## Effectively Measuring, Allocating and Managing Campus Wide Utility Costs

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## EXECUTIVE SUMMARY

Bowling Green State University (BGSU), like many colleges and universities, faced a situation of tightening budgets, escalating utility costs and challenges in reducing those expenses in order to free up resources that could be better spent directly on achieving our mission.

As we reviewed the initial situation, we realized that our campus community had no faith in the current utility expense allocation methodology and for good reason. Strewn throughout our original allocation methods were formulas that effectively subsidized the utility consumption of some areas by overcharging other areas. This resulted in business officers and department heads avoiding any investments or behavioral changes that may have lowered utility consumption because either they were not paying the full price for their consumption or they were being charged a fixed amount that would not change regardless of actual use.

Our goal then became “How can we accurately measure utility consumption and allocate accurate costs to departments?” This would give the campus consumer a true reflection of the costs of their utility usage as well as reflect accurate savings from energy and utility saving changes in behavior or as a result of department level investment. Campus wide this would lower our overall utility costs.

The first challenge was in updating and producing accurate utility maps of the campus and the each of 165 facilities. Then identifying, validating and calibrating existing utility meters and working with a civil engineering firm to use industry standard engineering models to replicate utility consumption for those areas not individually metered.

Armed with current maps and accurate utility consumption models of each facility, we could build an accurate and effective allocation matrix based on individual utility use.

The end result was a utility expense allocation matrix that was accepted by all campus stakeholders and has led to departments investing in utility conservation measures that have had a material effect on overall utility expenses. Our Dining operations alone projected and met over a 10% reduction in utility costs through both accurate expense allocation and changes in the behavior that reduced their overall utility usage.

This new approach has been valuable to BGSU and I believe would be valuable to colleges and universities of any size that are currently struggling with accurately measuring energy usage and harnessing campus stakeholders to collectively engage in behaviors designed to reduce utility consumption.

In the end, we can only truly manage what we can measure and freeing up resources spent on utilities for other activities directly tied to your schools mission is enormously valuable.

**INTRODUCTION OF THE ORGANIZATION**

Bowling Green State University (BGSU) is a large public doctoral university whose main campus is located in Bowling Green, Ohio. Coupled with its regional campus in Huron, Ohio, BGSU has a student population of more than 20,000 pursuing over 200 undergraduate majors, 54 master and 17 doctoral degree programs.

With over 165 facilities on a 1338 acre campus, BGSU prides itself on a friendly and welcoming environment for students and faculty originating from all fifty United States and over 70 countries.

## STATEMENT OF PROBLEM/INITIATIVE

BGSU has an average utility budget of almost $16 million dollars and which has been steadily increasing year over year. Historical attempts to introduce energy conservation measures and change campus behavior in a manner that would lead to stable if not declining utility costs had proven challenging, even when initially embraced due to a reluctance on the part of budget administrators to accept that changes in their use of utilities would be accurately reflected in their budgets.

A review of the underlying reasons as to why past utility conservation efforts had not led to meaningful change, revealed a broad mistrust across the campus community with regards to how utility expenses were being charged to departments and auxiliaries. There were numerous examples provided that showed that some facilities had utilities that they were not being charged for or were being charged amounts well in excess of their actual usage. A review of the allocation methodology revealed that numerous utility expenses were generated by formulas which had adjustment factors to increase or decrease the calculated expense that could not be supported by known issues that would have affected usage. For example, we found that the Student Union was being charged for steam use based upon a meter reading that was then multiplied by 150% without any supporting documentation as to why the markup was added to the meter reading.

The result of inaccurately measuring utility consumption and passing on the related costs, meant that there was little incentive for campus stakeholders to either invest in utility conservation projects or work on changing their collective behaviors. For example our Student Recreation Center had a large indoor pool and showering facilities, yet paid no water expenses. Therefore they had no incentive to reduce water use. On the other hand, the Student Union mentioned above had almost no opportunity to reduce their steam bill as not only was the amount consumed charged to them at 150% but a review of the utility maps indicated that the meter being assigned to them actually fed steam to downstream residential units that the Student Union had no control over.

