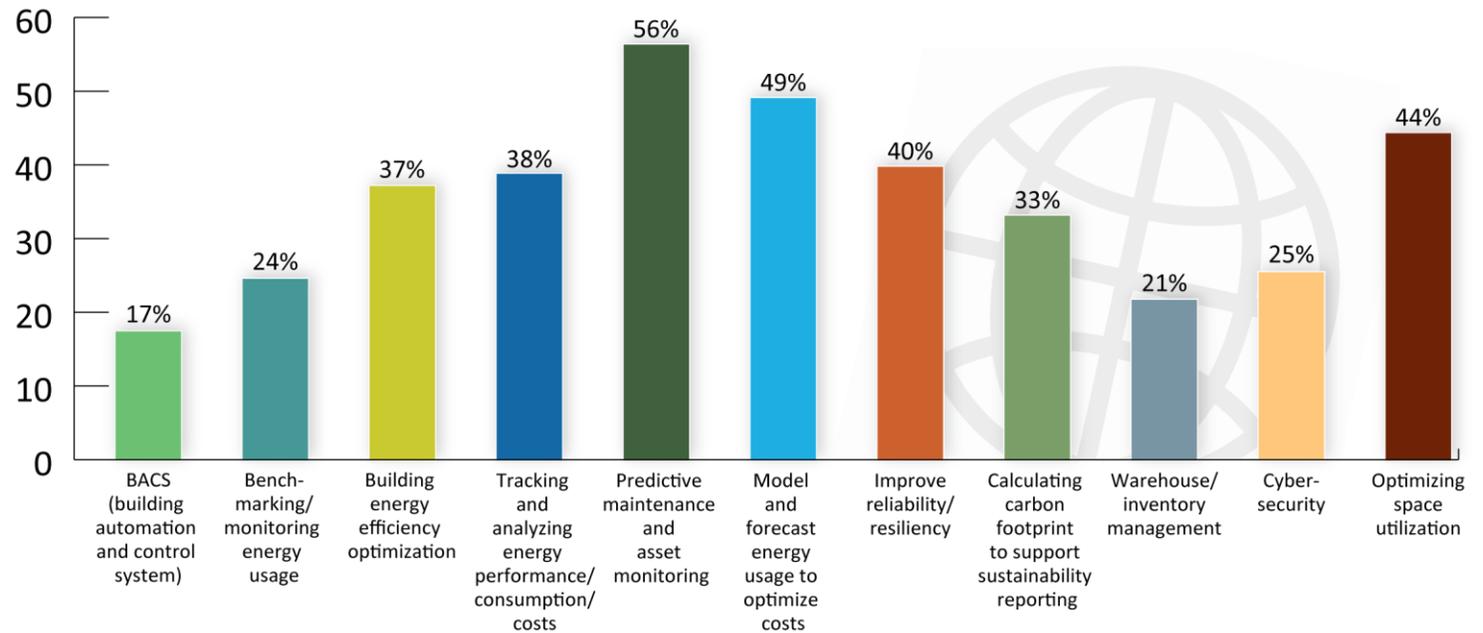
Q. How is your organization currently using IoT applications for building asset management? (Select all that apply)?

Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

Predicting problems in advance is key

Judging by IoT applications being considered, predictive maintenance and asset monitoring capabilities will be in high demand (56%) as organizations recognize that problems identified *before* they happen are less costly to correct. IoT connected facilities that identify faults in advance allow management to reduce backlog, track and schedule repairs, manage workflows and remotely oversee field operations. Modeling and forecasting, being considered by 49%, are increasing in importance as reliability and resiliency become more critical in the face of concerns around safety, security, and climate change.

