The Human Side of Retro-Commissioning

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Synopsis

Optimizing facility energy use requires more than technical solutions to bring about and maintain change. The human component of a building energy system not only affects on-going performance, but can confound Retro-Commissioning (RCx) efforts if *people* are not recognized as part of the energy system and included as part of the operational solution. My colleagues and I have observed several human challenges to RCx efforts that repeat: a building's many stakeholders often have competing motivations for their actions, they are working with incomplete information, they communicate less than perfectly, and they do not have routine procedures in place to retain savings. We have utilized *people processes* to address these issues—establishing a broad spectrum team, discussing objectives and priorities, building relationships, facilitating communications, and assisting with the establishment of new behaviors. The underlying issues, coupled with constructive responses, will be discussed drawing on public sector RCx efforts. Field experiences will be sprinkled in with generalized observations concerning the human side of the physical-mechanical-human system.

About the Author

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More than a Technical Solution

As a retro-commissioning (RCx) service provider, it is easy to assume that retro-commissioning an existing facility is a strictly technical exercise through which we optimize the energy performance of our built environment. This notion derives from seeing the building as a physical-mechanical system. From that perspective, it is easy to draw the conclusion that humans are getting in the way of our idealized operations. We have analyzed the data, applied best practices, and determined how to best achieve adequate comfort with the highest efficiency. We have tweaked the controls and delivered the fine-tuned building specimen.

But then, along come these occupants who live and work in the building, who behave in ways unprescribed in our operational paradigm, in ways that impede optimization: they open the windows while the heat is on; run space heaters in the summer; and even cover air outlets with cardboard! In addition, there are the building operators who ignore equipment alarms; don't keep up with filter changes; over-react to complaints, and override control setpoints rather than solve operational issues due to either heavy workloads, poor training in sophisticated systems, or misconceptions about how systems should work. To top it off, some building administrators believe they can buy their way to optimization with purchases of the latest technologies sporting all the bells and whistles, without considering the integration of these components into the existing facility's systems or the ability of their O&M staff to learn these new systems. Every group can act independently, and often no one gets feedback in the form of utility bills or energy use profiles. It is quite possible that potential performance gains of RCx either will not be established or may quickly evaporate unless we include the human element in our efforts.

Optimizing building performance can be extremely frustrating and indeed futile until we recognize and work with the people as an integral part of a physical-mechanical-human system, and include them as part of the solution. Successful RCx depends on addressing the human side of this multi-faceted system and including all stakeholders in the process. The individuals involved in the life of a building are appropriate, absolutely essential system components, with useful insights and valid concerns about facility operations. Establishing a framework of cooperation, shared ownership, and focused actions is indispensable to the effort to restore and maintain healthy, efficient building operations that will persist.

Overview

My colleagues and I have observed common human factor issues that recur across projects across time. We repeatedly see the following scenario: a building's multiple stakeholders have competing motivational drivers for their actions, they often make decisions based on incomplete information, they communicate less than perfectly, and they do not have routine procedures in place to retain savings. Our attempts to address these RCx challenges include five constructive responses that I call *people processes*:

- Establishing a broad spectrum team,
- Discussing objectives and priorities,
- Building relationships,

- Improving communications, and
- Assisting with the establishment of new behaviors.

Using these processes as an outline for discussion, the underlying issues will be reviewed drawing on several public sector RCx efforts. Field experiences will be sprinkled in with generalized observations that illustrate our themes. We hope our struggles will resonate with others involved in RCx and initiate conversation on how addressing the *people processes* will help achieve and maintain desired results.

1. Establishing the Team

The first people process we have found useful for improved building operations is forming a team. We begin with identification of key players who affect performance outcomes and facilitate their interaction. Establishing a team provides a means of corralling, focusing, and harmonizing disjoint objectives and shrinking gaps in understanding among stakeholders. Team creation includes inviting the assorted stakeholders to participate in the RCx process and provides a forum for exchanging ideas.

Including All the Stakeholders

A multiplicity of players affects a building's energy performance. In addition to the physical and mechanical components, the human players include building owners and administrators, boards of directors, facility operators, and occupants. They can be the key to success or the cause of operational failure. They are the ones talking at the water cooler or board meetings. They are the ones approving purchases or running equipment. They are the ones making physical alterations to the facility. They are the ones that can encourage cooperation amongst each other or sow the seeds of dissent. It is important to recognize that these stakeholders bring a history of experiences and insights that informs their current views as well as shapes their visions and desires for the future. Stakeholders each have their own set of needs and capabilities, as well as level of influence. They represent not only a wealth of ideas and skills, but also a diversity of agendas (such as prioritizing energy reductions over comfort or getting that new green technology at all costs). Without coordination, their actions can be at odds with each other. Since they are already players who influence outcomes, it makes sense to invite all the stakeholders to the game so they can get to know each other, share ideas and learn from each other, and make full use of each other's contributions in order to establish common goals, develop solutions, and gain buy-in to the commissioning program. A full-spectrum stakeholder's team deputizes everyone to serve as additional helpers for monitoring operations, developing solutions, and championing the cause.

