Addressing Operational Challenges in Commercial Facilities Using Automated Ongoing Commissioning

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ABSTRACT

Today's facility operators and managers are tasked with operating increasingly sophisticated systems to manage both tenant comfort and equipment reliability while simultaneously being held accountable to keeping energy consumption under control. Fortunately, facilities today produce a large amount of data that can be leveraged to help manage these efforts, and there are automated processes available to prioritize this information in a smart and efficient manner. One such process—automated ongoing commissioning—improves operations and enhances occupant experience by providing facility personnel with valuable insights into large amounts of building data on a real-time basis.

WHAT IS COMMISSIONING?

According to the California Commissioning Collaborative, the term "commissioning" as used in the construction industry is borrowed from ship building [1]. Before a ship can be considered sea-worthy, it must pass a rigorous quality control exercise to test that all materials, systems and staff have been thoroughly investigated and all issues discovered have been corrected. Once this process has been completed, a ship is deemed ready for service.

Commissioning for buildings follows a similar process of detailed inspection and correction of discovered issues. However, the process is not uniform and there are many ways to address commissioning throughout a facility's lifecycle.

Types of Commissioning

There are several types of building commissioning. Each offers a process to help ensure the building operates as intended by the designers and engineers.

New building commissioning (Cx) is used when a building is initially commissioned. It undergoes an intensive quality assurance process that begins during design and continues through construction, occupancy and operations. New building commissioning ensures that the new building operates as intended and that building staff are prepared to operate and maintain its systems and equipment.

Retro-commissioning (RCx) is the application of the commissioning process to existing buildings. Retro-commissioning can often resolve problems that occurred during design and construction, or address problems that have developed throughout the building's life. The process improves a building's operations and maintenance procedures to enhance overall building performance.

Ongoing commissioning (OCx) is the constant application of the commissioning process which ensures that building operations and systems do not deviate far from the intended performance.

Importance of Automated Ongoing Commissioning

The intent of all types of commissioning is to document facility operations and to identify performance issues before they become major problems. New building commissioning is applied at the start of the building lifecycle to mitigate issues resulting from design and construction. However, many additional factors are introduced during post-construction operations that must be addressed to ensure optimal system performance and tenant comfort.

The primary commissioning methods deployed in existing buildings are retro-commissioning and ongoing commissioning. Both retro-commissioning and ongoing commissioning can identify and correct issues associated with design decisions, occupancy challenges and operator errors; however, retro-commissioning has several limitations to consider:

- Commissioning is performed at a single point in time (sometimes over several days), and is therefore a "spot check".
- The Commissioning Authority (CxA) is unable to observe the systems through full sequences of operations; some sequences must

be simulated by forcing systems into different modes or temporarily modifying setpoints.
- The ability to observe multiple systems simultaneously is limited and some systems must be observed in isolation.
- Equipment can revert back to the previous state undetected once the RCx process is completed.

Automated ongoing commissioning addresses many of these issues by leveraging technologies that harness facility data. The benefits of this process include:

- Systems are monitored continuously, allowing valuable insights into all sequences of operations.
- Control parameters can be applied for any data point—no matter their relation within the facility—allowing for ongoing monitoring of multiple interconnected or disparate systems simultaneously.
- Operational issues can be detected as they occur which allows for immediate diagnosis and correction.
- Detailed histories of system performance and operations can be stored indefinitely to create robust operating profiles over years of operation.
- System data points can be analyzed over any desired time interval to enhance system diagnostics.
- Maintenance tasks are automatically prioritized.
- Energy efficiency measures can be identified.
- Measurement and verification of implemented measures ensures delivery of energy savings.

PAYBACK AND CARBON FOOTPRINT

Many of the benefits of automated OCx do not directly contribute to energy savings. Greater visibility into operations, prioritizing maintenance tasks, prolonged equipment life, and critical space monitoring, provide adequate justification to implement an OCx project in a facility.

The authors are currently working on an automated OCx project in a manufacturing facility with strict humidity and static pressure

requirements. In this facility critical sensors are continually monitored to ensure they stay within acceptable limits, and facility operators are notified if the values deviate too far from setpoints by a predetermined threshold limit. When notified, these alerts are moved to the top of their prioritization list. This automatic prioritization of critical tasks allows the facility operators to address potential issues before they impact manufacturing performance. By mitigating impacts on the manufacturing process, manufacturing uptime is increased and the key goals of the facility are not compromised.

Though many facilities deploy OCx strategies with little regard for anticipated dollar savings, this does not diminish the economic and environmental value of OCx. Figure 1 illustrates this point. OCx provides continual measurement and verification of implemented energy efficiency measures while simultaneously identifying new measures to reduce energy consumption.