IoT APPLICATIONS BEING CONSIDERED



Q. Which IoT applications is your organization considering for building asset management? (Select all that apply)

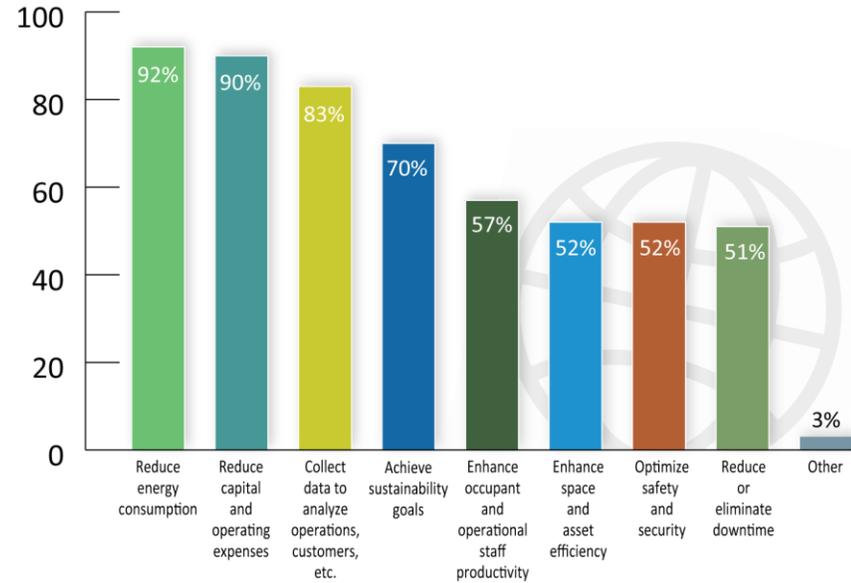
Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

Reducing consumption and expenses drives implementation

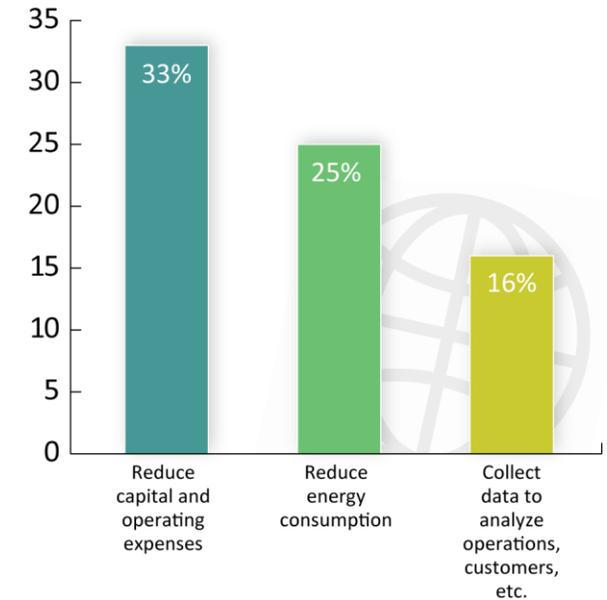
Reducing energy consumption and reducing capital and operating expenses were each chosen by an overwhelming majority of respondents (92% and 90%, respectively) among a list of reasons for implementing IoT applications for building asset management. These reasons remain on top when respondents were asked to choose the single most important factor.

This is no surprise: buildings have become more complex and are required to meet higher levels of efficiency, safety & sustainability. Robust data analytics that collect building condition information, identify underperforming facilities, and centralize information are key to giving management the tools needed to achieve desired bottom line results.

DRIVERS OF IoT IMPLEMENTATION



SINGLE MOST IMPORTANT DRIVER



Q. Which of the following are your company's reasons for implementing or considering the implementation of IoT applications for building asset management? (Select all that apply)

Q. Which is the single most important reason for implementing or considering the implementation of IoT applications for building asset management?

Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

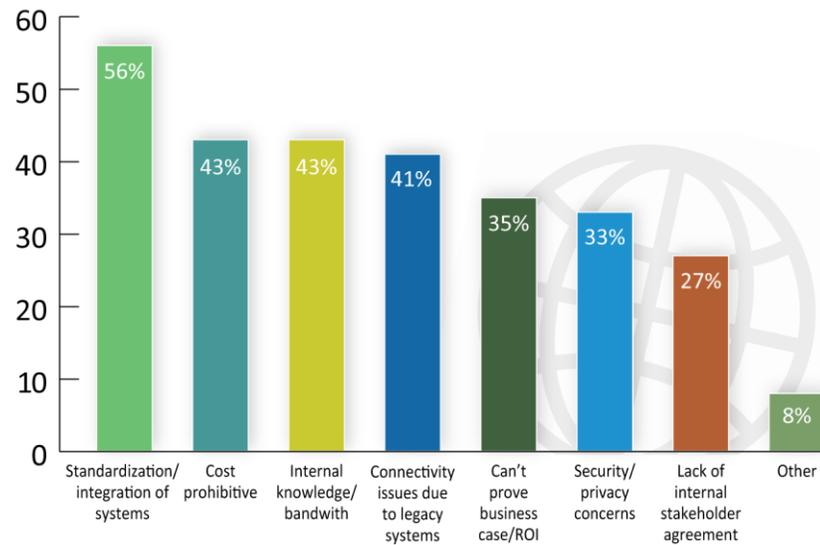
Lack of knowledge and standards are challenges

The single most important barrier to implementation is the lack of internal bandwidth (24%). Among respondents who are reaping the benefits of IoT, internal knowledge drops as an obstacle—not surprisingly as the complexity is better understood once the process begins.

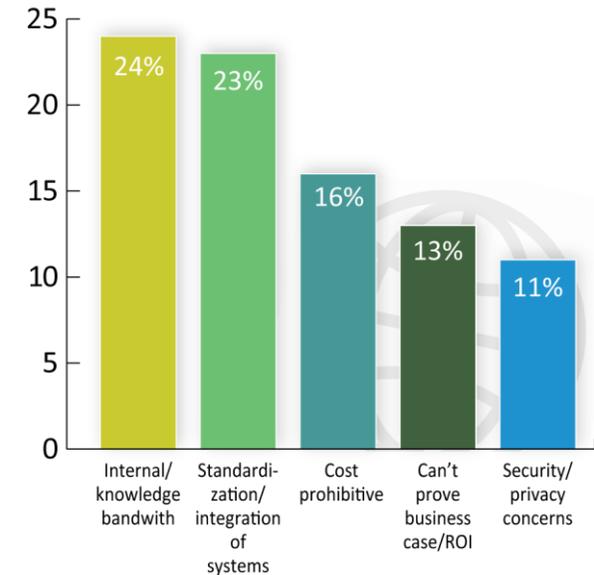
The lack of standards and ease of integration are viewed as key barriers to implementing new IoT technologies by 56%. Issues around connecting to legacy systems will likely be present for the foreseeable future.

Adapting for the future is critical for any organization. Even though IoT concepts are becoming more common, they are in the early stages of maturity and the benefits are not fully understood. Looking beyond the hype of IoT, understanding what to connect and how is complex and unfolds more clearly as projects advance.

BARRIERS TO IMPLEMENTATION



SINGLE MOST IMPORTANT BARRIER



Q. Which of the following are barriers or obstacles to implementing your first IoT application or adding to your existing IoT applications for building asset management? (Select all that apply)

Q. Which is the single most important barrier or obstacle to implementing or adding to IoT applications for building asset management?

Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

Barriers fade as implementation kicks in

It is striking to note that once IoT systems are implemented and in use, understanding the benefits are no longer a barrier and concerns over privacy and security are greatly reduced.

Standards and systems integration are highly ranked barriers for both categories, those with systems in place (#1) and considering implementation (#2). Connectivity issues came in (#3) for all respondents.

The upside is that as IoT technology accelerates so will the push for standardization, open communication protocols, more flexible integration, faster installation, and reduced costs.