Providing a Forum for Idea Exchange

A forum for sharing viewpoints allows people to be heard and acknowledged, have their opinions considered, and their struggles affirmed. Such a forum can go a long way toward developing a sense of unified purpose, building consensus, and generating creative harmonious

solutions. Whether that forum consists of large or small group meetings or workshops, phone or web conferences, periodic status reports, group e-mails or multi-access blogs, all parties benefit from hearing each other's concerns so that they can make informed decisions and act in complementary ways. We have found large group meetings to only be practical in limited numbers, due to the expense of dedicating labor hours to the effort and challenges with stakeholder availability. We primarily use interviews and surveys as tools for framing understandings. Serial one-on-one meetings and email work best for disseminating information. We note that ASHRAE's commissioning guideline finds these methods biased towards the interviewer's preconceived notions and lacking the ideal interactions between user groups.[1] We attempt to keep an open mind.

2. Discussing Objectives, Drivers, and Priorities

The second process to engage the people who affect building operations calls for discussing objectives, drivers, and priorities. This discussion occurs within the larger context of team, which may or may not be a large group setting. Understanding why people do what they do is key to formulating a workable solution for facility operations. This understanding can result from discussion about what people need and want, what their plans are, what drives their decision making, what challenges they face, and how they prioritize. The reasons behind their actions may reveal that some sort of compromise or course adjustment is needed. Their actions may suggest a need for reframing viewpoints or reveal that current technical solutions are insufficient or unsupportable with "business as usual." They may also solidify a commitment to an RCx effort.

I give special attention to the building operators as they hold the strongest influence on success; if they are not sold on proposed changes, facility modifications will not be effective. However, the overall facility culture, that is, the way all the stakeholders think or behave, can significantly impact outcomes.

In general, *objectives* are descriptions of the desired end state such as the achievement of a fully functional, efficient, sustainable facility. *Drivers* are conditions that cause people to act, which may or may not support their objectives. Drivers may include things such as a limited budget, a heavy workload, or insufficient training. Some drivers can directly compete with efficiency efforts and lead people to make less than optimal energy related decisions. Spending time to uncover these drivers can be foundational to operational improvements.

An explanation of documenting objectives in a Current Facility Requirement (CFR) will be followed with supporting ideas for CFR development. This explanation will offer insights on common objectives of user groups, as well as examples of constraining facility issues and avoidance of past unpleasant experience. Several field observations/examples of assorted drivers of stakeholder action will be shared to illustrate the great diversity of reasons why people do

[1] ASHRAE Guideline 0-2005, "The Commissioning Process," p36.

what they do. These observations will be followed with a statement that summarizes the idea of meeting objectives by understanding drivers.

Agreed Upon Objectives (the CFR)

It is useful to formally identify and document the team's objectives for functionality and sustainability within the facility in the form of a Current Facility Requirement (CFR). The CFR defines operational success that the stakeholders will support. At a minimum this requirement details comfort conditions for various activities according to the occupancy schedule. It also may include resolutions of urgent equipment or operational issues, avoidance of previously experienced problems, and movement towards efficiency goals. Scope and budget constrained projects will typically result in less than theoretically optimized energy systems. Although stakeholders may originally voice extensive, idealized objectives, if the methods for achieving and sustaining success prove more costly or time consuming than originally anticipated, or are not easily maintained, a more feasible agenda may emerge that reflects their key priorities.

I find it helpful to recognize that a current facility requirement may be different from original design requirements since the current use of the space may have changed and the original design intents may never have been adequate to meet functional requirements.

Common Patterns of Objectives

Objectives are varied across user groups, but often overlap. However, patterns that repeatedly surface are: building operators strive to reduce occupant complaints and lighten their workload, and often have strong desires for cool gadgets; the building occupants seek comfort and aesthetically-pleasing surroundings that engender happiness and inspiration as well as functionality to enable and improve productivity; and the building administrators want to reduce costs, enhance good will among stakeholders, and support environmental responsibility initiatives. Further, administrators want to have a selection of projects shovel ready for their budgeting cycles.

Constraining Facility Issues

Constraining facility issues that we have encountered include poor Building Automation System (BAS) network reliability, insufficient BAS capabilities, comfort issues, equipment failures, and media leaks. These issues either need to be attended to before other repair and control efforts can be implemented, or if they are not attended to, the project's overall impact will be viewed unfavorably.

