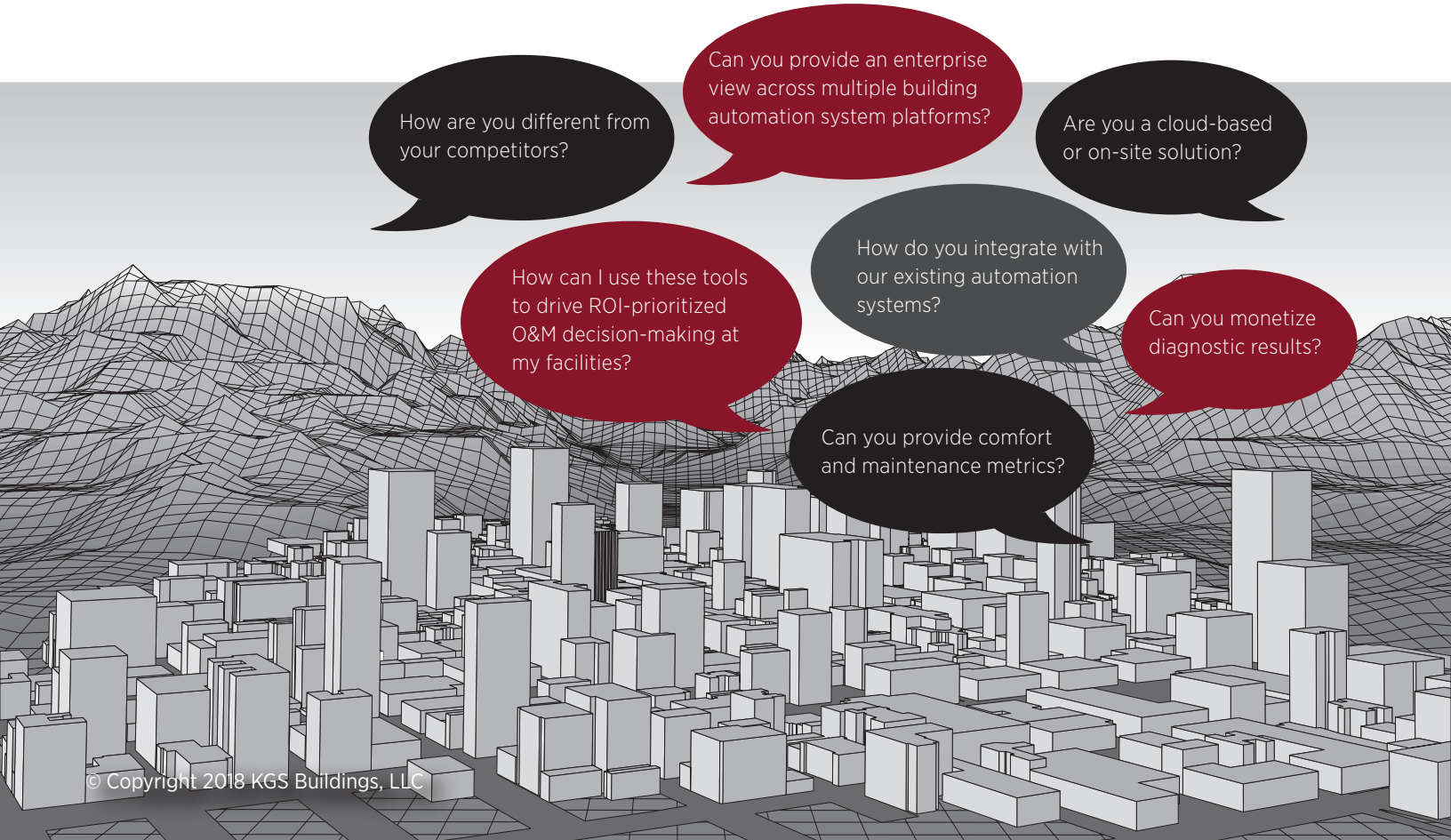
KGS BUILDINGS

WHITE PAPER

DEFINING THE GROWING MARKET FOR AUTOMATED FAULT DETECTION AND DIAGNOSTICS

In the last five years, the world of automated fault detection and diagnostics (FDD) in commercial buildings has grown exponentially. The ability to connect to open building automation systems has opened up a new technological path for software that analyzes building automation data to drive operational savings. There is now a growing interest in software that helps building owners and operators find missed opportunities, energy waste, and mechanical inefficiencies in order to drive high-impact, short-term improvements in operations and maintenance. Though several terms for this technology exist—Fault Detection and Diagnostics (FDD), Monitoring-Based Commissioning (MBCx) technology, and Continuous Commissioning software, to name a few—the market has now matured to the point where customers are no longer asking **"What are these tools?"** but:



