Tracking Program Performance: A Common Language for Energy Efficiency Program Data

David Lewis, Jonathan Kleinman and Adam Engelman, CLEAResult Consulting

ABSTRACT

With the extraordinary volume of data tracked and reported in energy efficiency programs, a comprehensive data tracking system is central to program success. However, with such diversity in the form, content, and relationships among the data required by both Utility and non-Utility entities, accurate data tracking is one of the biggest challenges facing energy efficiency program administrators today.

Creating a system for tracking, reporting and auditing the data required to run energy efficiency programs is greatly hampered by the inconsistency and at times incongruity of the data. To further compound the issue, there are vast differences between systems used by Administrators. As a result, interface among systems to in order to validate customers and evaluate programs is expensive and time consuming. With the advent of more robust methods for gathering information about customer usage patterns, the need for a common language for energy efficiency is more and more pressing.

In this paper, the Authors describe and present recommended solutions to two of the key data tracking challenges faced by energy efficiency program administrators and implementers. The analysis proposes a common language for energy efficiency data, which will hopefully be shared and adopted industry-wide.

The Importance of Data Tracking Systems

Tracking information about program performance is a key component of energy efficiency program administration. First, an effective system can provide real time information on progress towards meeting program goals. Second it holds pipeline data that allows for adjustment of operations and tracking of market impacts. Third it collects data useful for analysis of program function and Utility. Effective performance data tracking enables:

- Assessment of the cost efficiency of savings,
- Optimization of program operations in real time and
- Improved program design over time.

Topics That This Analysis Will Not Cover

Many topics pertaining to data tracking systems have relevance to program administration. Some of them include:

- Specific functionality that a tracking system should have,
- Difficulty on implementing changes to a data tracking system ,
- Technical protocol and code language specifications.

This paper is not a comprehensive treatment of issues related to data tracking systems. Rather this paper excludes the topics above to focus on problems with data tracking systems that can be impacted or even resolved through data tracking system organizational structure and naming conventions.

Relational Database Introduction

This analysis uses concepts and terminology specific to relational database systems. A disconnect between program designers and IT professionals leads to miscommunication about data structures and relationships. This disconnect reduces the impact effective system design can have on efficient program operations. This analysis does not include a treatment of relational database design principles or definitions of the technology terminology. The References section includes listings for "Data Mining: Concepts and Techniques" (Han, Kamber, & Pei. 2012) and "Master Data Management" (Loshin. 2009) both of which cover relational database principles effectively.

Overview of Data Tracking Challenges and Resolutions

Data Tracking Challenges

Lack of energy efficiency program administration industry standards increases cost and limits program design and analysis. This starts with the lack of evaluation and avoided cost standards and cascades outward. Lack of evaluation standards creates uncertainty in the kind of data that will be required by evaluators. Variation in the time at which data is collected, the source from which it is collected and the level of detail needed creates variation. Finally, the lack of standard program designs means that variations in program approaches lead to variations in system structure and terminology. While there are many topics related to these problems, this analysis will focus on two:

- Complex Relationships Among Identifying Information and
- Changing Program Rules around Complex Measure Data

Data Tracking Resolutions

Setting a common language and relationship structure for energy efficiency program data impacts or solves many of the problems in this analysis. In each topic described here the suggested approach is helpful at an individual program or Utility level. However, the approach recommended is only fully effective if adopted on an industry wide basis. The primary topic areas include:

- Entity Identifier Relationships and
- Measure and Measure Calculation Definition

Complex Relationships among Identifying Entities

Many identifying entities describe a participant, their properties and how a Utility knows who they are. Entity identifiers can include addresses, Utility accounts, meter numbers and other meter identifiers. Eligibility requirements are often based upon historical participation, so the administrators need to know whether participant have received payments or services at that location or other locations. Among these relationships rules must be enforced and operational efficiency must be supported. In order to pay a customer for participating in a Program an Administrator needs a set of information such as:

- Where was the Measure performed?
- Who gets paid or who received the non-cash benefit?
- How does the Utility identify the Participant?
- How does the Utility identify the location at which the measure was performed?

Resolution: Standard Identifier Relationships

In current approaches Utility Account, Location and Premise data are often used as attributes of Account or Contact. This grouping of data limits flexibility. Instead they need to be treated as separate entities. Instead of creating multiple fields on an Account to handle each Utility Account each Utility Account becomes its own unique record with relationships that can be used for reporting and simplification of future data entry.

Standard terms and relationships will facilitate communication with evaluators and among Administrators. For example, under current approaches the address at which a commercial audit is performed can be treated as the address of an Account and can have the Utility Account as an attribute. A data structure in which the address at which the commercial audit is performed is unique allows for one Account to participate in many Programs over time for different Locations. Administrators do not need to create new data records for the Account and reporting on the payments to the Account is centralized. Standard terms and relationships allow for flexibility in adaptation of new program designs, improve reporting capabilities and enable communication.