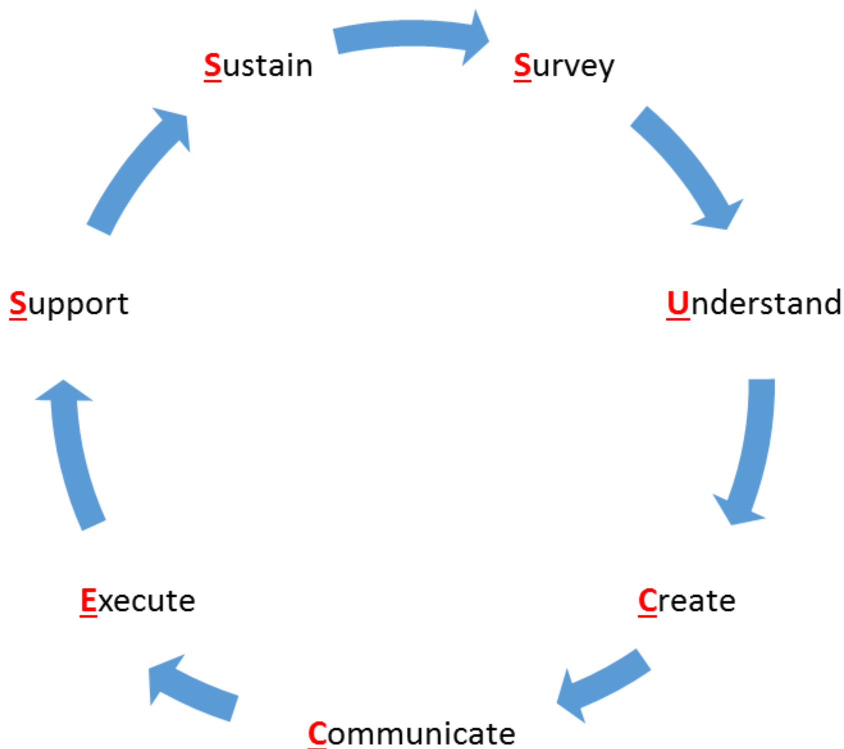
As a result I was tasked with developing a project to accurately measure utility consumption and develop an allocation matrix that would assign accurate utility expenses to departments. This was to be accomplished in a manner that engaged all stakeholders and gained both their support for the project as well as its final form.

**Design**

The first step in the process is to assemble a representative group of campus stakeholders to provide a Steering Committee. This should include representatives from Auxiliaries, Facility or Plant Operations, Campus Projects (or the department that oversees new construction), Finance & Accounting and an independent civil engineer versed in utility consumption and energy models.

The importance of including relevant stakeholders at the outset cannot be stressed enough. It is critical for campus wide acceptance of an expense allocation method that ultimately will directly affect budgets throughout your institution.

Once the Steering Committee is established with a single Project Manager, I then began to progress through the SUCCESS project management process model beginning with the Surveying step:



The Surveying step begins as you gather the Steering Committee together to discuss the desired end state of the project which is:

Measure & Allocate Utilities in a way that:

1. Makes Sense
2. Is accurate*
3. Changes Campus Behavior

You will also at this point describe the four (4) potential outcomes with regard to what utilities will be metered and which will be modelled. For each possible outcome I have listed the pros and cons:

1. No allocation and only measurement is by the local utility
    - Pros: Dead simple, minimal arguments
    - Cons: No allocation, impossible to challenge behaviors.
2. Allocate utilities based on square footage.
    - Pros: Still pretty simple, at least we are allocating utilities.
    - Cons: Accuracy is open to debate, still fairly hard to challenge behaviors. This option does not take into account building use, insulation factors, etc.
3. Meter Everything
    - Pros: Very accurate, very easy to challenge behaviors
    - Cons: Complex and costly system, required meter maintenance and calibration schedule. Meter replacement costs may be prohibitive.
4. Utilize a combination of meters and "predictive" allocation model
    - Pros: Good accuracy, lower financial threshold, allows university to grow, forces buy-in from various groups.
    - Cons: Accuracy is not perfect, time required to construct and implement.

During the surveying stage you will want to have issued a Request for Proposal for any expert assistance that may be needed. In our case we needed to contract with a firm that could provide technical guidance on: metering systems, remotely read meter integration, and both energy and utility modelling software.

We next gathered all relevant data:

1. Utility maps of the campus as well as of each facility for each type of utility (electrical, water, sewer, gas and steam maps).
2. Utility bills that listed meter numbers.
3. The current allocation spreadsheet.
4. A list of university installed meters that our physical plant maintenance staff were aware of.

Then we proceeded to the Understand phase where we asked the civil engineer to review the utility maps and meter listings and interview our maintenance and capital projects (construction) staff on the accuracy of our utility maps as compared to observations made around campus.

Each facility was reviewed with maintenance and campus construction employees as well as the affected building manager or stakeholders. As a result we found that almost all utility maps more than five (5) years old had missing information or had information that had since been changed. We found that new construction or remodeling frequently tapped into existing utility lines without updating relevant utility maps. We also found that we had meters on campus that were not on the utility maps as well as meters indicated on utility maps that no longer existed. There were also various versions of utility maps found for single facilities and we would need to determine which was the most current or accurate.

This phase resulted in a large number of meetings, but identifying your knowledge gap is critical to the overall success.

