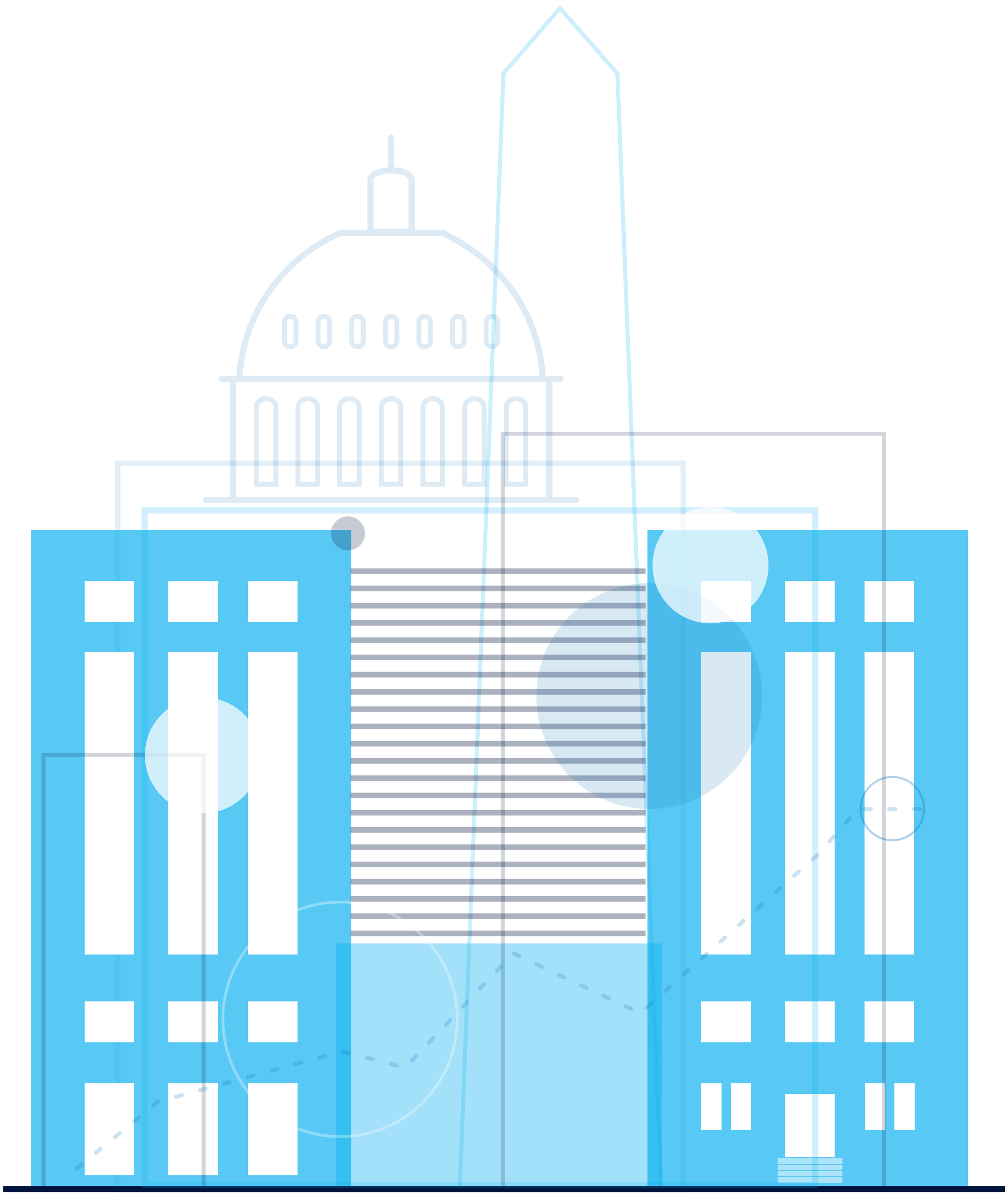
Case Study

GSAlink



Connecting GSA building automation systems with Smart Building standards and advanced analytics to deliver scalable and secure performance visibility and operational savings.

