



A Guide on Retro-Commissioning for Resiliency and Code Compliance

Retro-Commissioning for Resiliency and Code Compliance

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About this Guide

Commissioning is perhaps most commonly viewed as a way to verify a new building functions the way it was designed to once the keys are turned over to the owner. The retro-commissioning process is similar, yet it has unique hurdles to overcome and can be less concrete in scope when the process begins. During the life cycle of a building, it will be renovated (in most cases many times) to meet the changing needs of the owner and business sector usually without being fully functionally tested again. Healthcare facilities can change the second they are occupied, and the changes never stop during its life cycle. Why then, should we expect the way it was originally designed to be constant throughout the life cycle? The intent of this guide is to bring attention to Retro-Commissioning and to discuss what it is, what its challenges are, and most importantly, what the benefits to the building owner can be.

This guide answers the most frequently asked questions about retro-commissioning:

- How can retro-commissioning help create more predictable operating budgets?
- How can retro-commissioning ease the burden on limited operations staff?
- What effect does the retro-commissioning process have on the healing environment?
- How can retro-commissioning reduce operating costs?

About the Authors



Matthew Wheeler, PE, CxA, LEED AP

As Commissioning Market Leader, Matt serves as the overall supervisor of the project and the primary contact to clients throughout project development. As part of his position, he ensures that all client requirements are met by developing a strong client relationship through his participation beginning with project inception and remaining up through construction closeout. Matthew's approach to commissioning focuses around his operational background. His focus as Market Leader is to leave the owner and maintenance staff with an efficiently operating building that meets all required design criteria and provides a high level of physical comfort to all of its occupants and staff.



Chris Wysoczanski, PE, LEED AP

As Associate and Mechanical Group Leader within the technical team, Chris coordinates entire systems from concept through construction, conducting site visits, systems evaluations, cost estimates and specifications. He has provided these services for a multitude of project types. As the Mechanical Group Leader, Chris ensures the project's mechanical designs are fully code compliant and up-to-date with industry standards.

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Isaac Arey
Catholic Medical
Center



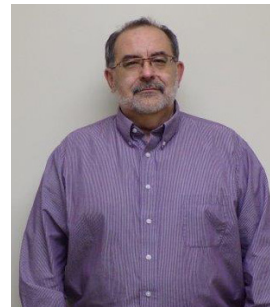
Chris Clorite
Control
Technologies Inc.



Chris Roberts
Johnson Controls,
Inc.



Kevin Cummings
Granite State



Ken Duchesne
Granite State

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WHAT IS RETRO-COMMISSIONING?

1

What is Retro-Commissioning?

Retro-commissioning is the act of engaging a commissioning firm to review the operation of existing building systems; primarily mechanical and electrical. This includes, but is not limited to, heating systems, air conditioning, building automation and controls, domestic hot water systems, emergency and standby power and lighting controls. The process can be proactive or reactive but is typically focused around mitigation of risk for the end user and the healthcare organization. Perhaps an owner wants to find potential issues in a clinical environment before they occur or maybe a regulatory investigation has uncovered an issue that needs to be addressed. In healthcare facilities, reactive measures often carry unplanned costs and thus proactive retro-commissioning provides the most benefit.

Buildings are constantly changing, the mindset going into retro-commissioning should be “how do we adapt these systems to work the way we need them to” rather than “how do we make these systems work the way they were originally intended to.” Building systems are designed by a mix of best practice, assumptions and input from end users. Input from end users is often limited to a few individuals which represent the entire owner’s facilities team and end user groups. This approach is necessary as it is impractical to solicit the input from every end user. The dynamic environment of healthcare facilities, both from a regulatory and programming standpoint, requires consistent re-evaluation of these user group requirements to ensure the delivery of a compliant, comfortable, safe, healing environment.