BARRIERS TO IMPLEMENTATION

| Respondents who are considering IoT | Respondents who have implemented IoT |
|--|---|
| 1. Internal knowledge/bandwidth | 1. Standardization/integration of systems |
| 2. Standardization/integration of systems | 2. Cost prohibitive |
| 3. Connectivity issues due to legacy systems | 3. Connectivity issues due to legacy systems |
| 4. Cost prohibitive | 4. Can't prove business case/ROI |
| 5. Can't prove business case/ROI 5. Security/privacy concerns | 5. Internal knowledge/bandwidth 5. Security/privacy concerns |

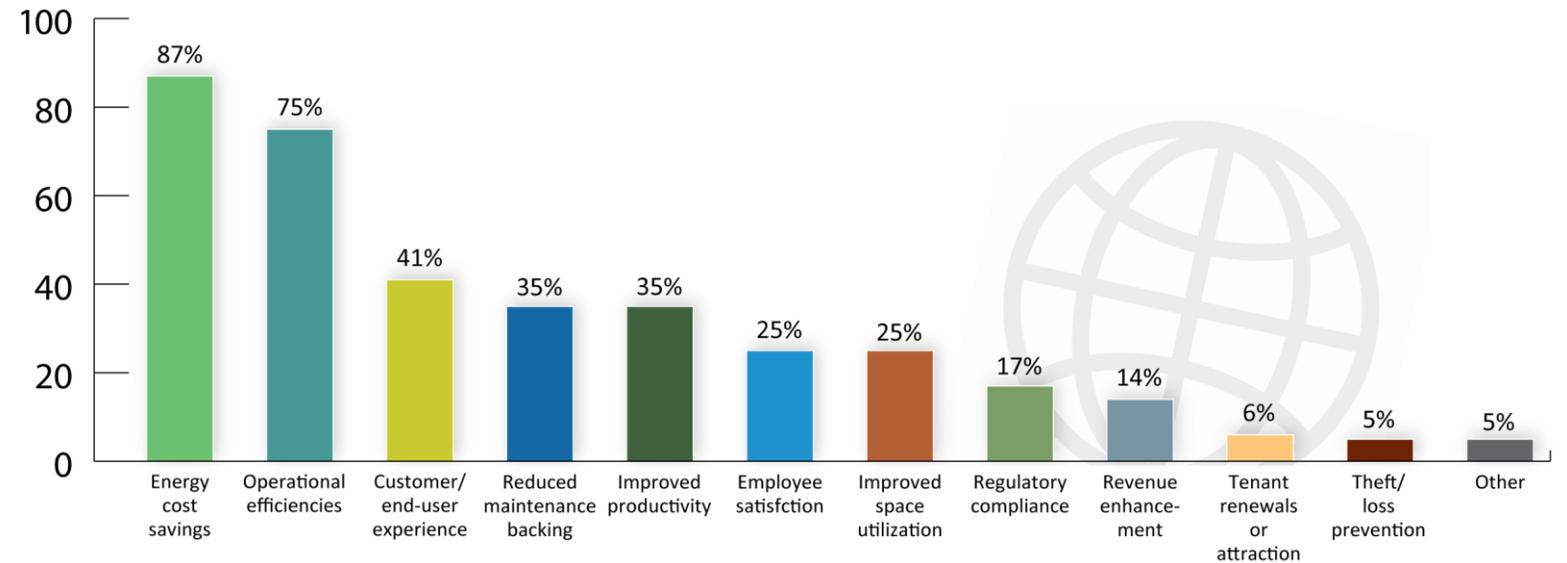
Q. Which of the following are barriers or obstacles to implementing your first IoT application or adding to your existing IoT applications for building asset management? (Select all that apply)

Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

IoT drives energy savings and efficiencies

Energy cost savings (87%) and operational efficiency (75%) are not surprisingly top-ranked as measures of the success of IoT. Capital intensive industries with limited budgets require that proposed investments offer returns within tight timelines. Once the objective is identified, streamlining business processes with IoT connectivity enhances the business case. Data gathered from IoT devices enables the establishment of baselines, new business models, accurate assessment of profitable upgrades, and improved customer relationships.