Once we knew what we had and more importantly what we did not have, we moved into the Create phase where we developed our action plan and cost of our approach.

This phase is where you decide what you can do internally based on your available resources as opposed to what you must contract out.

The following areas need to be part of the action plan:

1. Walking the “field” and physically verifying existing meters against the utility maps. This task requires visiting each facility and locating the relevant meters and what the metered lines feed.
2. Updating the utility maps – will you use your staff to bring the maps current or outsource? The input for the changes is the output from walking the field.
3. Meter integrity check – are the meters found in working condition? Date of last calibration? Obtain meter numbers and note the coordinates of the meter for future purposes.
4. Building use and for mixed use facilities, develop a narrative or outline of what portions of the facility are assigned to what uses. For example you may have a book store in a building that also has dining facilities and classrooms. Each of those are generally assigned to different budgets and have very different utility consumption rates.

5. Who will run the utility consumption models? This will need done by an engineer to take all situations into account.

Next we made sure to communicate our final plan of action to senior University offials as well as to all stakeholders to allow concerns to be brought up and addressed. This step helps continue the buy-in process needed from campus stakeholders.

The next step was the Execute phase where we did the following:

- Validate information
    - Walking the buildings
    - Work with maintenance staff
- Run utility consumption models to fill gaps
    - Trane Trace, **Carrier HAP**, eQuest, etc. – these are various energy models that may be used. They will use the following data:
    - Use "typical" weather data to generate predictive utility usage.
    - Utility usage vs weather
    - Electricity increases with temperature = cooling.
    - Natural gas/oil/electricity increases as the temperature drops = heating
    - Create mathematical formula to predict usage
    - Determine base utility usage
    - Determine how weather influences usage
    - Square Footage
    - These models will be run multiple times to obtain the cooling and heating rates.
- Build allocation matrix
    - Use actual meter readings in the allocation matrix where possible.
    - Electric: (Base Rate + Cooling Rate * CDD) * Square Footage
    - Steam & Gas: (Heating Rate * HDD) * Square Footage
    - Water: (Square Footage/Occupancy Load) * Usage Factor * 30 * 0.00134
    - Ensure ease of user modification for future changes
    - Incorporate average monthly temperature and the number of Heating Degree Days (HDD) and Cooling Degree Days (CDD) for the subject location.

We then moved into the Support phase whereby we brought in all affected parties, ran the new model against the last year's monthly usage and talked through how their expenses were calculated and how they are calculated now as well as the economic impact on their budgets.

Because some areas were positively affected and some negatively affected, we chose to spread the financial impact over three years. Each month they would have the actual expense charged trough and then receive either a credit or debit to offset a portion of the expense with the effect being 1/3 of the change in Year 1, 2/3 of the change in Year 2 and the full effect in Year 3.

The final phase of sustaining the project lies in updating the allocation matrix with new meters or removing ones taken off line as well as accommodating new construction.

## IMPLEMENTATION

A good portion of the implementation phase was discussed earlier, however it is important to note that by leveraging your consultants knowledge to assist you in deciding what can be done in-house as opposed to what can be done by them can materially reduce the overall project cost. While my staff knew the facilities inside and out and therefore it was efficient to use our staff to "walk the field" and locate the meters, it was more cost effective after a meter was found to have the consultant's staff determine the effectiveness of the meter and its accuracy.

The idea being to leverage what is in each party's wheelhouse to its best effect.

The entire project took us 12 months from start to finish of which the execution of the plan only took 3 months. We lost a lot of time up front by trying to design a rough action plan and figure out the utility maps ourselves as those that owned the maps were the only party with any in-depth knowledge of the utility mapping process and of course were defending their own work. The next time, I would have brought in independent help far earlier and we could have completed the project in 6 months or less as the independent civil engineer was able to intelligently work through the utility maps and ask the hard questions that needed asked.

## BENEFITS

The real benefit to the project was that it allowed us to accurately measure the actual utility consumption in a facility and by doing so we could charge through the corresponding utility expense. Once campus stakeholders could rely on the amounts being passed through, they then saw the effect of their decisions and investment to reduce waste. Because out budget for utilities is significant, we immediately realized economic benefits.

In particular our Dining Operations alone forecasted and saw an 11.6% decrease in utility costs. Overall the University has seen no overall increase in utility costs even as the cost per unit from those we purchase utilities from has increased.

## RETROSPECT

As noted earlier, I would have engaged an outside, independent voice earlier in the process. We had a significant disagreement in house in the early stages as to whether we would retain an accounting firm or an engineering firm to consult on this project. In the end we settled with an engineering firm and are very grateful that we did.

We would also have saved a lot of time and energy if our utility maps were current. That alone cost us a lot of labor hours in the field tracing utility lines and finding meters.