# METHODOLOGY: ASSESSMENT & MAINTENANCE

The assessment phase is in many ways quite similar to data analysis – the goal is to analyze and assess the impacts of experimentation. The key difference is that the purpose of the experimentation data analysis is to determine which strategies or operational adjustments will be kept as part of the overall sustainable preservation strategy, and which ones either need further experimentation or are deemed inappropriate for the preservation environment and/or the system.

Assessment seeks to answer three critical questions concerning the experiment in question:

- Did it accomplish the desired operational or environmental change without putting the collection at risk?
- What is the quantified difference between the original operation and the experimental result?
- Is that difference significant enough to maintain the new operation, or would it benefit from further experimentation?

Each of these builds on the previous. Failure to accomplish the goal, or putting the collection at risk, may mean that the strategy is abandoned or requires further testing. Experimentation and assessment can become a repetitive loop of the optimization process – take the following example:

- Institution A decides to experiment with controlled system shutdowns for ten hours every night in summer, based on occupancy schedules;
- The initial shutdown test fails due to an inability to manage the schedule with the BMS;
- Programming capability is updated, and the shutdown test is repeated;
- The second test shows the shutdown control to be successful, but space temperatures rose by 5°F overnight;
- A third test is conducted using a six-hour shutdown;
- The shutdown control is successful, and space temperatures only varied by 2°F.
- Part of the team is satisfied with the gain, and wants to implement and maintain. Part of the team wants to test an 8-hour shutdown. The 6-hour shutdown is implemented for summer months.
- At the beginning of the winter season, a new test is conducted for a 10-hour time period.

While this is extreme, it illustrates the fact that experimentation can be taken as far as the environmental management team wants to pursue the strategic opportunity. What allows the process to remain practical is that assessment is often much easier than the original data analysis – as long as the team is only experimenting with one operational variable at a time, cause and effect are fairly easy to determine.

Quantification during the assessment phase is critical – it allows the team to communicate their activities in terms that other parts of the organization can appreciate or value. Being able to communicate the impact on both preservation and energy is necessary; achieving an optimal preservation environment means working toward achieving the balanced goals of the best possible preservation at the least possible energy consumption.

Quantifying the preservation impact can happen in various ways. The team may choose to define it by reduction of risk – for example, original RH conditions above 70%, which placed the collection at risk for mold germination, have been corrected and RH is now maintained at 60% or less. Another option is using the IPI's Preservation Metrics, especially when looking at long-term chemical decay. Using Time-Weighted Preservation Index (TWPI) as an indicator can be difficult as it takes into account the entire history of data, and a short-term test (or even an entire year) may not be enough to significantly alter the TWPI metric. However, when quantifying the impact of the change, it is often helpful to compare the relative Preservation Index (PI) of the original versus the adjusted set point conditions. Take this example:

- Original winter set points:
    - 72°F/50% RH PI: 34
- Tested new winter set points:
    - 65°F/35% RH PI: 85
- Increase in seasonal preservation quality: 150%.

Teams may also choose to compare the test performance against a previous period, say the test period versus the same calendar dates from the previous year. The key is understanding that, while the numbers will never be entirely accurate – environments rarely stay at precisely the set point condition, and year-to-year operation can vary significantly – the metrics nonetheless give a sense of the scale of improvement, which is valuable for planning and assessment.

There are also various methods for quantifying energy impact. The simplest may be working with the degrees of work method described in the data analysis section – totaling and comparing the degrees of work performed by a particular operational process before and after the test and expressing the impact as the percentage of work saved. Additional numbers may also be available, depending on the building and the size of the AHU being experimented with, the energy impact of the test may be great enough to show up in the energy meter readings often maintained by the facilities department. Institutions may also pursue actual energy calculations based on altered energy usage at various components. Degrees of work, volumes of air worked on, and amperage consumption over time can be converted to total BTUs, tons of cooling, and kilowatt-hours respectively. Once actual energy rates are known, energy-savings may be converted to actual dollars.

Be aware of how you communicate the potential impact of the altered operation. A common disappointment among energy managers and environmental management teams is that projected monetary impact – especially when experimenting with small AHUs – can be relatively minor, sometimes no more than a few thousand dollars a year, depending on the strategies tested. Depending on the institution, this may either seem like an excellent outcome, or a disappointing result for the amount of effort involved. In practice, and with the goal of sustainable preservation in mind, it is often more useful to express any achievements in terms of percentages. A 40% reduction in energy consumption at the primary AHU that serves the collections environment is a sustainability success regardless of the actual monetary amount, and the environmental management team should take satisfaction from contributing to the overall sustainability goal of the institution.

Assessment of the experiment is only accurate for the time frame in which the test was conducted. For many strategies, including shutdowns, fan speed alterations, and seasonal set point changes, tests will likely need to be conducted seasonally to determine the appropriate operation during hot, cold, humid, or dry weather conditions.

In many cases, once the experiment is conducted for a season, and assessment has confirmed appropriate operation, that control can be repeated from one year to the next, unless mechanical upgrades or architectural renovations occur.

If data review and assessment have shown a particular experiment to be successful, the environmental management team should determine whether the new strategy should become part of the permanent operation of the AHU and space. Optimization is in many ways a cumulative process – successful strategies are adopted, and subsequent tests are performed with the new operation in place. If the strategy is to be kept, two critical actions need to be taken:

- Communicate with the facilities, controls staff, or controls contractors to implement the new operation into the programmed control sequence of the AHU in question.
- If there is a written, plain-language sequence of operation – whether in the original mechanical drawings, in the BMS, or some other source – work with facilities staff to update the sequence of operation record immediately, noting what the changes were and when they were implemented.

Many successful strategies and experiments have been lost operationally because they were never properly documented in the sequence of operation or controls programming. If not documented, subsequent controls upgrades, recommissioning studies, or other efforts may revert the operation of the unit back to a previous or original sequence of operation, without implementing the new strategies.

Once a strategy has been implemented into the permanent sequence of operation, the environmental management team may choose to pursue another improvement or strategy, whether for improvement of preservation or energy purposes (while maintaining preservation quality). That next strategy should be tested with the previously adopted strategy in place – for example, if the team settled on an appropriate shutdown protocol, new experimentation with adjusted fan speeds should be conducted with the shutdown in place. In rare cases, the team may choose to alter a previously adopted strategy in order to accommodate a new test, but generally it is best to build on successful operation.

As discussed in *IPI's Guide to Sustainable Preservation Practices for Managing Storage Environments*, optimization and sustainable preservation are long-term processes, not single-time projects. The formation of an environmental management team should be considered a permanent commitment on the part of the institution, even if its members change over time. Building and mechanical operations also rarely remain exactly the same over time – small building or system adjustments, aging of equipment, and new staff and ideas can all translate to undocumented altered behavior over time. An experiment and operation that was successfully implemented five years ago may easily be lost or changed over time. The long-term role of the environmental management team is to be involved in continuing discussions about system and space upgrades, the implementation of new preservation guidelines based on research, and striving to maintain optimal operation for preservation and energy. This maintenance mode should include ongoing data analysis of collections environments, regular review of AHU controls and set points, periodic analysis of mechanical operation – especially if environmental conditions or energy usage are seen to change – and, as necessary, periodic retesting of various strategies. With the environmental management team in place, institutions should be well-positioned to take these changes in stride, analyzing the impacts, responding appropriately, and experimenting with new operational strategies where necessary.