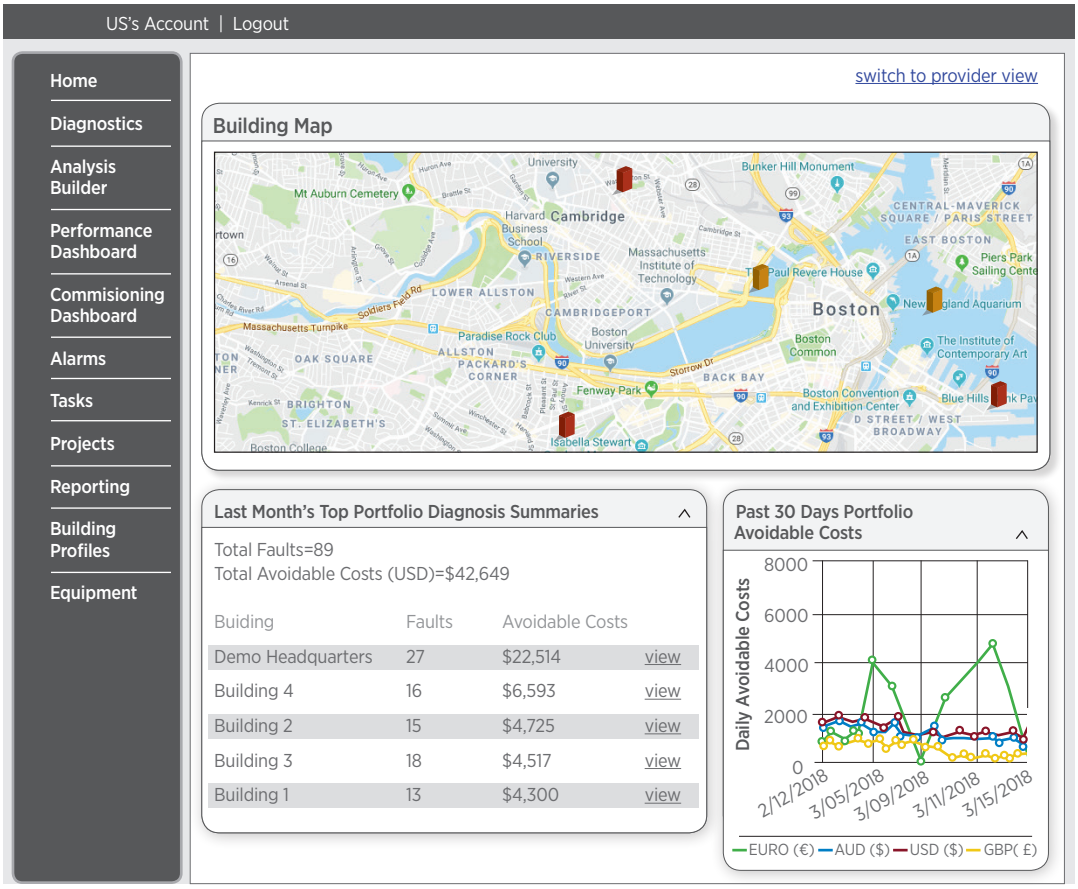
With companies using similar words for different technologies and different words for similar technologies, there is understandable amount of confusion about what the various solutions actually do and how facilities management teams or service providers can drive value with each one. This whitepaper seeks to clarify such confusion in the market so companies can evaluate the best FDD solution to fit their organization's needs.

WHAT CHALLENGES ARE ADDRESSED BY AUTOMATED FDD?

As facilities teams race to meet energy efficiency goals while lowering maintenance costs in existing buildings and optimizing the performance of new ones, they're tasked with answering two major questions:

- How can we manage our buildings better?
- How do we constrain our operational expenditures while still meeting our goals?