MEASURING ROI/SUCCESS OF IoT APPLICATIONS



Q. How does your company measure the ROI or success of IoT applications for your building asset management program? (Select all that apply)

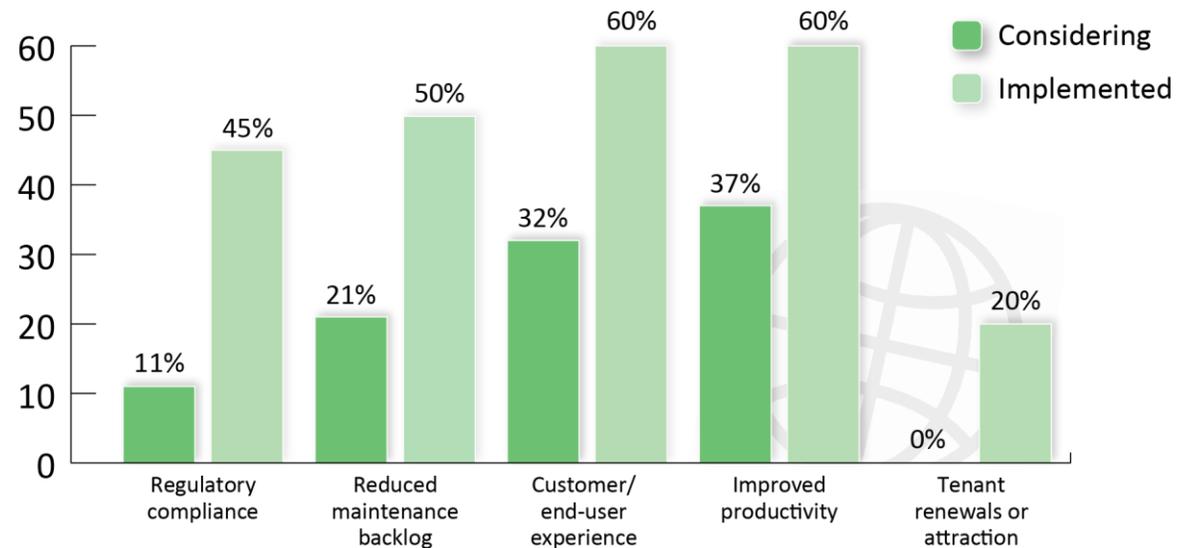
Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

Benefits of IoT exceed expectations

Comparing ROI as viewed by those who are considering implementation with those who have applications in place and are already reaping rewards shows us some unintended benefits of IoT. For example, at 37%, improved productivity doesn't even crack the top five expected benefits of IoT among those still considering their options—but this benefit rises to 60% among those who have completed implementation.

Likewise, regulatory compliance is rated relatively low among those considering implementation and higher by those with applications in place. Additionally, significant cost reductions associated with improved maintenance backlog control are proving to be greater than expected.

MEASURING ROI: CONSIDERING VS. IMPLEMENTED



Q. How does your company measure the ROI or success of IoT applications for your building asset management program? (Select all that apply)

Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

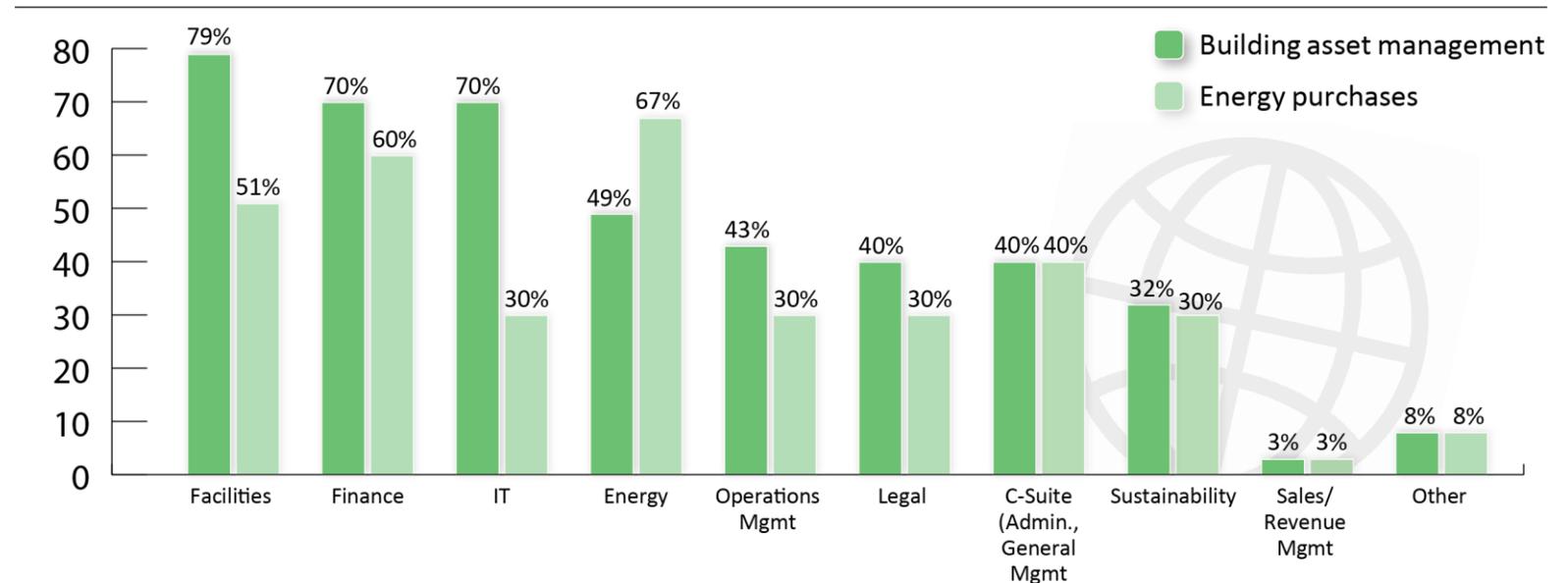
Who gives the go-ahead?

The three departments cited most often as responsible for signing off on IT purchases for building asset management are facilities (cited by 79%) and finance and IT (at 70% each). Operations, energy, legal and C-suite functions are also in the mix.

In contrast, when IoT for energy purchases are made, 67% of respondents say energy departments must give the okay. For these purchases, finance and facilities departments are each consulted by more than one-half of respondents.

It is worth noting that while finance functions are heavily involved in IoT purchase decisions for both building asset and energy purchases, this department often has the least IoT background around cost benefits—again, a reason that lack of internal understanding is a key barrier to implementation.

