
Research Space

## Strategies for keeping partially occupied facilities operational during renovation

Two steps forward, one step back. It's not a dance; it's a mantra to remind us that sometimes getting to a better place requires going to a worse one for a while. Anyone who has renovated a building knows that it's true. You also know that scaling back or halting production can dampen productivity, disaffect employees, and interrupt work, all of which ultimately delay progress and cost money.


Fortunately, you can control how far back you go before you start heading in the right direction. Detailed planning and precise execution of operational interruptions can avoid costly delays or detrimental impacts on research. It also gives clients a measure of control over the process and the communication about it.

**And when you do it right, you can renovate for months without interrupting operations for more than a few days.**

"The best projects are highly coordinated and expertly executed. The right team can control the process to better minimize disruptions for the client, and the benefits of this will be apparent in the project timeline and budget as well as in employee morale and turnover," says Pat Spoden, an architect with Flad Architects. **"There's always a lot at stake, but research space considerably ups the ante."**

# PBI/ a case study

Spoden refers to the scheduled shut-downs as "planned business interruptions." It's a name that grew out of work with a Fortune 500 company that renovated an old research building.

## / project profile

The existing research building (ERB) was built in the late 1970s in the heart of the client's research campus. By the time the building was 30 years old, it had grown out-of-date and had fallen out of favor with leadership and employees.

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The company had moved all research to newer facilities; however, some vital site services, such as glassware cleaning operations, and some lab operations, including spectroscopy services, remained.

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Also, utilities extended beyond the perimeter of the building to two adjacent, fully operational, research buildings.

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The company wasn't using the ERB optimally, but it was using it and needed to continue doing so during renovation.

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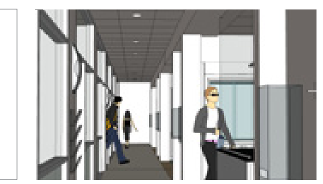
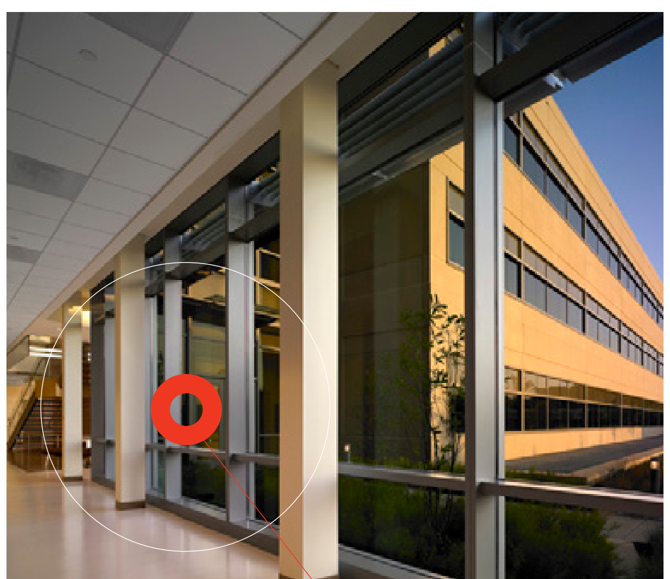


**Obviously, renovating an occupied building presents unique challenges that constructing a new building or renovating a decommissioned building would not. Logistics alone are a challenge, but dust, noise, and vibration are also factors with research facilities. An unexpected power outage or otherwise poorly managed renovation could derail months, sometimes years, of work.**

# There are cases when renovation is the most prudent way to meet business goals

Often the decision boils down to cost – renovation, even considering disrupted operations, is less expensive than new construction. Lab projects must factor in equipment – moving, reassembling, and recalibrating can profoundly alter the economics of construction projects. Other times there simply isn't land available where the company needs or wants it.