Once a building is constructed and occupied the operating sequences need to be fine-tuned to address unforeseen characteristics of the building. These adjustments can be related to factors such as thermal performance of the building envelope, real-world efficiency of the equipment operation and in some cases even the effect of solar glare on the facility. These adjustments can often take several months to get a building operating smoothly. Fine tuning can also be a double-edged sword. Overriding setpoints to quickly meet an individual’s request can inadvertently alter sequences and could have long lasting effects on the operation of

“The process of retro-commissioning can be proactive or reactive.”

systems. Thermal comfort is a primary concern for building operators and often takes precedence over other aspects of the building operation even though it does not benefit the original design, install or legal requirements of third party CMS's or joint organizations.

It is difficult for engineers to design to all occupants. No two people are alike, and neither are their preferences in thermostat settings. Change is a word that is synonymous with healthcare. Codes change, patients are continuously turning over, physicians come and go. The one constant is the expectation that buildings perform to the need of the end user. Facility managers are tasked with operating buildings to hit this moving target of end user and regulatory requirements. Retro-commissioning is an invaluable tool to ensure systems are operating to meet existing requirements, monitor the effectiveness of adjustments and evaluate success in reaching the correct balance between comfort of occupant expectations.

WHAT ARE THE CHALLENGES OF RETRO-COMMISSIONING?

2 The Challenges of Retro-Commissioning

The first and foremost challenge in getting a retro-commissioning program off the ground is getting buy-in from the right players. Facility operations staff who are involved in the day to day maintenance and repair of the building systems must be involved early in the scoping phase, as they can provide the most insight into known problems or operating characteristics of the systems under review, and they should be consulted throughout the process. They often hear directly from space users when systems are not performing properly. The staff in charge of capital planning should be involved or made aware of the retro-commissioning process because many times funding for the project comes from an operating budget not a capital one.

Retro-commissioning can sometimes result in the recommendation of equipment replacement. The earlier they are made aware that equipment replacement is a potential recommendation for system improvement the more effectively they can plan. Heads of user groups are also less obvious key players in a successful process. They are the boots on the ground and letting them know that the purpose of the retro-commissioning process is to improve the healing environment is pivotal. There will be some inconvenience to them with the execution of the process and if they are vested early in the outcome, they will play a key role in the success of retro-commissioning.

Another challenge is access. Like construction commissioning, retro-commissioning requires access to building systems and manipulation of them as part of the functional testing process. The process generally involves commissioning engineers meeting with facility system operators and the controls vendor to test the operating sequences of the existing systems. Doing so can cause disruption in space

temperature, airflow and/or space pressurization. Since maintaining these setpoints is critical in occupied spaces, to meet regulatory requirements and comfortable conditions for patients, the commissioning process often cannot occur while the spaces are occupied. Facility staff and commissioning engineers must work out scheduled down times for the commissioning process; sometimes this must occur during off hours.

In order to identify where retro-commissioning can be effective and to measure the outcome of the process, data acquisition is key. Many healthcare facilities still have a mix of pneumatic and digital control systems for their HVAC systems. Pneumatics, which used to be common several decades ago, have fallen out of use in favor of electronic controls and direct digital control (DDC) systems. Once state of the art, pneumatic control systems inheritably lack data output capability. Some systems have analog dials to indicate temperature or pressure locally, but they do not provide a source of output to a data acquisition platform. Even when present, these devices are often out of calibration or broken and cannot provide meaningful data. This presents difficulties in determining if existing control systems follow sequences and accurately maintain commanded setpoints. Failed devices and out of range setpoints are fundamentally masked and generally require either end user input or physically checking each device to be found.

Data acquisition can also be difficult when data points have not been installed or mapped to the graphical user interface. This can occur as a result of points not being specified when the system was installed, lack of integration capability, or systems not being properly set up. However, when DDC systems are present there is the capability to add points for

data collection. Often the information is available but requires a controls technician within a defined scope to bring the system shortcomings to the surface. Today there are numerous cost-effective data analytics software packages available which are an essential tool in spotlighting issues in large facilities, where the point count is simply overwhelming. Once installed the software will continue to provide essential data to the facility team typically on a monthly basis. This helps to ensure that the condition of the building systems operate at a higher level. The success of the retro-commissioning must be measurable, and reliable data acquisition is essential to this end.