IntelligentBuildings®

SkyFoundry

Overview

The General Services Administration (GSA) manages 1,500 GSA-owned buildings and 9,624 building assets overall. As with any major building portfolio, the GSA portfolio includes buildings of various ages, designs, and conditions. This presented a challenge when the Energy Independence and Security Act of 2007 (EISA 2007) mandated that federal buildings must reduce energy use by 30% by 2015. Without the data to identify the best energy-saving strategies for each building or the portfolio as a whole, the GSA implemented a variety of capital and operational energy-saving investments, including the collection of building performance data for analysis in GSAlink—a centralized fault detection and diagnostics (FDD) system. Intelligent Buildings, LLC (IB) worked with the GSA to develop Smart Building data and network standards, unlocking building automation system (BAS) data by using open standards to connect it to the GSA network. While the capital investments included standard industry upgrades, GSAlink required the development of building systems networking infrastructure on an unprecedented scale. Analyzing the impact of the different investments, the GSA found that buildings that incorporated only GSAlink and advanced metering operational upgrades on average reduced electricity use by 25% and gas use by 19%, energy savings similar to those found in buildings with only capital energy-saving investments.

EXECUTIVE SUMMARY

Building Profile
- **Location:** National GSA-owned building portfolio
- **Building footprint:** 370 million square feet
- **Building type:** Government office
- **Owner:** The United States General Service Administration (GSA)

Challenge
- Update the GSA portfolio's building automation systems (BAS) to enable secure and effective communication with the GSAlink platform—the GSA's national fault detection and diagnostics platform created to measure and improve the performance of building systems throughout the GSA portfolio

Solution
- Develop the GSAlink program and manage the onboarding, training, and deployment of the GSAlink program at implementation sites
- Assist in developing building control system data and network standards that leverage commercially available products, open protocols, a secure converged network, and compliance procedures to enable communication between BAS in the GSA portfolio and GSAlink
- Develop BAS point naming and data tagging standards to normalize data throughout the GSA portfolio for GSAlink analysis
- Develop Smart Building program key performance indicators

Intelligent Buildings Services
- Strategy Consulting
- Design Services
- Operational Technology (OT) Cybersecurity Services

Benefits
- Adding GSAlink with advanced meters reduced building electricity use by 25% and gas use by 19% on average

370M	19%	25%
SQ FT	GAS REDUCTION	ELECTRICITY REDUCTION

Deploying operational and capital investments to meet energy reduction goals

Addressing implementation variation in the GSA building portfolio

The GSA's 370 million-square-foot portfolio is a microcosm of all U.S. buildings built before 1980[1]. As the U.S. Federal Government's landlord, part of the GSA's mission is to continually develop and implement taxpayer cost-saving and value-appreciation strategies. However, as with any large real estate portfolio, there were concerns about the long-term viability of its aging building stock. On average, older buildings are smaller, consume more energy, and have poor indoor air quality resulting from aging infrastructure, negatively impacting the operational cost and occupant experience[2]. They also often require space repurposing as their uses evolve. On top of these concerns, the GSA had barriers to conducting portfolio-wide building performance evaluations. For more than twenty-five (25) years, the Facilities Standards for the Public Buildings Service (P100) has been the primary document outlining building policy and technical criteria employed in the programming, design, and documentation of GSA-owned buildings. However, across the 370 million square feet of office space under the GSA's management, individual buildings applied a varied range of P100 implementation methods, project labeling, and building system infrastructure adoption. This heterogeneity in building organization made it difficult to connect to building systems across the thousands of assets in the GSA's building stock.

Legislating energy reduction mandates

Federal building standards and energy reduction goals were initially defined with the Federal Energy Policy Act of 2005 and Executive Order (EO) 13423 in early 2007. These policies were then further detailed in EISA 2007, which set targets for existing federal buildings to reduce energy use by 30% by fiscal year (FY) 2015, and for newly built federal buildings to perform 30% below the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards or the International Energy Conservation Code (IECC). These energy savings goals were extended with EO 13692, which was signed in 2015 and set yearly energy reduction targets at 2.5% through FY 2025. This legislation quickly impelled the GSA to explore multiple paths to reach these energy-saving targets across their portfolio.