NRB and ERB

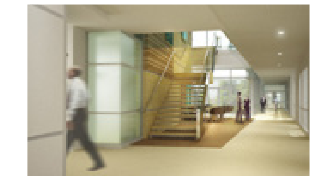
## * The main motivation was location

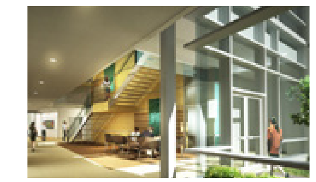
While the building no longer met company standards, its location was desirable. The client had also developed a campus consolidation plan in an effort to optimize its current facilities and to guide future construction and renovation. The company planned a new research building (NRB) next to the existing, which they decided to renovate rather than demolish and reconstruct.

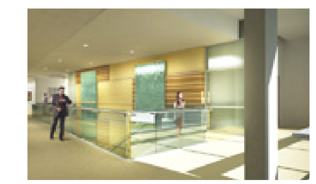
The pre-renovation building was a four-story, 80,000-square-foot lab building with a racetrack hallway configuration and central elevator core. The labs on the second through the fourth floors were on the east and west sides of the building. Embedded private offices and zones of support labs were in the central zone that flanked the elevator core. The first floor was predominantly a support level housing the main mechanical room, loading dock, and miscellaneous lab support functions.

Like many other lab buildings of similar age, the ERB had a lower floor-to-floor height (13'-4") than is used today, and its original layout had frequent vertical risers for lab gases and utilities in a closet configuration along the corridors. These utility closets were so frequent that the hallways were seen as vast series of metal doors interrupted at infrequent intervals by lab entrances. Visual connections from hallways to the exterior were almost nonexistent. This hampered wayfinding and orientation, and there was little natural light.

The client wanted to eliminate the ERB's organizational inefficiencies by developing a space plan and design that would accommodate contemporary research staff needs as well as current industry and company-specific safety guidelines. The company also wanted to build







in some flexibility so that the new labs could accommodate changes in business direction and research initiatives.

The company also had some specific process goals for the phased expansion. Along with minimizing construction impact in order to maintain current lab operations, they sought a "feeling of completeness" for intermediate steps. The company wanted to avoid the sense of temporary relocations during construction in an effort to mitigate negative impact on the staff, as employees can find multiple moves inconvenient or even demoralizing.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# Addressing Challenges

One of the specific challenges of renovating the ERB was addressing the shortfalls in the existing air-handling system. Although the primary mechanical room was on the first floor, the two primary air-handling units (AHUs) were over-taxed. Supplemental units had been added over time, but most were in the secondary mechanical rooms on the fourth floor. Intake air for the first-floor AHUs was pulled down through rooftop intake dog houses.

Renovating the lab necessitated updating the air handling system that could not handle required exchange rates, but the building limited the options. The roof could not structurally accommodate any additional AHUs. The first-floor mechanical room was full and adding AHUs on the remaining floors would steal space from labs.

The solution to the air handling issues was a novel one: It involved a mechanical marriage of the existing to the new. Spoden says Flad's strategy was to provide additional air capacity to the top two floors of the ERB via two new air-handling units housed in a penthouse on the roof of the neighboring NRB. The existing AHUs would be severed from the upper two floors and redeployed to serve only the lower two floors. Supply air from the new penthouse AHUs was dropped down through the abandoned top sections of former supply risers that had previously delivered air from the lower levels of the ERB. Exhaust air was pulled out of the existing building and across the roof of the building connector to a combined heat recovery system on the NRB roof.

It sounds complicated, and it was. Yet it was also the best option, Spoden says, for this building program. "Without this solution, the ERB could never have provided the kind of optimal lab space that the company really desired," he explains. "With its own discreet mechanical system, the ERB would have offered some improved function, but conjoining the air-handling of the ERB and NRB vastly expanded the opportunities and gave the client a better return on their investment."

# 3PBIs

## Maintaining operation during construction

Accomplishing the vast mechanical and design changes while keeping the aging ERB operational was no small task. Success hinged on three highly coordinated planned business interruptions, or PBIs, as the shutdowns came to be known. These PBIs involved a series of highly coordinated moves within the building, early completion of a few key areas, temporary lab swing spaces, and a series of short utility stoppages.