As an example of a constraining facility issue, at one school there was only a single building operator who knew how to schedule the equipment in the BAS. There was no redundancy in the scheduling skill set. The BAS did not allow remote access. Since the sole scheduler lived an hour away from work, in order to cover last minute decisions to use the facility on nights or weekends, he ran all systems 24/7. From the building operator's perspective, before he would consider scheduling equipment based on occupancy, he needed a way to change schedules from home. The remote access capability was pressing and prerequisite to equipment scheduling.

Avoidance of Past Unpleasantness

Avoidance of past unpleasant experiences motivates action. At one campus, the facilities operator had an experience that he did not want to repeat. In order to accommodate a request from the utility company to reduce electric load for an anticipated peak, a chiller was turned off for two hours in the afternoon. The facilities operator reported that the building experienced sweating on the floors as the warmer supply air condensed on the already cooled surfaces and required four hours to recover. Since then, he is wary of all equipment setbacks and has been taking off-hour setbacks out of the schedule, especially if he is going to be on vacation and will not be available to respond.

Example Drivers

Some drivers behind the actions of facility operators include heavy workloads, insufficient training, missing documentation, unestablished relationships, competing desires, corporate policy, and culture.

Heavy Workloads

Heavy workloads with multiple duties explain many of the building operators' actions. Depending on the size of the facility and the organizational structure, the HVAC maintenance staff can range from a single individual who is also responsible for the overall facilities and grounds maintenance and therefore, contracts for support; to a team of dedicated controls technicians that can spend hours each day checking equipment schedules and setpoints. In both scenarios, I have found that these hard working building operators are time strapped, they are at capacity, but the jack-of-all-trades more so – in addition to working on the BAS, the solo operator needs to shovel the snow, cut the grass, and oversee the contractors. He is going in several directions and is repeatedly interrupted with calls. He does not have time to think through the equipment operations. Because the solo operator is spread far too thin, he resorts to doing what he knows and doing what is easy, which may well be the decision to set equipment to "manual on" all the time. Because so many things are broken, the hurried operator only has time to attend to the most urgent concerns. Reactive failure maintenance becomes the standard mode of operation.

Insufficient Training

Building operators often have not received formal training on the systems and understandably pride themselves in their self-taught skills. However, their present understanding of systems operation may not be adequate or accurate. We have encountered building operators who do not know how to set schedules in the BAS, how to review trends, check for systems in manual operation, or check equipment alarms as part of their daily routines. Basic BAS training was required to begin investigating systems. At another location, the building operator presented the air compressor for the pneumatic controls as the biggest energy hog in the building. He said that the compressor ran non-stop. We assumed this problem was indicative of significant air leaks in the system. We put a state sensor on the motor and found the compressor was not running non-stop; the duty cycle was only 15%. This operator's perception of the compressor as the major energy consumer did not match reality.

Insufficient Documentation

Many existing building systems have been modified over the years to accommodate changes in functional use and often, to save money, these changes were not fully documented. Systems documentation is frequently spotty or non-existent. Many facility operators have no up-to-date as-built drawings and may not have the applicable equipment manuals. Maintaining systems without a full understanding of them leads to sub-optimal performance. At one location, the only as-builts of the pneumatic controls were hand drawings in the bottom drawer of one technician's desk. No one else was aware of these drawings. It was only after several interactions with the "tech in-the-know" that he let me into the inner circle of knowledge.

Unestablished Relationships

Reservations about working with large companies caused one facilities director to drag his feet. At this facility, there were two proprietary controls networks - one for air handlers, one for unit ventilators. For years, the local staff had limped by with limited interaction with their brand name companies. For our retro-commissioning effort, we needed to work with the controls experts to resolve an assortment of networking issues. The local staff did not know which servicemen to call for help or how to ask for the specific needed skillset and they did not want to.

The "big guys" were perceived as too expensive and the local staff was irritated about being locked into a proprietary system. The websites of the large companies were difficult to navigate. The local staff wanted to do work with the small companies, where they knew the people by name and could call directly and get the same person each time. But these small companies have technicians that do not have access to the proprietary controls systems, so they could not solve the network issues. The local staff was frustrated that the big guys sent out different technicians each time and thus, needed time to learn their system. Because the local staff had personally known technicians who were reprimanded by their companies for being repeatedly requested by name, they were hesitant to insist on a specific tech in deference to the brotherhood of technicians everywhere.

For retro-commissioning, we needed a very specific guy, the automation specialist—not just any equipment technician—and we needed the same automation specialist every time as we dug into understanding the system. What is more, we needed two controls experts from the two brand name companies at the same time, more than one time, to do the necessary end to end checks. Once we established who to call for controls service and how to ask for the needed controls help, good things happened. Over time, the local staff did warm up to the large company technicians as they got to know them as people and observed their keen and necessary expertise.