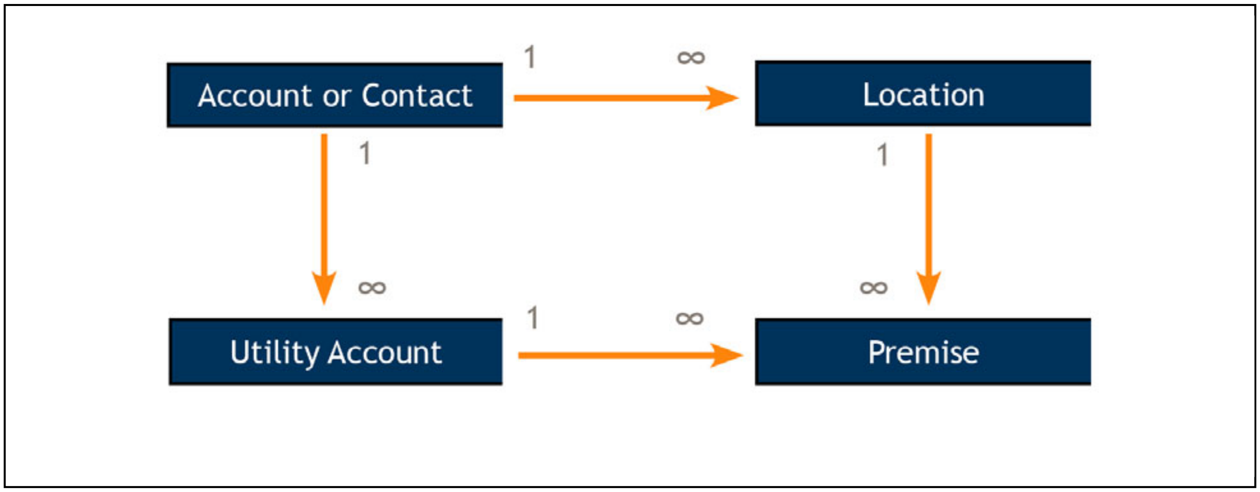
Administrators should adopt five key groups of identifying information and set standard relationships among them. The table below outlines the definition for each term while the figure that follows defines their relationships.

Identifier Definitions

Name	Definition
Account	Business of any type including trade ally, contractor, client, participant and data tracked about them including address, contact information, principal payment contact. An Account may have multiple types.
Contact	Record representing any person. A contact can be a participant, contractor employee, or other type. Includes data such as contact information and tax identifier.
Utility Account	Utility payment identification information for a Utility customer. Contacts and Accounts can have Utility Accounts. Utility Accounts have premises.
Location	Physical Location of apartment, house, building. A location has a premise, which has a Utility account. Contacts and Accounts have locations.
Premise	A meter ID or other unique ID used by a Utility to identify a meter. Such as an EID. A meter has a location.

(CLEAResult. 2012)

Location, Premise, Utility Account Relationship With Contacts and Accounts



(CLEAResult. 2012)

Examples

In a Schools focused Program where a School District is an Account, it has many schools that are potential Project Locations. Each School District and each School has Contacts for Payment, building access, public relation and other purposes. Each Location has many Premises that represent its Utility meters. The premises may be defined by the Utility Meter Number or by another formal ID used to represent the meter. At the same time the School District has multiple Utility Accounts. The data structure must take into account the resulting complexity. For example:

- The Utility Accounts may be tiered and centrally managed or distributed and separately managed.
- A school may have separate Premises for its auditorium, offices and classrooms or it may have one Premise.

In a residential Program a Contact is the person who owns a house. The address of the house is the Location of the Project. The Utility Account and Premise belong to the homeowner. In addition, an Account is a Contractor who receives payment for the Measures installed on behalf of the Contact. The data structure must take into account the resulting complexity. For example:

- Each time a homeowner moves out of a house they might claim an incentive at the new location and be subject to an incentive cap.
- The new owner of the house may not be eligible to earn a new incentive at the location because it was claimed by the previous owner.

Changing Program Rules around Complex Measure Data

The largest variance across program design is in the measures they include. At the same time optimizing program design often requires changing measures. A data structure must enable flexibility while ensuring effective tracking and reporting over time. To further complicate the issue the word measure is used to mean many different things. Measures can refer to technologies or services, they can provide savings of multiple resources such as electricity, natural gas or water), and those savings can persist over varying lengths of time. Jurisdictions use varying parameters to fully characterize a measure. A key goal of data systems in energy efficiency program administration is to:

> "Maintain the flexibility to rebalance portfolio initiatives as needed to achieve the portfolio's goals and objectives. Having the ability to realign programs as needed is critical to being able to effectively manage the portfolio to meet its goals. Management needs to have the leeway to add new programs and program elements, or eliminate or adjust poorly performing existing programs as needed, in order to optimize the portfolio's performance." *(Itron. 2008.* P1-49)

Data systems need to account for the complexity of measure data, the need to change it often and the need to use data for evaluation.