Manually monitoring alerts and automation data across the entire portfolio in an attempt to pinpoint problems and opportunities is a slow and tedious process—one that costs companies even more in time and money. From simultaneous heating and cooling in air handlers, rogue zones driving suboptimal ventilation control to dampers short cycling and abnormal fan currents, there are many issues that are difficult to detect manually across large facilities and larger building portfolios. Even with a room full of engineers, it is not always easy to detect hidden opportunities such as more efficient cooling tower staging or improvements in primary chilled water loops, costing facilities money they may not realize can be spotlighted with automated tools. When facing a high volume of automation system alarms, maintenance service calls, and pressure to reduce HVAC costs and increase operations and maintenance efficiency, building operators need an automated way to prioritize where internal teams and service providers should be focused so problems can be tended to quickly and cost-saving opportunities can be acted upon to drive short-term, high-impact efficiency gains. This is where automated FDD comes in.



These panels are from Clockworks Commissioning Dashboard, revealing performance trends at the executive-level. Users can view the avoidable costs associated with repair and maintenance needs and operational changes, such as adjustments to control sequences or faulty dampers and valves. The impact of faults and opportunities in terms of cost, energy, comfort and maintenance priority can be viewed over time.

WHAT IS THE VALUE OF AUTOMATED FDD?

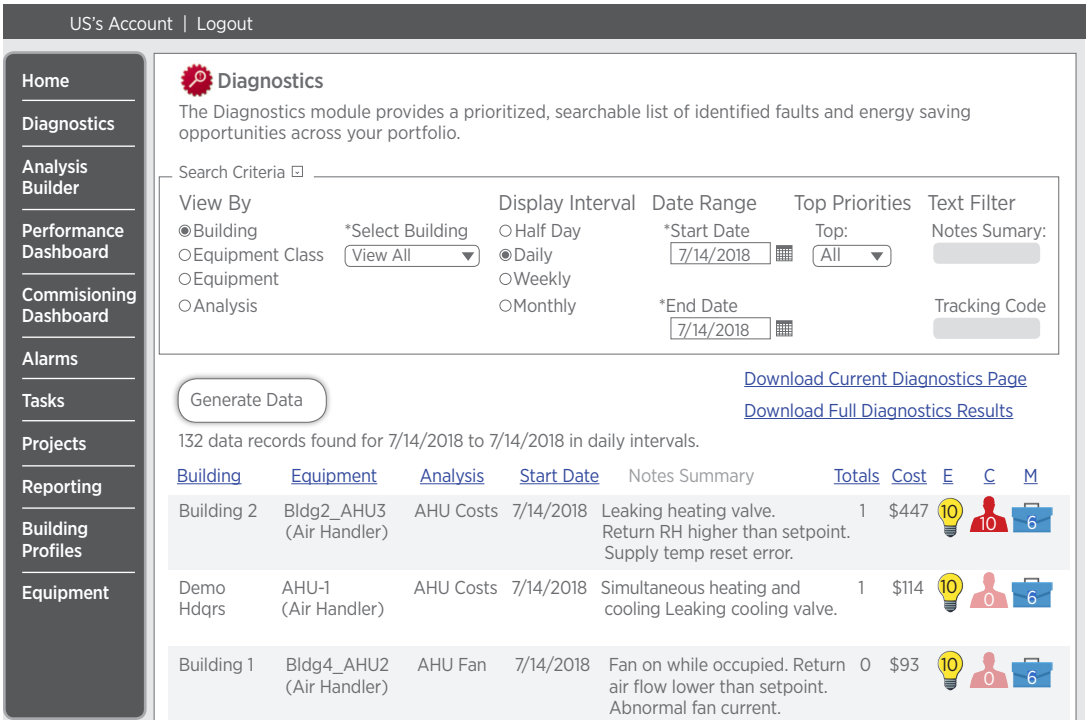
FDD technology is able to turn mountains of data into actionable information by analyzing millions of data points from building automation systems to determine where operational inefficiencies and energy waste is taking place. Effective FDD tools must not only identify a comprehensive list of problems, they must also identify root causes, direct resolution and prioritize findings based on the actual energy value, as well as the impact to comfort and the maintenance severity. For example, a facility manager at a hospital may care about comfort first and energy savings second. Such preferences make it imperative to be able to sort diagnostic results by impact type to identify the biggest opportunities for improvement and stay ahead of occupant complaints. To do this, FDD web interfaces must be able to help building operators identify, investigate and track inefficiencies to prioritize maintenance activities, reduce energy consumption and improve occupant comfort. In summary, the right FDD solution will inform you how to make your buildings better in a number of ways:

- Identifying and prioritizing opportunities to improve energy performance and fix controls and mechanical maintenance problems before they grow into bigger headaches
- Supporting troubleshooting through root cause analysis to guide the resolution of issues
- Targeting personnel and resources towards improvements that will make a real impact based on flexible, relevant priorities

TO DRIVE GREATER VALUE FROM FDD, THE SOFTWARE PLATFORM YOU USE MUST CONNECT THE DOTS FOR YOU BY PROVIDING COMPREHENSIVE DIAGNOSTICS THAT COMBINE MULTIPLE RULES INTO AN OVERARCHING HIERARCHY TO IDENTIFY THE ROOT CAUSE OF THE PROBLEM AND DIRECT ITS RESOLUTION.

IS THERE A DIFFERENCE BETWEEN "RULES" AND "DIAGNOSTICS?"

There is in fact a big difference between rules and diagnostics. A common example of a rule is the identification of leaking valves. If not caught in time, they can cost a lot of money and waste a significant amount of energy, especially when they trigger simultaneous heating and cooling. In practice, a rule to identify that a preheat valve in an air handling unit is leaking might say that if the temperature rises more than five degrees across the hot water coil and the valve says it's closed, then it must be leaking. That is a useful rule. However, it is very similar to an alarm, and buildings have a lot of alarms already. To drive greater value from FDD, the software platform you use must connect the dots for you by providing comprehensive diagnostics that combine multiple rules into an overarching hierarchy to identify the root cause of the problem and direct its resolution. Clockworks™ by KGS Buildings does just this, leveraging diagnostics that incorporate thousands of lines of code using complex logic, delivered in a single, streamlined interface.



Clockworks™ has a comprehensive library of diagnostics for all HVAC equipment and systems, which is curated and updated continuously. The software has the ability to run in-depth diagnostics at scale and to prioritize the results by energy cost, as well as comfort and maintenance on a 0-10 scale. All results from equipment and system level analyses appear in the punchlist that you see above according to the date range selected. This list can be sorted by portfolio or individual building, as well as equipment class and type of analyses. This allows a user to drill into a specific building, piece of equipment, or type of analysis. This figure illustrates the results of diagnostics across a portfolio with a daily interval of 24 hours.

EVERY BUILDING IS UNIQUE. WHAT IS THE VALUE OF CONFIGURATION OVER CUSTOMIZATION?

A central challenge for FDD is the need to deploy diagnostics across many different building profiles, systems and types of equipment. Effective solutions must be able to avoid re-writing diagnosticswith every new building, a cost prohibitive process, while at the same time avoid false positives. Clockworks™ addresses both of these priorities with a centrally managed code set that is configured to individual facilities through scalable software variables that enable rapid deployment. This means that a complete library of diagnostic code can be rapidly applied to individual buildings, entire campuses or even large building portfolios by mapping point, equipment and system parameters to produce accurate diagnostic results.

IS FDD MORE EFFECTIVE IN THE CLOUD?

The cloud provides a number of meaningful benefits—from scalability to cost savings—which enables more effective FDD. Specifically, "A network of on-demand, traffic-managed, load-balanced, virtualized servers, working together with geo redundant storage, and distributed caching in a 'cloud' can accomplish more than any single server could do on its own, especially for collecting, storing and analyzing large volumes of data." (Source: How I Learned to Stop Worrying and Love Building Data). For FDD purposes, it means no "choke points" and no limits to data storage or the number of equipment and buildings that an owner and operator can analyze on a single platform. A deliberate decision was made early on in the development of Clockworks™ to build a cloud-based (rather than on-site) software solution. After all, one only needs to open the business section of any newspaper to see the exponential growth of big data and cloud technologies. Fundamentally, we see two main advantages of the cloud for building owners and operators: scalability and making sure your investment is future proof.

SCALABILITY

For large organizations with hundreds or thousands of sites, scalability across the enterprise is very important. Cloud software technology enables large deployments with an unlimited amount of buildings, equipment and points. Effective FDD platforms must have the ability to process and display millions or even billions of data points quickly through an accessible, intuitive web platform. When data is streaming into Clockworks™ from hundreds of sites, cloud based servers spin-up automatically to handle, store and analyze that data. Thousands of virtual servers can be used as needed to process all diagnostics on every data point globally in under two hours. That means when many users within an organization

CLOCKWORKS CURRENTLY COLLECTS OVER 1 MILLION DATA POINTS EVERY 5 MINUTES ACROSS MORE THAN 160,000 PIECES OF EQUIPMENT IN 20 COUNTRIES.

log into Clockworks™ at the same time, multiple servers can spin up to handle the requests from those users, altogether eliminating bottlenecks. The bottom line is that cloud technology eliminates both the data storage and processing power limitations of PC or single-server based applications, enabling immense scalability.