Figure 1: Key Challenges of Retro-Commissioning



WHAT IS THE BENEFIT OF RETRO-COMMISSIONING?

4 Benefits of Retro-Commissioning

Retro-commissioning has obvious benefits to facility owners but also some less obvious benefits that are just as easily realized. Retro-commissioning can be narrowed into one of two outcomes: the process can identify an issue that can be easily remedied (low or no cost) or it can identify an issue that requires a higher level of intervention, such as a major repair by a contractor or a full design-bid-build process. The retro-commissioning process should ultimately result in the development of a report that not only identifies the issues but provides recommendations on what should be done to correct them. This output can serve as a detailed basis for RFPs or term contract scopes.

Development of a report that identifies issues and provides recommendations	Outcome One: Identify an issue that can be easily remedied (low or no cost)
	Outcome Two: Identify an issue that requires a higher level of intervention

Regulatory Compliance

Any time human lives are affected by services provided by companies or organizations there are often regulatory bodies in place to ensure that standards are maintained to protect those lives. As such, healthcare facilities are subject to regular inspections to determine if they are compliant. Any facility staff member can agree that the days or weeks when regulatory bodies are scheduled to visit is a high stress time, with much preparation.

Facility staff can only do so much with preventative maintenance and capital upgrade projects to ensure that their systems continue to meet regulatory standards. Hospital environments have Temperature, Humidity, Pressure and Fresh Air requirements which are monitored by the Building Automation System (BAS). Though this data may read correctly and look normal from the user interface, the sensors required to measure these conditions will fall out of calibration over time, which can lead to critical environments falling out of compliance with regulations. Non-compliance

carries repercussions that no facility manager wants to be faced with. Retro-commissioning can be used as a tool to minimize, if not eliminate, non-compliance marks when dealing with building systems. The financial risk associated with infection claims due to non-compliance are extremely costly and can be avoided by ensuring spaces are within compliance. By proactively testing systems ahead of scheduled compliance visits, issues can be detected and addressed ahead of time.

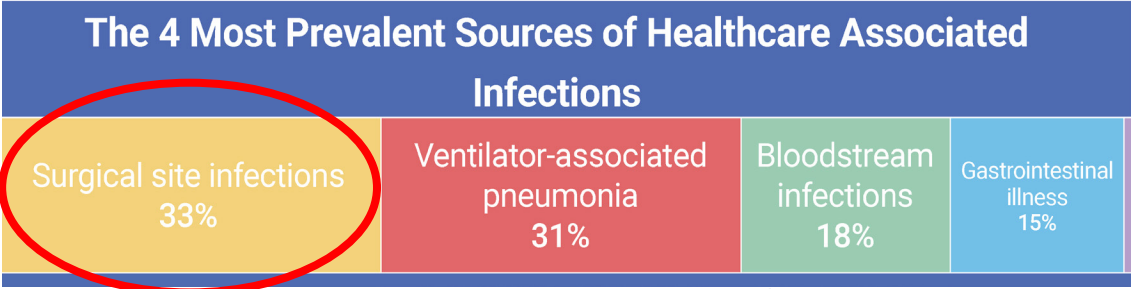


Figure 2: Most Prevalent Sources of HAIs. ¹

Mitigating infection claims also has impacts on the financial health of healthcare organizations. Healthcare providers, like any business, strive to provide satisfaction to their customers. Satisfied customers return to businesses to seek their services. Dissatisfied customers look to other businesses. In today’s world the internet is becoming a primary tool in patients search for healthcare services and the vast amount of data available on it allows them to research metrics such as claims patients file against facilities. By examining the data on hospital acquired infections or other claims against the facility related to building systems, common denominators can be drawn and used to determine the source of issues within facility and remedy them.