Data-driven operational and equipment capital investments

Without a proven energy reduction strategy that could be applied across its portfolio, the GSA applied two (2) main energy reduction strategies: capital and operational investments. Capital investments under evaluation included HVAC, lighting, and utility improvements, as well as building envelope upgrades for existing buildings. Due to the variability in the labeling of these projects and the data assembled, consistent evaluation of these capital investments was difficult to determine and had a wide range of potential services from commissioning to repair to partial or full replacement of building components.

To avoid the same problems in the future and improve long-term building performance, the GSA looked to developing operational solutions that would improve building performance and visibility throughout its entire portfolio. This led the GSA to pursue data and networks standards that would deliver building performance data to a centralized FDD software solution that would identify deviations from expected building performance and provide facilities managers actionable work orders to proactively fix operational issues.

Freeing GSA building performance data with GSAlink

Evaluating energy-saving operational strategies

The GSA recognized that their capital investments would act as one-time upgrades to provide the desired energy reductions. However, without centralized operation and evaluation processes, those impacts would be difficult to measure. Similarly, the GSA saw the need to eliminate system redundancies and gain visibility into building performance. As a part of their operational investments, the GSA installed advanced meters, which could collect data regarding a building's energy use every fifteen (15) minutes. Another operational investment included exporting BAS data, which included detailed information regarding building performance, to the GSA's centralized network. This data would then be analyzed by GSAlink, the GSA's national FDD platform. To reduce operational redundancies, the GSA also developed a centralized NationalComputerized Maintenance Management System (NCMMS), which would provide work orders for the entire GSA portfolio, including those from GSAlink. Evaluating the impact of a building's energy performance from these data-driven work orders using BAS and advanced meter data would help the GSA to better characterize the long-term performance of building systems and their total cost of ownership.

Connecting disparate systems to a single network

With different mixes of control system manufacturers, vintages and implementations in every building, connecting the BAS to the GSA network was a challenge, but normalizing that data for GSAlink to allow computer algorithms to effectively interpret it was another obstacle entirely. For this complicated and unique challenge, the GSA engaged IB to develop Smart Building standards that would characterize BAS communication protocols and network configurations. This standardization would ensure systems could securely connect to the GSA network and simplify future implementation with a repeatable process. IB began by defining overarching principles that would guide the standards development:

- Support for commercially available off-the-shelf products
- Open design incorporating standard communication protocols
- Leveraging an interoperable secure converged network within buildings for BAS and control systems
- Compliance procedures to meet the GSA's informational technology (IT) requirements and point naming conventions

Building off this approach, IB successfully integrated facility Use Cases for nearly twenty (20) operational systems, technologies, or Building Internet of Things device types to create a solution that provided each of the GSA-owned buildings with as many competitive configuration options as possible. Vendor risk management is challenging at best and IB's methodology and services ensured the BAS software meets all of the GSA's IT requirements, is capable of exporting data, and can be maintained without any future dependencies on the original contractor. At the same time, the interoperable converged network eliminated redundant control systems infrastructures, such as cables and switches, and ensured cybersecurity compliance. IB's standardized approach also partitioned business applications from building control systems, creating the GSA's physical IP network, as well as a collection of virtual local area networks that connected building management systems to a central cloud-based platform, which could leverage the existing GSA single sign-on for authentication and role-based access. These products, network, and communications standards would become mainstays of the P100 Facilities Standard and other facility guidelines.

Initial implementation

The GSA began development of the NCMMS in 2011[3] and GSAlink in 2012[4]. The NCMMS and GSAlink's front-end is built on IBM's Maximo software, with SkyFoundry's SkySpark acting as GSAlink's operational analytics engine. GSAlink tracks and analyzes building performance through millions of data points from various control systems and meters in real time to provide actionable insights on identified performance anomalies, even before tenants recognize the symptom and it becomes a noticeable issue. GSAlink works to keep a building operating in its ideal condition and identifying sources of wasted energy. For example, an actuator in the HVAC system that has been misadjusted could cause a heating valve to vent hot water to the coil even when it is programmed to be completely shut, wasting heat energy and potentially cooling energy. GSAlink would identify this issue and create a work order in the NCMMS for the facilities managers.