FUTURE PROOF YOUR INVESTMENT

The pace of technology change today is so rapid that a standard software package loaded on a server or PC is outdated within a year of installation. Cloud-based FDD solutions can now constantly innovate and iterate by building features and functionality continuously, rather than yearly, and deploy those upgrades dynamically to all users. That means customers are no longer asked to upgrade to new versions periodically; upgrades appear through the web interface consistently and seamlessly over a rapid development cycle. This agile software development method allows the Clockworks™ team to respond rapidly to customer and market feedback. Clockworks currently collects over 1 million data points every 5 minutes across more than 160,000 pieces of equipment in 20 countries.

HOW DOES FDD INTEGRATE WITH BUILDING AUTOMATION SYSTEMS?

There are different approaches in the market today to communicate with building automation systems (BAS) and extract data for fault detection. Clockworks™ utilizes a customized Data Transfer Service (DTS) to stream data to the cloud without the need for additional hardware. The DTS is a Windows service that sits on the same network as the building automation system. It communicates with global/supervisory BAS controllers or databases to poll temperatures, pressures, flows (inputs and outputs) and setpoints (numeric and virtual points) from the building automation system and push one-way to the cloud.

HOW DO YOU BRING FDD INTO FACILITIES MANAGEMENT OPERATIONS?

Technology is essential, but without a process for managing and responding to diagnostics findings, there is only limited value. Ownership over FDD programs is vital, and a defined workflow is necessary for scheduling maintenance and responding to diagnostics results. The extent to which maintenance work is performed by an in-house facilities engineering team or by outside engineering or services providers is dependent on the organization. Some customers use Clockworks™ to dispatch and plan maintenance every week internally. Others do not have the resources or time to manage the platform and prefer to have an energy services company, trusted consulting engineering firm, retro-commissioning firm or controls contractor utilize Clockworks™ to drive energy reduction. Since some diagnostic results require programming changes and sensor replacement and others require mechanical work to be performed, a well-defined process is important for maximizing ROI.

CHOOSING AN EFFECTIVE FDD SOLUTION

The market for FDD software is expanding rapidly with more and more organizations looking to drive value from the HVAC data that they already have locked up in many different controls systems. In order to stay ahead, organizations need to choose an FDD solutions that is able to:

- Identify root causes through comprehensive diagnostics, not just rules
- Accurately calculate energy impact, as well as provide comfort and maintenance metric
- Scale across entire portfolios rapidly and be capable of constant evolution
- Provide intuitive web-interfaces with multiple tools to manage building performance across the enterprise
- Drive an effective process for action

GET STARTED WITH CLOCKWORKS

Clockworks by KGS Buildings is a cloud-based FDD solution providing comprehensive diagnostics to improve facility performance and reduce HVAC costs. Clockworks' scalable software architecture quickly turns mountains of data into actionable information by identifying, prioritizing and tracking operational inefficiencies and energy waste from millions of data points every day.

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or contact us directly:
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(857) 598-6439

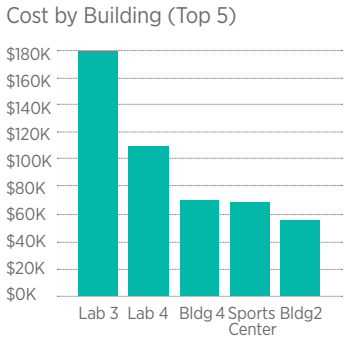
Identified Avoidable Costs
$654,658

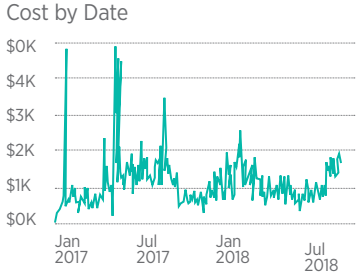
Average Daily Avoidable Costs
$1,059

Avoidable Cooling Use (Ton-Hrs)
1,344,429

Avoidable Electric Use (kWh)
1,821,751

Avoidable Heating Use (kBTU)
13,336,653





Annual Projected Task Saving
$1,005,778