Competing Desires

At one school, a computer lab aide submitted repeated comfort complaints for overheating in her classroom. The lab was an interior room with no outside windows. To get fresh, cooler air the lab aide tunneled to the outside with a series of propped doors and fans running between the rooms. We observed that the numerous computers and monitors operated in the space 24/7 and were a prime heat source. Temperature data showed that temperatures in the space were highest in the middle of the night when the space temperatures were supposedly set back. The aide explained that she could not turn off the computers because she did not have time during her

twenty minute prep period to boot up and log in to each computer individually. In addition, IT did not want her to turn them off; they needed to push out updates during the night. Further, IT did not want to enact updates on startups as that would cut into teachers' lesson time. Most importantly, the aide had a solution in mind: a separate air conditioner to cool away all this heat that was being generated. The aide and the IT folks thought they wanted the computers on all the time to meet their needs. Running the PCs 24/7 led to overheating that the facilities folks were asked to remedy. Additionally, continual operations caused unnecessary power consumption. The desire to leave equipment on competed with the desire to avoid overheating.

Policy and Priorities

I worked at a large campus where the facilities director set a policy of "If it's not broke, don't fix it." And the definition of *broke* was "totally inoperative." So when a relief valve on a steam boiler failed open and the boiler was spewing steam into the mechanical room, it was not broke, the boiler still provided heat to the building. This policy challenged our efforts to show energy savings at the facility while we were running a sauna. When I repeatedly lobbied for making the relief valve a top priority, the facilities director let me know that his top priority was repairing the numerous potholes in campus streets; the safe travel of the people on campus streets was a higher priority than eliminating the sauna. The facilities director had to make a call about use of his staff's limited time and resources.

Culture

At one dormitory, they got repeated calls for more heat in the building. Our temperature sensors in the space indicated that the building was quite warm, in the upper 70s. When we went to the meet the person who submitted the comfort complaints, we found him dressed in shorts, no shirt, no shoes, even though it was winter in a cold climate. It turns out that the dorm resident was from the South and because he was acclimated to much warmer temperatures, had habits of dressing lightly. His culture was undermining our grand plan to reduce temperature settings in the space.

Meeting Objectives by Understanding Drivers

The motivations for stakeholder action are varied. Thoughtful review of the full context of the building energy system—including the history, mindset, and desires of the stakeholders—facilitates influencing and moving the culture of the building to a new equilibrium with higher energy performance. By meeting people where they are, we are appropriately positioned to nudge them to where they want to be in a way that they can feel comfortable and accept.

3. Building Relationships

The third process for acknowledging the human side of RCx is building relationships. Not as an industrial psychologist, but as an average engineer and fellow human, I will share my take on some important features of relationship building. I hope to provoke discussion on approaches to the human factors in RCx, the business side of RCx, as a means of achieving lasting benefits.

Building trusting relationships with the stakeholders is one of the most rewarding parts of a retro-commissioning effort. It is about getting to know each other, enjoying each other, and learning to work together in a constructive fashion. It is about having fun by solving a problem together. It is about learning how to help people help themselves and move toward a more sustainable world.

Much to an engineer's dismay, people are not data chips that can be probed and analyzed—they are complex intelligent beings. People will not share their real concerns, and the real obstacles to energy performance until they trust that you will do them no harm, have something of value to offer, and will not waste their time. People will not act on recommendations unless they believe you are suggesting prudent changes, with accurate calculations, and have their best interests in mind.

I offer three rules of engagement that I have found useful in relationship building: assume a constructive viewpoint, read the non-verbal communications, and employ positive framing for desired results.

Assume a Constructive Viewpoint

Even if I show up smiling with outstretched hand, it is not uncommon to find building operators who are guarded when we first meet. Often these reserved individuals are concerned that I have come to find fault with their efforts, to expose their ignorance, to potentially make them look bad, or change out their system without their permission and replace it with something excessively complicated, and leave them with a system they need to learn without adequate staff, or time, or training. Mindful of these possible barriers to our budding relationships, I approach my interactions with facility stakeholders, my "client-teammates," with the underlying intentions of being respectful, non-threatening, and helpful. I find that when I adopt this constructive mindset, supporting actions flow naturally from my attitude. My intention drives my action.

Showing Respect

My idealized vision of relationships, although not fully attainable, steers my efforts. I try to convey respect for clients through actions that reflect my underlying attitude. I spend time with them, listen to them, and strive to be attentive to their concerns. I recognize that they know a lot about their facility and I want to learn from them. Aware that their time is valuable, I prepare for our interactions. I try to be reliable: I make every effort to do what I say I will do and follow through on my commitments to them—from showing up on time, to getting them information in the promised time frame, to returning borrowed items. I usually clean up after myself by clearing out any temporary instruments. I use multiple modes of appreciating clients from smiles and compliments to letters of appreciation copied to their boss. I attempt to give them my best and assume they are doing the same. And try as I might, I stumble regularly, so then I apologize.