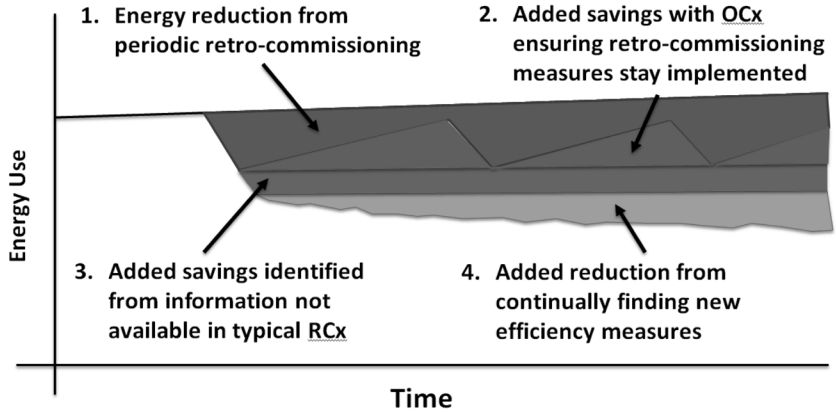

Figure 1. Energy benefits of OCx.

Payback

Initial costs for automated, ongoing commission can be relatively large due to the cost to set up the monitoring system and to retrieve data from the facility. However, studies have shown that performing commissioning in existing buildings results in significant cost savings and rapid payback periods. For instance, one study of commissioning in existing buildings found median savings of 16% and a median payback of 1.1 years as shown in Figures 2 and 3 [2].

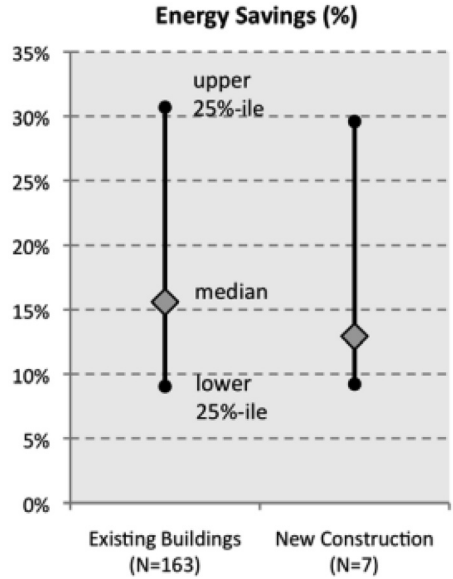

Figure 2. Commissioning energy savings.

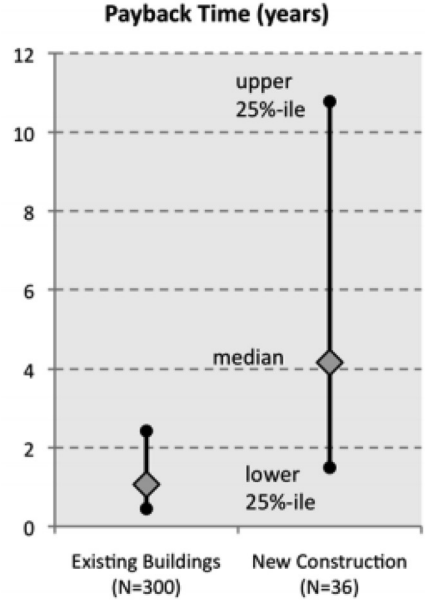

Figure 3. Commissioning payback time.

We have experienced similar financial benefits as detailed in the referenced study and with our professional experience when commissioning existing buildings. One recent automated OCx project at a healthcare facility yielded over $300,000 in energy savings within the first several weeks by identifying operational anomalies across the campus. This resulted in a simple payback period (technology costs plus ongoing fees) of less than one year.

Carbon Footprint

Many countries and organizations have pledged to reduce their environmental impact and reduce their carbon footprints. China recently pledged to stop increasing their carbon emissions by 2030 or sooner and to reduce their carbon intensity by 60% to 65% by 2030 [3]. GE has recently pledged to invest a cumulative $25 billion (USD) in research and development to reduce water consumption and greenhouse gas emissions by 20% by 2020 [4].

Buildings are one of the largest consumers of energy in the United States, and as a result are also responsible for a large portion of the United States' greenhouse gas emissions. Studies have estimated that buildings are responsible for 39% of all CO_2 emissions in the United States while industrial sources contribute 29% and transportation systems contribute 33% [5].

Commissioning in existing buildings is one of the most cost effective ways to reduce carbon emissions. Mills analyzed the cost of avoided carbon emissions using many differing carbon abatement strategies and found that not only does commissioning existing buildings have a negative cost (in other words, it makes money), it has the most negative cost of all the strategies analyzed [2]. Figure 4 details the cost of avoided carbon emissions for numerous popular abatement strategies with commissioning in existing buildings.