Recognizing the financial burden litigation for infection can cost, there are also other forms of financial incentive to maintain spaces that are regulatorily compliant. The Centers for Medicare and Medicaid Services, or CMS, are government entities that provide considerable reimbursements to healthcare organizations. These reimbursements rely heavily on the quality of care and maintenance of a standard level of quality care is required for these heavily relied upon reimbursements to the healthcare organizations. Properly operating systems, adjusted and verified through retro-commissioning, can help to raise the level of care and patient experience that healthcare facilities can provide.

Summary of meta-analysis additional cost estimates

	Studies	Ranges of Estimates	Estimate (95% CI)
Surgical Site Infections	5	\$11,778–\$42,177	\$28,219 (\$18,237–\$38,202)
Ventilator-Associated Pneumonia (VAP)	5	\$19,325–\$80,013	\$47,238 (\$21,890–\$72,587)
Adverse Drug Events (ADE)	2	\$1,277–\$9,062	\$5,746 (-\$3,950–\$15,441)
Central Line-Associated Bloodstream Infections (CLABSI)	7	\$17,896–\$94,879	\$48,108 (\$27,232–\$68,983)

Figure 3: Additional Cost Estimates. ²

Resiliency

In light of the changing climate, natural disasters are at the forefront of many healthcare organization's minds. The recent hurricanes in New York City brought to light many shortcomings in disaster preparedness. Emergency and standby power systems were compromised, and many did not perform as required. Active shooter trainings are now conducted regularly to plan for the unthinkable yet there are many organizations that do not actively exercise their emergency and standby power systems in a full outage simulation scenario. This outage simulation testing demonstrates much more than the one-hour, monthly exercising of the engine that is standard in most of the industry. The outage simulation included in the retro-commissioning process is an "all-hands on deck" exercise that simulates the worst-case scenario of power loss under controlled conditions. If something is found to not perform properly there is the ability to resume normal power and work to address the issue, a luxury not afforded during the worst-case scenario when the emergency and standby power systems are needed most. Peace of mind knowing that systems have been exercised and should perform properly cannot be underestimated.

In the 2012 Hurricane Sandy, Eighty-nine percent of hospitals reported experiencing critical challenges during the storm³, such as:

- electrical failures
- communication failures
- challenges with community collaboration
- patient surge causing lack of patient beds

Maintenance

One of the biggest challenges in operating a facility is ensuring systems are maintained to be able to continue to meet the needs of the occupants and facility as a whole. Preventative maintenance is often focused on replacing filters, fan belts, and similar parts. This could be because it is easy to see when filters need to be replaced or a belt is broken. However, it is not easy to determine when a sensor is out of calibration or has completely failed. Filter technology has not changed much over the years; when a filter needs to be replaced it will have a high pressure drop and visible dirt. Sensors and devices, however, are constantly subject to changing environmental conditions and thus it is almost very difficult to keep up with the maintenance requirements. Since engineers examine these sensors and devices in addition to mechanical parts during the commissioning process issues that require correction can be identified.

Energy Use

Healthcare facilities are often the highest energy users on a square foot basis when compared against the other comparably sized buildings. The high levels of ventilation and often cooler space temperatures result in high HVAC energy use. The retro-commissioning process can uncover systems that are not operating efficiently. In many cases, the retro-commissioning process takes

place on systems that have lacked adequate maintenance for decades. Though that system may have been state of the art when it was installed, technology has made tremendous leaps towards improving energy efficiency of how new systems today operate. Going through the retro-commissioning process provides owners with the opportunity to evaluate new technologies which can be adopted into their existing system to further improve the functionality and efficiency. If efficiency gains are significant enough, there may be an opportunity to evaluate the energy payback and also utility companies may be willing to pitch in some funding. Sometimes this can be the tipping point for a project to move forward.