Being Non-threatening

In response to the defensive posture encountered with building operators, keeping what they know or do not know private, and protecting what they have, I try to establish that I am safe, approachable, and human.

Hand Holder, Not Finger Pointer

I try to let them know, through our assorted conversations, that I am a hand holder, not a finger pointer. I am not interested in exposing ignorance, but promoting understanding, and formulating stakeholder consensus. What the building operators know right now is sufficient to be helpful to me. I have no intention of embarrassing them. Of course, no one knows everything. We are all multi-tasking and working within time and cost constraints. Further, we all have differing experiences and understandings which can shed light on pertinent solutions. I will not be a tattle tale. Any uncovered operational errors/issues will be addressed together in order to develop potential solutions. I aim to facilitate, not find fault.

Physician, Not Cop

At times we are perceived as "Btu cops" who hand out citations for energy waste. In fact, our objective is not to slap hands, but to together build better building energy systems, which are, after all, human-mechanical systems. Human are not a virus on the system and a cause of problems, they are part of the system. We are not "building cops;" we aim to be *building physicians*, interested in promoting, restoring, and maintaining healthy and efficient building operations.

No Power Plays

To address the apprehension over needless changes and unwarranted added system complexity, I tell my clients that I will take their concerns about changes seriously. I will not foist my solution upon them, I will keep iterating with them until we find a solution that satisfies them. I want to help a client improve their processes in a manner that support their values.

Complexity of Issues

To set operators at ease, I acknowledge the complexity of issues and reassure them that it is ok that they do not know with phrases such as "that's quite understandable," "it sure looked like [their misunderstanding]." I tell them anecdotes that illustrate that "even the experts don't know it all" and how we have to explore together. I point out the routine nature of issues with "it happens all the time."

I'm Human, Too

I will dare to look stupid as a means of promoting easy discussion. As we are discovering a system together, I may suggest an alternate interpretation in a non-challenging way such as "I could be wrong, but I'm thinking this is how it works…" "I was reading that this equipment is called an *X* and that typically, this is how it works…." "It appears to me that…" I ask lots of questions to gently extract information that individuals might not even know that they have: "How does this work?" "Can you help me understand?" "Could it work this way?" "What would happen if we tried this?" "What do you think?"

Since many troubleshooting exercises are evolutions of understanding, it is easy to point out my own mistakes or early understandings that were changed with additional information and study. I believe this makes me more approachable. As an example, at one location when I saw that the electric phase analyzer showed a phase that was zero, I wondered if there could possibly be a phase down. The facility had experienced a compressor motor burn out and currently had thirty motors in alarm. There was data that supported a potential phase issue. As it turns out, the current transformer for the phase analyzer was incorrectly placed on the ground leg and the thirty motors had sensors for motor current that were out of calibration.

Being Helpful

I strive to help my clients get what they want and need. Often, that involves securing additional information with document review or web research, and checking with skilled colleagues. For example, if the chiller throws an alarm, I look up potential causes in the manual. If a building operator's description of systems is not clear, I check with people who are familiar with similar systems to help us determine what we are seeing and hearing.

RCx offers across-the-board help to building stakeholders. Pointing out the support provided through the RCx effort can strengthen relationships. We help the facility operators do their job better. We help them get their complaint calls down. With our detailed analysis of data, we find failed equipment and less-than-optimal controls strategies. This knowledge then focuses their limited time towards making changes that make a difference such as replace this sensor, check that actuator, try this setpoint. This assistance frees them up to attend to their overflowing to-do list. We help the financial officers get the utility bills down. We help the building occupants feel more comfortable.

What is important is that the client is integrally involved all along the way. We do not do something to them, we do something with them. We get their buy-in before information goes into the report. We make use of their insights; we factor in their concerns and desire to formulate solutions that they want and that they can live with.

Read the Non-Verbal Communications

In the midst of all this apparently naïve optimism, I recognize that all systems are not aligned to promote joy, happiness, and mutual cooperation. There is more happening than people are willing to admit. Life has subtext. People bring their personalities and egos to their actions. There are assorted interpersonal games taking place. Some individuals are driven by desires for power, or glory, or profit, or even revenge. Others are apathetic and just want to be left alone. Some may quit, change jobs, or retire during the RCx effort. Over time, I try to make sense of what is going on by gathering information, analyzing what I observe, and making judgments on the undiscussed issues.

People are dealing with their personal lives at the same time they are attempting to contribute to their professional lives. Health, financial concerns, and family tensions may mean that people come to work tired, are unable to attend or unproductive. Recognizing that I have no idea about the challenges they are facing, I try to be gentle with those with whom I am working.

Additionally, it is helpful to recognize that many facility guys are not big talkers. I have even found campus controls guys who do not routinely use email and do not carry a cell phone, only a pager. At one facility it was three years before I heard the words "Thank you." But the facility director's actions spoke louder than his words as he implemented $100k in my recommended projects. Although he rarely responded to my emails and only returned my calls when I specifically asked him to call me, when we got together it was clear that he had studied the documents and messages I had sent him. The fact that he gave me his time when I visited showed me that he felt it was worth his while.