COMPANY SIGN-OFF



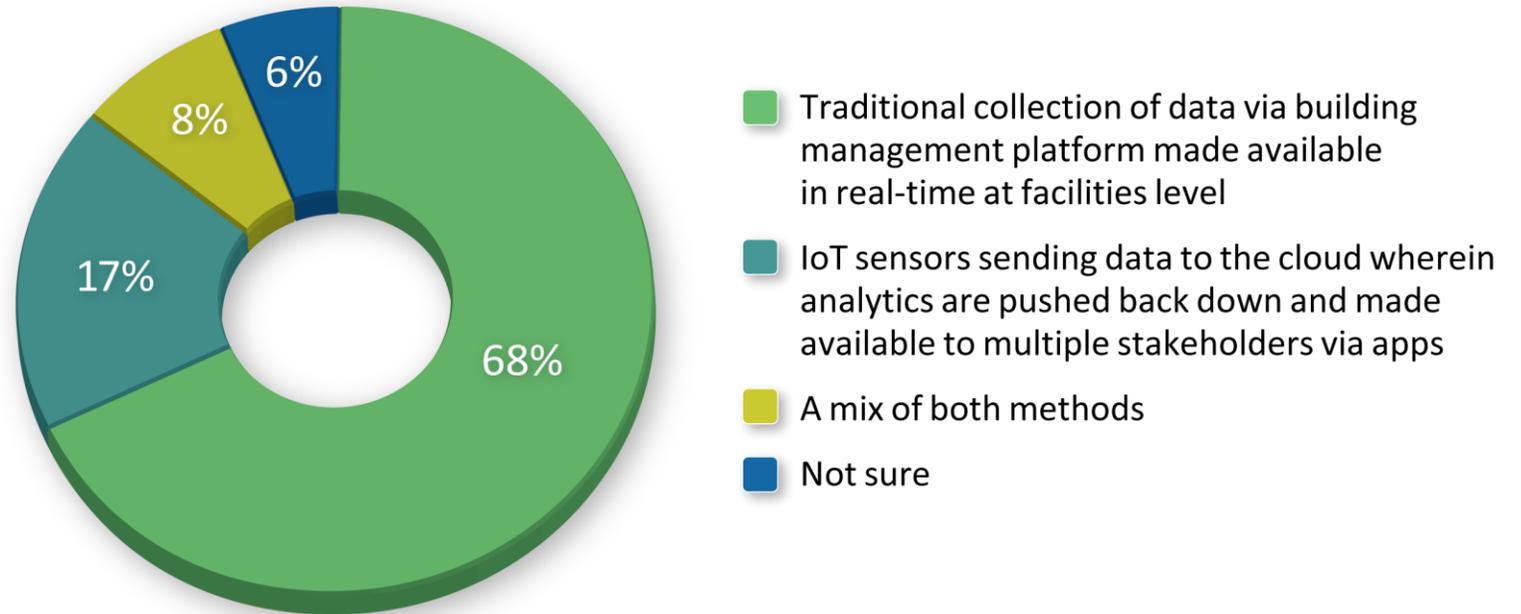
Q. Which of the following departments within your company must sign off on an IoT application purchase for building asset management and energy purchases? (Select all that apply)

Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

Traditional and new methods will co-exist

The majority of respondents (68%) still collect data through traditional methods, as legacy equipment is deeply rooted in the industrial and commercial world and was not designed for connectivity. Suppliers are addressing this by reducing costs, offering more flexible technologies and ease of installation all helping to bring machinery into the IoT era. Unless your organization has state-of-the-art facilities equipped with smart sensors, IoT architectures, and edge gateways, and is using best practices, there will likely be a mix of both old and new methods for some time. Current events—weather, economic instability, concerns about cyberattacks, etc.—all mean that resiliency, reliability, and security demands are more top of mind and will likely speed up implementation.

PREFERRED DATA COLLECTION METHODS



Q. Which best describes your company's preference?

Base: Respondents who are using or considering IoT applications for building asset management • Source: SED Research, 2020

Case studies



Case studies provided by respondents demonstrate actual benefits derived from IoT implementation. Here is a snapshot of use cases and how they benefited:

- At a company headquarters, more than 4,000 equipment sensors were installed to perform continuous FD&D (fault detection & diagnosis) driving an average of 6% savings in energy and operational costs.
- Using an analytics platform as an asset management tool has considerably reduced manpower and costs to push data to IWMS (integrated workspace management system).
- A company expects a one-year payback based on maintenance and energy savings. FD&D examples: simultaneous heating and cooling, sensor errors, stuck dampers, scheduling discrepancies.
- Predictive maintenance helps monitor HVAC systems and provides a look at run times and schedules maintenance before faults occur.

Conclusions

- Future-proof your facilities. Early adopters have measurable advantages over those who are considering or have no plans.
- Reducing capital and operating expenses by streamlining and meeting higher levels of efficiency is the top driver for IoT applications.
- Benefits of IoT often exceed pre-implementation expectations.
- Monitoring and predictive capabilities of IoT devices are viewed as key features because they identify weaknesses *before* events happen.
- Greater internal knowledge and use-case studies should be used to achieve corporate buy-in.

“We spend more than 90% of our lives in buildings, so individuals and businesses are right to expect more from them. Smart buildings today should actively contribute to the wellbeing and business success of those who rely on it.”

—Cedrick Neike, Member, Managing Board of Siemens AG and CEO Smart Infrastructure

Acknowledgments



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Our mission is to help large electric power users improve their profitability and reduce their carbon emissions by adopting best practices in energy efficiency and renewable energy sourcing.

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