"The PBIs required immense coordination on the part of the entire team," Spoden says. "What we were doing was complicated, and yet we had promised the client that we would not disrupt the research going on in the ERB."

## Schedule

**Flad worked to minimize the PBI number, duration, and cost with careful mapping and capture within construction documents prior to bid. The CD shutdown schedule contained all the information necessary to make the space and systems switchover possible.**

## Details

This schedule clearly delineated the locations on the floors affected by the PBIs, and it then itemized and described the primary steps associated with the change required for each discipline (e.g. mechanical, electrical, or piping). The schedule also provided, in one location, a listing of all affected or referenced pages in the multiple-volume set of drawings. This detailed cross-reference guide clarified the myriad details associated with the defined shutdowns.

## Timelines

The schedule also provided general timeframes for each shutdown, but exact timing was determined with the client as the construction calendar was set. For example, the team executed the first PBI as part of the NRB construction schedule during a seven-day holiday period to minimize impact. The general contractor's scheduling process slated the remaining two PBIs into specific quarters of the two-year ERB renovation timeline. Specific PBI windows were tightened with the selected subcontractors as construction progressed.

## Collaboration

The client's Director and Site Lead says it took intense collaboration of the entire team – the company, the architects, the engineers, and the contractors – not only to plan the PBIs but also to minimize their impact on operations. "What could have been weeks for a shutdown or multiple shutdowns was reduced to three well-planned interruptions that never exceeded three days in duration."

## PBI 1

Spoden agrees that the level of coordination was critical to optimizing the value of each PBI. He points to the first, which required a total power outage for a first-floor lab fit-out. This PBI necessitated a substation shutdown along with installation of breakers and disconnect switches. However, the disconnect switches aided further renovations by allowing isolation of power to specific areas of the building rather than requiring additional complete building shutdowns. Without those switches, it would have been impossible to complete the project with just three, three-day PBIs.

**"The key difference to planning these PBIs was that they required us as a team to think through 'means and methods' beyond what we typically do," Spoden says.** "Generally the documents show design intent, but how to get to the finished product is generally not for us to dictate. Because the owner wanted to schedule these shutdowns to align with the ERB users' schedules and research, the steps required could not be left to chance. We laid out specific sequences of events for the shutdowns and equipment switchovers so that the approach was clear, and we solicited feedback from the construction manager and MEP subs so that the approach was vetted prior to going out to final bid."

## PBI 2&3

The second and third PBIs included various piping demolitions and installations, AHU connections and commissioning, electrical distribution installation, and electrical switchover to new transformers and distribution panels. Along with minimizing shutdowns, the PBI sequencing enabled the team to move building operations into newly renovated spaces before vastly disrupting current ones. That meant that while employees had to endure construction on the ERB building while they worked, few had to spend any significant amount of time with active construction in their specific lab spaces or work areas.

# Nothing Routine

While PBIs are a routine part of sophisticated renovation projects, each PBI is unique and reflects individual facility operations, equipment, and client priorities. The design and construction team must be able to anticipate problems, accommodate client needs, and balance the impact on overall budgets and timelines.

Here, Flad, the client, and the rest of the team optimized the PBI periods (in terms of cost, duration, and number) in part by thoroughly planning and capturing the shutdown processes in construction documents prior to bidding. This enabled Flad, as well as the client, to better predict and manage costs and timelines.

Also, the detailed plans allowed the client to better manage staff expectations and distress during the construction process. The company could communicate planned shutdowns with enough notice – sometimes as much as months – so that researchers could, well in advance, incorporate the PBIs into work and experiment schedules. This empowered staff and gave them a sense of control – something that is a common challenge during construction projects.

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"PBIs are not unique to Flad or this client" Spoden says. "What was unique to this project was the extent of the planning and execution. Our precision allowed us narrow potential PBI windows from months to weeks to days.

**We kept the facility operational during the vast majority of the two-year construction project, and we did it without compromising the final result."**

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