Employ Positive Framing for Results

At times I get annoyed and surmise that the folks I am working with are not using common sense (at least not my version of it), or I wonder if they are trying to get away with something or throw their weight around. But regardless of any perception I may have of less than ideal actions or less than noble motivations, when I discuss issues with my clients, I choose to frame activities with the supposition that the people involved are really doing the best they know how, are well intentioned, and mean to help. This perspective helps me release any irritation and I act more constructively. Consequently, clients usually respond positively. I do not attack them and force them to defend themselves. I give us all a way to save face by suggesting a benign explanation for conflict, typically a misunderstanding or incomplete communications. Often I suggest a desired response to move us toward our shared ideals.

The Missing Central Station

I deemed a particular debacle at one facility as a failure of communications. I believe the positive framing of the incident maintained cordial relations and allowed us to move the project forward. I had what I considered a solid understanding with the IT guy. I had recommended a new central computer station for a BAS at our on-site meeting. In a follow-up string of group emails, we discussed hardware and software choices as well as timing for a purchase decision that would take place in the next month. The RCx team was presently deeply involved in BAS intensive activities: troubleshooting some systems, optimizing controls of others, logging data on everything, and upgrading graphical interfaces. The facilities operators, controls contractor, and the analysis team were all accessing the BAS multiple times a day through remote desktop connections that the IT folks had set up for us. The central station was the single connection port between us and the building controls.

When we were unable to connect to the BAS one day, I asked local staff to cycle the power on the central station for me—a process that often reestablished communications. The facility operator discovered the central station missing from the mechanical room and disassembled in the IT office of a remote building. Without telling the team that he had made a decision, the IT guy purchased equipment. He decided to be frugal and not purchase a new computer, but rebuild the old one with an expanded internal disk and new operating system. When the IT guy swapped out the disk on the central station, he apparently did not consider that without a coordinated equipment upgrade with all of us who were using the system, he would disable our access and halt our work by removing our interface software. [The controls contractor had the software

disks, but would not be available on-site for weeks.] By swapping out the disk unannounced, the IT staffer stranded our trend data and software upgrades that resided on that old disk.

Originally, I assumed the IT guy had been careless about coordination. I also wondered if there had been a bit of a power play going on; he did not fully implement my recommendation for a completely new computer. Nevertheless, I thanked him for his efforts to help, calmly explained that we were not ready for the unscheduled disk swap and requested that, in order to continue our current efforts, he reinstall the old disk until we could schedule a visit with the controls guy. The IT guy graciously changed back the disk.

Miscommunicated Scope of Work

With another incident, I again played the communications card with good results. When contracted controls tasks were marked "completed" and operational observations showed otherwise, perhaps there was a genuine misunderstanding about the language and the objective. After all, one person had bid the job and another individual completed it. By sharing the data I was viewing, I was able to communicate my concerns about network reliability with data gaps, blacked out panels, and panel failure logs. In the end, the controls guy and I worked very well together and succeeded in establishing a reliable network. We developed a synergistic working relationship that continues.

4. Improving Communication

The fourth people process for RCx tackles communication among stakeholders. Some opportunities for improved communication within an RCx team include bringing everyone to the table, setting up easy computer connections, and clarifying language. These efforts make it easier for people to discuss what is going on, make it simple to connect with each other to discuss, and make sure that during this discussion what is heard is what was meant.

Bringing People Together

I bring multiple contractors together to troubleshoot systems that interact. At one site the facilities operator reported that the effort to get two proprietary controls systems talking to each other was at a stalemate. He had the controls techs out one-at-a-time and each claimed the other system was the hold up, a classic finger-pointing match. I urged that we have both control techs out at the same time to solve the problem. Contrary to the facilities operators expectations, the technicians were happy to work together to achieve the shared goal, a working system. The level of communications that transpires when people are able to hear, see, reflect back and question each other face-to-face is much more thorough and expeditious than indirect communications. Of course, it was important to stay with them and coordinate the site visit, come prepared with data, questions, as well as a sense of humor and optimism. But it worked.

I bring multiple departments on one campus together. More than one facilities services shop did not want to talk with their IT department, which was a separate shop. However, the heat

production from computers is an issue that the facilities folks have to address. I usually start with contacting the IT folks directly, invite them to joint meetings, and loop them in on group emails. I send my site visit notes to everyone who may be potentially interested. Having people sit in the same room at the same time makes people aware of each other and what the other is doing and, as well, fosters a sense of shared purpose and teamwork.