FUTURE APPLICATIONS FOR OCX

While it is impossible to know what the future holds, the explosive growth of big data and the internet of things (IoT) are difficult to ignore. It is estimated by various sources that upwards of 25 to 30 billion devices will be connected to the IoT by 2020. As all of these previously unconnected devices come online, efficient ways to track, manage and

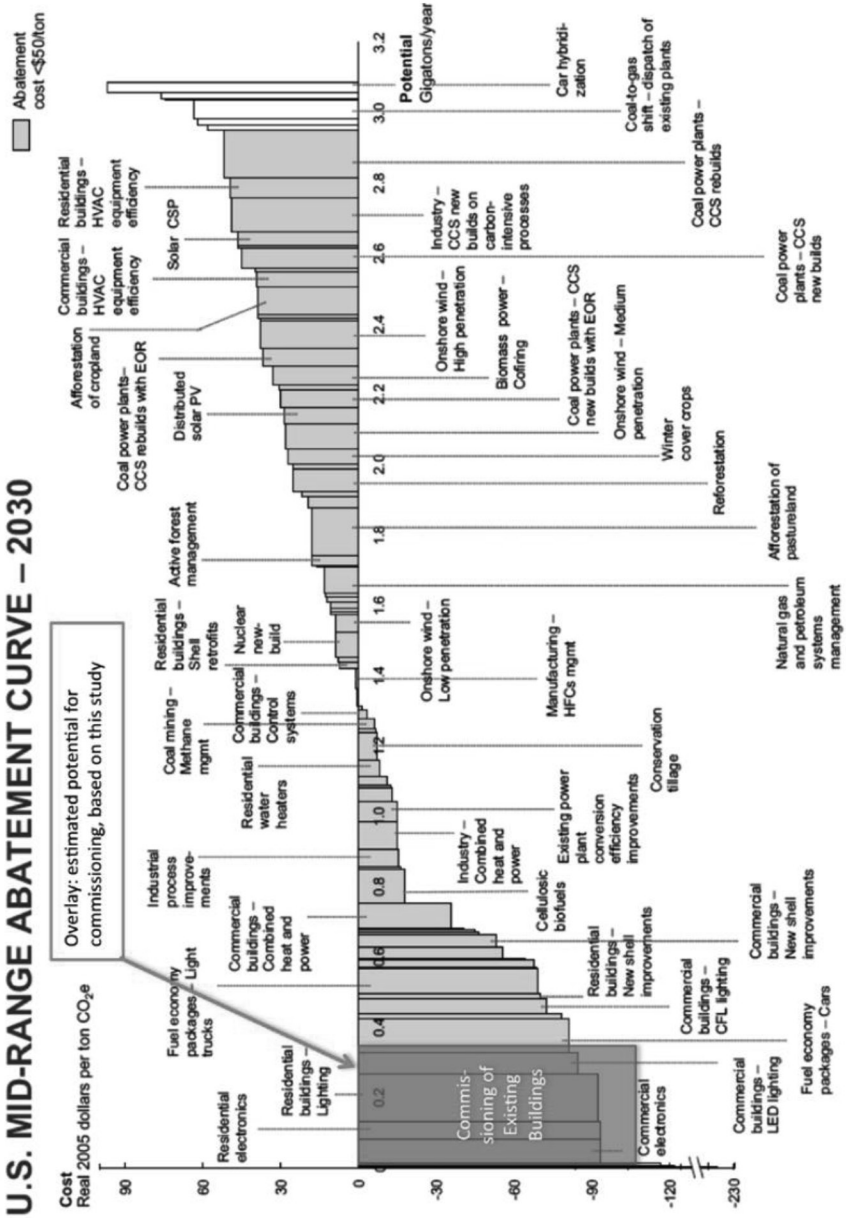

Figure 4. Cost of avoided carbon emissions.
Source: www.mckinsey.com/~/media/McKinsey/dotcom/client_service.

utilize these data will be increasingly necessary to capture the value of big data.

In buildings, previously "dumb" devices such as light switches, doors and outlets will suddenly become "smart" and will begin communicating valuable information about their usage and performance. The only way to harness these data will be through the use of technology. Automated OCx will have a key role in unlocking this value.

For instance, automated OCx will ensure that equipment isn't brought on too early or too late in accordance with information from the security systems or occupancy sensors in the space. Electrical outlets can communicate and manage devices such as computer screens that are left on overnight, or detect space heaters which may cause a hazard. The amount of data that will be streaming from connected devices will provide enormous opportunities for improvement of our built environment, provided that the appropriate technology is in place to utilize it.

CONCLUSION

Automated OCx provides facility operators and managers with invaluable insights into system operations. It allows personnel to track, manage and optimize all sorts of disparate systems in a cost effective manner on a scale not previously available. The exponential growth of the IoT ensures that increasingly more devices will come online and report data. Accordingly, the value of automated OCx also increases, becoming a more indispensable weapon in a building operator's arsenal. Automated OCx provides tremendous value today and positions operators for success in the not-to-distant future.

References

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