A Metrics Oriented Approach to Utilities Management

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Executive Summary:

It was a December 2006 report of Steam System Energy Audit Findings that triggered the idea to participate in the CACUBO Best Practices Award Program.
The Purdue Utilities Department used a US DOE qualified Steam Specialist to audit the steam generation system at the Power Plant. A light bulb went off: The three page report by an external review source is the result of an evolving culture over the last ten years that has caused us to manage the operation through metrics, continuous staff improvement and adopt the attitude that Physical Facilities Utilities is a business. The highlight of the report was the finding that Purdue's steam system when compared to best practice operations rated at 89.7% where the national average is 65.1%. Furthermore, the recommendations for potential savings would yield a very modest $17K against a $11 million dollar Fuels & Purchased Energy budget.

The results for the steam distribution system audit are an echo of the level of excellence and productivity that has been sought throughout the Heat & Power Plant and Utilities Distribution department.

How does an organization arrive at this level of proficiency? While metrics had always been a component of management, it was the renewed effort that came about as a result of a new University President in 2000. The efforts to provide regular and meaningful metrics were considerable, but the outcomes have mirrored the efforts. Periodic reports became monthly, and operational reports became weekly and even daily, as in the case of the Utilities Commodity Delivery Report, which gives the pulse of plant operations.

Components that resulted from the quest for metrics included:

- A programmed preventative maintenance program
- Dedication to a long range major maintenance plan.
- Fine tuning of staff development through the Milestone training program.
- A more timely communication of fiscal impact based on energy issues.

Purdue was blessed with a Power Plant designed fifty years earlier to take advantage of co-generation. This forethought manifests itself in having the lowest energy cost/student when compared to other Big Ten institutions.

Introduction of the Organization:

History: Founded in 1869 and named after benefactor John Purdue, Purdue University began its journey with six instructors, 39 students and a mission to provide agriculture and mechanic arts education. Purdue is the land-grant University for the state of Indiana.

Student Body/Faculty and Staff: West Lafayette enrollment of 38,712 students (fall 2005); students from 50 states and 130 countries. The West Lafayette main campus is comprised of approximately 14,966 faculty and staff.

Location: Main campus in West Lafayette, Indiana (126 miles southeast of Chicago, 65 miles north of Indianapolis). The statewide university system includes five campuses and numerous teaching and research sites.

Athletics: Member of Big Ten Conference.

The Utilities Department: Purdue University has a power plant equipped with four boilers, three generators and a core of nine chillers. The plant provides 100% of steam (for heating and equipment power) to campus, about 55% of electricity on a regular basis, 100% of cooling and heat. Steam is produced by the combustion of coal, natural gas, and fuel oil in the plant boilers.

A staff of sixty eight full time Heat & Power employees provides 24 by 365 efforts to keep the plant in production for Purdue. A seven person engineering staff provides support to the plant and Utilities distribution for major project implementation. The Utilities Operations staff of thirty manage and provide distribution of steam, chilled water, potable water, high voltage electric as well as collection of waste water to all of West Lafayette campus.

Problem/Initiative:

A new University president in 2000 introduced a more intense requirement for performance reporting. This initiative of regular metrics reporting drove home the idea that measured performance recognizes and stimulates greater levels of productivity. More frequent reporting brought about an increased level of refinement in frequency and details of operational communications.

The result of regular measurement has shown itself in a greater movement in plant culture to embrace a business attitude towards utility production and distribution. Armed with a plant that can be flexible in how power is generated, staff is able to pick the best fuel to yield the most cost effective energy product. Computer modeling is the decision tool to support production changes as well as purchased utilities forecasting.

The on-going challenge is now to strive for continuous improvement through benchmarking against outside sources as well as the review of metrics against standards or our own expectations.

In addition to regular review of our own metrics and performance, the Power Plant has also been reviewed by the State of Indiana as part a review to identify activities ripe for outsourcing.

The metrics approach has provided the basis for any major decisions, as well as steering daily operations.

Methodology:

In the spring of 2000, the data collection system for the Power Plant was upgraded with the addition of PI which allows for collection and archiving of data for modeling and reporting purposes. The new system had the benefit to provide a greater level of production detail for operating and management reporting. The advancement in performance data was then matched with increased desktop computing capabilities to systematically provide operational data. As an example, the electric usage is recorded on an hourly basis for comparison against the monthly utility bill, as well as to use as a tool for forecasting peak demand for our electric contract. The system made it practical to have production cost reporting daily, as well as monthly and quarterly.

As one can imagine, once there was data warehoused, there was a steep learning curve and development window to utilize the historical information for projections or to assist with budgeting. This same information was utilized in performance models to generate specific performance standards. The performance models are continually improved to reflect current daily operations and market trends.

In today's computing world, utilizing the data stream from a 24/7 operation would not be an issue in terms of hard drive space, or the speed application manipulation. In 2000 the desktop was still evolving. Desktop system operating speed, while better than ever before, was slow by today's equipment. Looking back, it took time to develop working models, but this was a use of data to assist with future operations or equipment specification.

To speak to the costs of data use, it is a function of trained personnel and properly sized equipment then given direction to create data models to assist with operations or budget forecasting.

Implementation

It is one thing to have volumes of data; it is another thing to make it work for the operation.

Management leadership was required to reinforce the benefits of the increased data. Having the data and knowing how to use it effectively can take small steps to start the run. Understanding the data sources and some of the subsequent interpretations provide many "teachable moments" in working with the daily power plant staff. At the same time, the use of this data would support a decision process to enhance control room technician positions.

The same leadership had the foresight to provide the tools and training and encouragement to take the raw data and build models of use to the plant.

The availability of more refined data also assisted in providing feedback that led to adjustments in the Milestone employee training program. The training could be adjusted to reflect greater operational proficiency. Well-trained employees are then able to support regular maintenance schedules to optimize plant operation, and affect a high level of reliability. And all this supported by the metrics.

Looking back is the easy view of the process. Patience had to be practiced to get to the greater goal of reliable data models as well as reasonable reporting templates.

Benefits:

As a state funded university, the concept of stewardship for the assets of the state comes into play. Driven by metrics, the Utilities department can show its value to the State, and make business decisions that affect the University operating budget in a positive manner. The vision statement for Physical Facilities states: “People are our most important asset; knowledge is their most important tool.” The Power Plant has put this into practice by implementation of a staff development/training program. A Power Plant employee has a career, not a job.

In an era of short funding, having data to model outcomes has provided a management tool in forecasting. While this doesn’t always lead to a desired outcome for the plant or utilities distribution, at least upper management can be warned of warmer building climates in the summer if chillers are not added. In the summer of 2006, there were two days where cooling was curtailed, and for the summer of 2007, there are two new chillers coming on-line.

For the day-to-day operation, the idea that knowledge is valued, that performance is counted and that improvement is continuous and on-going provides a first-class work environment in the Utilities Department.

Retrospect:

If we had it to do over, we would have upgraded the Plant data collection system earlier. The benefits of easily available data on a consistent basis point out how painful it was to limp along with less than automated data collection, or reporting capabilities.

Homegrown systems fill the bill at the time, but there can be a limitation to the ability to meet challenges and grow effectively over time.

Regular formal monthly reporting to upper administration has taken the data review from monthly or weekly to a daily review of performance. This is a good thing in the opportunity for regular feedback on equipment utilization and staff performance.