Be the Go-Between

On one job, when it was clear that the controls experts were stumped, I sought out the manufacturer's networking support group and a technology support group. I acted as the go-between for the assorted individuals. I presented the understandings that the individual control techs shared with me one-on-one as if they were my own and took the flak from the senior engineer on the hotline that "clearly, I didn't understand the system" if I was asking these questions and using such inexact language. That is true: I did not understand the system as a controls expert; that's why I was asking for help! We discovered some really important things such as we did not have the appropriate technical support manual for the network. I followed up with phone conferences with all the hotline guys and the local controls guys to discuss technical aspects that no one person fully grasped. Later, I arranged for the hotline guys to stand by as telephone support while we were trouble shooting on site. It turned out that, for many years, the space temperature setbacks had never been enabled because some—but not all—local potentiometers were rendered inoperative when a host BAS assumed control. Months later, the hotline guy contacted me for my site visit notes. And some time later, the networking issue we encountered at this project was repeated elsewhere.

Remote Computer Connections

We work with clients throughout the state of Illinois; most of them are not located right down the block. Although we do spend significant time on site, we spend more time back in the office, analyzing data to identify operational faults. For us, accessing a facility's BAS over the internet is a prerequisite to our offering our state-sponsored services. We try to get that access set up on one of our first visits. I was surprised to find that not all controls contractors have remote access to the systems they service. Once we get the client's control technician's remote desktop connections, our speed in diagnosing increases greatly. A remote desktop connection to the central workstation allows the controls experts to quickly answer many BAS questions while on the phone with us. A shared desktop connection (with tightvnc software) allows the facility operator, the controls contractor, and me to all look at the same screen simultaneously and discuss equipment operating abnormalities or BAS software navigation.

Language Issues

Facility operators and engineers are often not renowned as communicators. They are folks who have self-selected to work with machines or equations. These individuals often feel more comfortable in non-verbal situations. There is opportunity to keep the team pulling in the same direction by clarifying words, distilling words, and supplying words for the efforts.

Homonyms?

In engineering school we pride ourselves in using technical words accurately. And we develop a bit of arrogance about our technical verbal prowess. But the world of facility operators did not go to the same college, and often no college. If we do not carefully listen, reflect back what we hear, and systematically establish what is meant by words that we think are unambiguous, we may well be on the wrong planet in terms of understanding a particular energy system. It takes time and effort to go through this process, but can lead to key understandings.

Here are some ostensibly simple words that carried different meanings for some facility operators I encountered on RCx projects: hot water boiler, primary pump, and midnight. If others are not spending significant time with product literature or enculturated into my office environment, it is easy see how we could get our wires crossed.

I use the expression *hot water boiler* to refer to a piece of equipment that heats and circulates hot water in a liquid state, but it makes perfect sense for a building operator to call a steam boiler a hot water boiler as it boils water to make steam.

A primary pump vs. secondary pump designation has been a tripping point when discussing circulating water in heating or cooling systems. For me, I use the word *primary* on the generation side of an energy system, but to some operators what is *primary* is delivery. It has been helpful to use the terms *boiler loop, chiller loop,* and *building loop* as the modifiers to the word *pump* so we can understand each other.

The use of the term *midnight* has not only caused confusion, but resulted in excess run hours on HVAC systems. There is ambiguity about the day's transition terminology. In our everyday life, if we hear that a merchandise sale ends on *Midnight Saturday*, we expect to be able to shop until the end of Saturday. In the controls world, a day starts at midnight, the zero hour. Because of this confusion in terms, we have seen systems start a day early, at the zero hour of Sunday rather than the zero hour of Monday.

Less is More

We all battle our overflowing email inboxes. RCx requires a lot of back and forth communications with people who classically are not big talkers or readers, but doers. Short, to the point emails that distill information are appreciated. If I can boil questions down to something that can be answered with a "yes" or "no", I have much greater probability of getting a prompt response. If I have more than a few points, I highlight key words in the email, or put the information into a trip report or issues table.

More is More

Often, it is helpful to provide busy clients with language that they can use to describe the RCx efforts to others: to their boss, their board, or their contractors. If I can provide them with the succinct paragraph, the compelling graph, the explanatory bullet points, or scopes of work, they can turn ideas into action.

5. Establishing New Behaviors

The fifth people process for RCx focuses on establishing new behaviors. The objective of RCx is to correct building operational faults and tighten control schemes that allow the client to accumulate savings from these changes for several years to come. We cannot just walk away from a job and expect the savings to stay. We need to put procedures in place that encourage persistence of savings with on-going monitoring, adjusting, and tracking that fits the client and addresses their current skillset and routines.