A prime example of potential large energy gains reside in economizer controls and programming for air handling systems. Economizers are intended to reduce cooling energy usage by bringing in higher amounts of outdoor air when outdoor conditions are suitable to meet space setpoint. Economizers programming is executed through the use of temperature and humidity sensors that compare outdoor conditions as well as the mixing dampers that modulating return and outdoor airflow. All of these components need maintenance and are often overlooked. Improper setpoints can also result in premature or delayed entrance into economizer mode, resulting in unnecessary mechanical heating or cooling. By commissioning the economizer sequences the systems can perform more efficiently and save energy.

A compliant environment can potentially result in increased energy usage. Retro-commissioning of an air handler may show that it is only bringing in one air change per hour of outdoor air. Many healthcare spaces require a minimum of two air changes per hour of outdoor air and so by commissioning the air handler and adjusting it to bring in the minimum required outdoor air, the energy use of the system goes up, but the quality of the space is improved.

Reliable Capital Planning

A complex process that involves staff across many backgrounds, sound capital planning is a crucial component of operating a stable healthcare organization. Staff involved with the financial planning must interact with operations and maintenance personnel as well as capital planning personnel to balance spending on existing facilities and new facilities that are needed to realize the strategic plan of the organization. Operations and maintenance personnel have their lists of equipment or systems that need an infusion of capital to repair, replace or upgrade. This is often based on known issues with systems or equipment based on day to day operations. Retro-commissioning can take this a step further and identify systems that may need attention in the near future. This allows staff to more accurately

“ If efficiency gains are significant enough, there may be an opportunity to evaluate the energy payback and also utility companies may be willing to pitch in some funding.”

prioritize planned capital improvements. Without this, planned improvements often get thrown aside when more pressing needs suddenly appear because something failed without any warning.

Summary

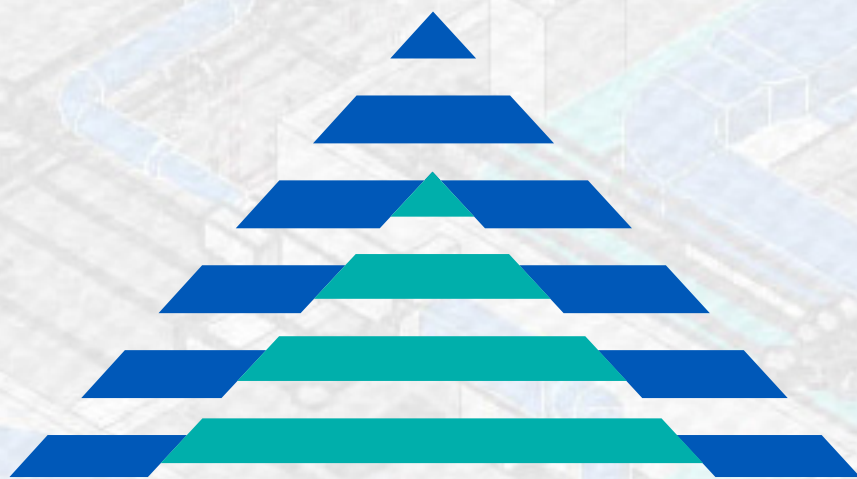
A well-executed retro-commissioning process can be a relatively cheap investment in ensuring regulatory compliance, efficient usage of energy and provide for comfort environments that promote healing. Detailed results from the process can aide in capital planning and inform operating budgets. An effective commissioning team will integrate with all levels of an organization and feel like an extension of an owner's capital and operations team.

END NOTES

¹ Readmissions Due to Hospital-Acquired Conditions (HACs): Multivariate Modeling and Timing of Clinical Presentation Analyses, Draft Final Report, R.D. Miller et. al., CMS Contract No. HHSM-500-2005-00029I, Aug. 2012.

² Summary of meta-analysis additional cost estimates. Agency for Healthcare Research and Quality. Retrieved from www.ahrq.gov/professionals/quality-patient-safety/pfp/haccost2017-results.html.

³ Levinson, Daniel. Department of Health and Human Services. Office of Inspector General. Hospital Emergency Preparedness and Response During Superstorm Sandy, Sept. 2014.



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