As the GSAlink rollout began—eventually totaling eighty-five (85) GSAlink installations—the GSA was also installing advanced meters that collect data in 450 high energy consumption facilities every fifteen (15) minutes[5]. IB worked to bring this advanced meter data into GSAlink. The advanced meters used Schneider Electric's ION architecture to capture and record meter data, leading IB to create an ION implementation that could connect to the GSA network and be queried by SkySpark for GSAlink analysis. IB implemented this solution in 100 buildings as part of a pilot program intended to evaluate the impact of the GSAlink FDD using meter-level data.

The economies of scale of GSAlink for building operations and energy savings

Expanding standards and reducing costs

As they implemented GSAlink beyond the initial buildings, IB worked with the GSA to codify the point naming standards for building control systems that were used in GSAlink. At first, the GSAlink-installed buildings had their own point naming systems. This cacophony of standards required the manual mapping of each building's specific naming system to the global naming system that could be interpreted by GSAlink. The global point naming standard was finalized in 2017 and codified in The GSA Data Normalization for Building Automation Systems. This established standardized requirements related to BAS point naming, implemented Project Haystack (project-haystack.org) tagging requirements, and clarified the necessary fields in the NCMMS system for matching assets to BAS equipment across the entire GSA portfolio. Additionally, the National Operation & Maintenance Specification (O&M spec) now requires contractors to utilize the available analytics tools, including GSAlink, and to ensure the tools are operating correctly.

Evaluating capital and operational energy-reducing investments

With eight (8) years to achieve its mandate to reduce energy use by 30%, the GSA implemented a broad set of capital and operational interventions. These interventions ranged from upgrading boilers, HVAC, lighting, and building envelope components to committing to operational investments, such as advanced meters, FirstFuel meter analytics, Shave Energy and E4 training programs, and GSAlink. These implementations reduced energy use across the GSA's portfolio, but it was unclear exactly how those energy reductions were reached.

In 2016, a Carnegie Mellon University study set out to determine the impact of the GSA's various methods[6]. Reviewing over 2.5 million fields of data, the study found that capital and operational investments saved similar amounts of energy, with buildings that only incorporated GSAlink and advanced metering operational upgrades reducing electricity use by an average of 25% and gas use by an average of 19%. Additionally, these operational investments revealed nightly energy savings ranging from 5%–20% on weekday nights and 4%–6% savings on weekend nights. Overall, the study recommended a mix of both types of energy-saving investments to optimize long-term building energy savings: applying capital investments to building systems that had substantial baseloads and would provide the greatest initial energy saving opportunities combined with operational investments that would maintain the energy savings over time.

GSAlink impact and economies of scale

After the initial investment in the development of GSAlink, the cost of implementing GSAlink has fallen by 50% through standardization, product improvement, and experience from dozens of installations.

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> Buildings that incorporated only GSAlink and advanced metering operational upgrades reduced electricity use by an average of **25%** and gas use by an average of **19%**.

As a project bringing operational savings to an expansive portfolio, GSAlink garnered national recognition from the U.S. Department of Energy, receiving the 2018 Smart Energy Analytics Campaign – Energy Performance in a Portfolio Award.

Today, the GSA's Smart Building program has expanded GSAlink's initial goals to include: updating the O&M spec to utilize the GSAlink system; requiring key performance indicator reports of how many faults are detected at a building in a period of thirty (30) days; producing comfort reports that detail the frequency at which a building's temperature is measured to be within the set tolerance of the target temperature; providing deferred maintenance reports when costs reach $100,000 with a plan for addressing the backlog or reasoning for inaction. With the NCMMS and GSAlink systems in place, there is a significant opportunity for the GSA to continue meeting the goals set out for their teams and assets, and to achieve the ongoing objective of a 2.5% energy reduction per year through 2025.

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