Coaching Building Operators

If funding allows, coaching the building operators with site-specific insights on maintaining system performance is helpful to fill knowledge gaps. We have provided building operators training for using the BAS; developed "cookbook" operator instruction sets for common tasks such as scheduling and sensor calibration; and demonstrated methods for systems diagnosis such as checking for systems in alarm, sensor readings out of bounds, or equipment in override. We have reviewed with clients how we detected operational faults such as looking for temperature differences across un-energized coils. Sometimes, we have worked through functional testing with them. We have saved trending templates for visualizing operational errors and recommended goals for persistence such as getting and keeping systems out of alarm. We have printed out the BAS Getting Started Guide for them. At times, we have left system diagrams on the BAS desktop and hung them up in the mechanical rooms. In some locations, we have helped the client get energy dashboards in place so they can see energy usage in real time versus weather normalized expectations. We often encourage our clients to get coaching from their controls specialists as well as generalized building operator training.[2]

Requiring Action

It is human nature to choose inaction over action. We have attempted to force a response from certain clients to complete equipment scheduling by setting up base schedules that require the addition of night and weekend activities (such as a volleyball game at a school) to get their space conditioning needs met. They need to get into the BAS and add the equipment schedule to get conditioning for the evening's activity. However, programming vacation schedules involves taking away equipment run times. If those schedule modifications are not made, the equipment still runs while the facility is vacant. Since vacation scheduling does not meet an immediate need, we have seen this activity skipped. To help motivate the client to take action, we calculate the dollar savings of the vacation scheduling activity. At one location, a ten minute effort saved $2,000 for the month.

[2] http://www.boccentral.org/

Centralizing Documents

People leave and change jobs over time. Electronic documents given to one person may be lost during those transitions. Establishing centralized computer locations for documents such as construction documents, equipment manuals, and issues logs ensures access to future employees and allows these files to be a living systems manual.

Ongoing Tracking

To help clients keep track of their progress, we sometimes set them up with accounts in the ENERGY STAR® Portfolio Manager where they can get feedback on building energy performance. We try to keep them on task with periodic status updates on goals achievement. We help them celebrate success with press releases and thank you notes. We make every effort to resolve energy concerns along the way so that they are not sidetracked from their energy goals. We encourage our clients to secure ongoing maintenance on their BAS so they can stay on top of software updates, and identify failed sensors and equipment in a routine fashion before systems errors pile up.

Conclusions

Over the years, I have attempted to improve the energy performance of buildings with technical solutions alone. In many circumstances, the technical solutions are insufficient to achieve and maintain expected performance gains. Unless people are recognized and included as part of the building energy system, their impact can overwhelm technical efforts. I am convinced that to effect real savings that persist, I need to work the human side of the physical-mechanical-human energy system. To help people operate as part of the solution to systems optimization, we need to utilize *people processes*, which include forming a team, discussing objectives and drivers, building relationships, facilitating communications, and assisting in the establishment of new behaviors.

Multiple stakeholders with unique mindsets and skillsets affect building operations and pull in competing ways. To coordinate and harmonize the many disjointed objectives of the people involved in the life of the building, I recommend forming a broad spectrum team as a means of corralling and focusing efforts, and filling in gaps of understanding among stakeholders. By documenting agreed upon objectives in the form of a Current Facility Requirement, stakeholders define the operational success that they are willing to support.

Within the team, discussing objectives, drivers and priorities will uncover why people do what they do and can shed the necessary light on workable solutions. Prime drivers of actions are heavy workloads, lack of building operator site-specific training, comfort issues, and cash flow limitations. A thoughtful review of the full context of the building energy system, including the perspectives and desires of the stakeholders, allows for influencing and moving the culture of the building to a new equilibrium with higher energy performance. By meeting people where they

are, we are appropriately positioned to nudge them to where they want to be, in a way that they are comfortable with and accept.

Developing trusting relationships is essential to obtain a full understanding of drivers and constraints and to convince people to implement recommendations. People will not share their real concerns and the real obstacles to energy performance until they trust that you will do them no harm and that you have something of value to offer. People will not act on recommendations unless they believe you are suggesting prudent changes, with accurate calculations, and have their best interests in mind. Useful methods in relationship building include assuming a constructive viewpoint, reading the nonverbal communication, and framing interactions positively. For me, the constructive viewpoint that drives my actions is that of being respectful, non-threatening, and helpful.

Facilitating communication means offering support so that people can discuss what is happening, so that it is simple to connect with each other to discuss, and so that during that discussion *what is heard is what was meant*. Facilitated communication entails bringing people together, setting up easy computer connections, and clarifying language. Clarifying language involves verifying understandings of words and using words judiciously, both by distilling words to make them more accessible to busy stakeholders and by providing language so that they can describe the RCx efforts to others.

Persistent energy savings does not happen by accident. It requires operator coaching and methods for ongoing tracking and adjustments to ensure performance gains do not evaporate.

Working the human side of RCx is challenging, but also very rewarding. The challenges present another layer of the detective-like work of systems optimization. Addressing the human facilitation component of enhanced systems operations is a fundamental piece of overall energy sustainability.

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