Resolution: Measure Calculation Structure

Administrators should adopt a standard set of measure relationships and terminology. The new set of relationships and terminology provides flexibility while allowing for the many different uses to which the word measure is applied. The key new term is measure calculation. A measure calculation includes the eligibility, savings and incentive value that results from the work on a project. A measure calculation takes into account:

- The base measure and efficient measure,
- Program rules for eligibility, savings and incentive payments and
- Jurisdiction rules around cost effectiveness, impact assessment and evaluation factors.

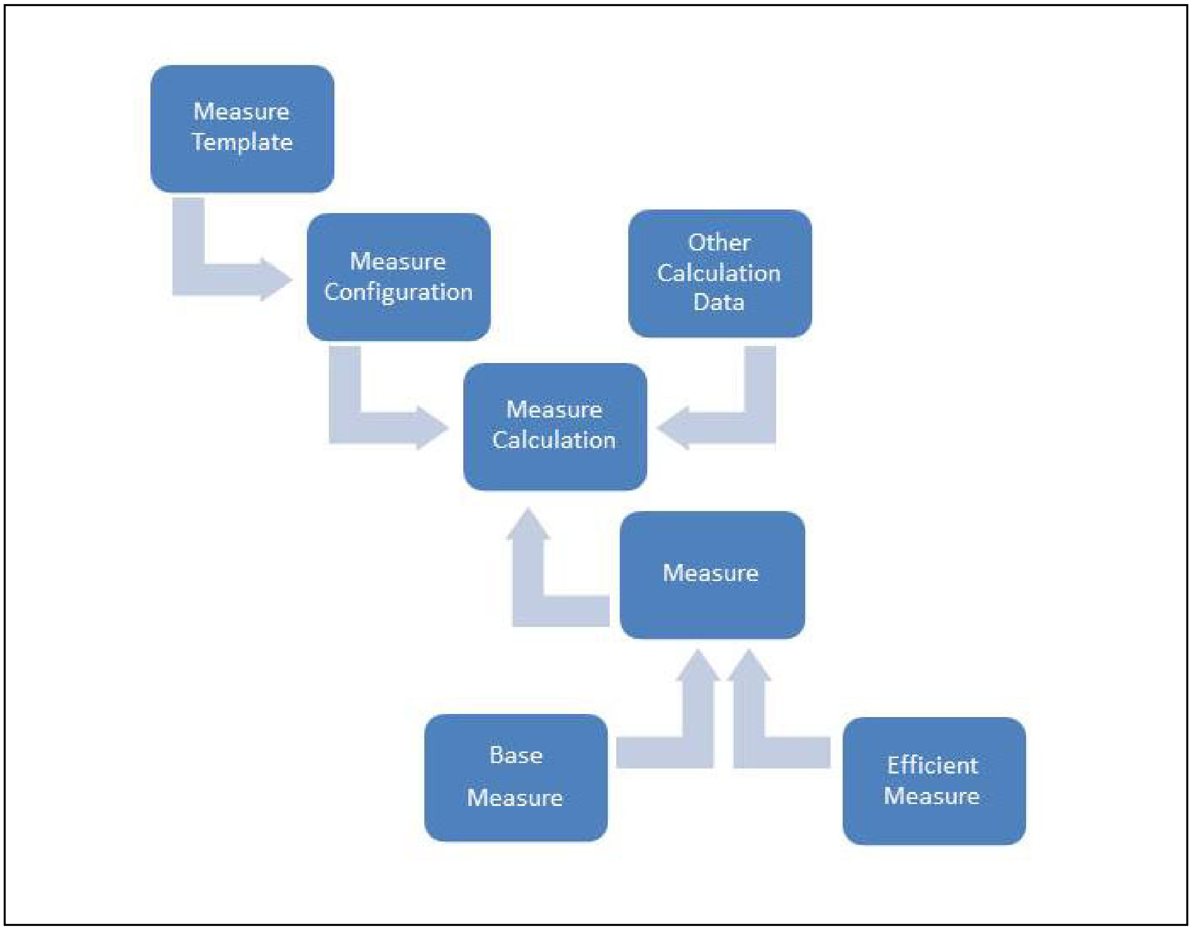
Measure Definitions

Name	Description
Measure	Summary term for either a base measure or efficient measure.
Base Measure	A piece of equipment removed or inventoried while executing a project.
Efficient Measure	A piece of equipment installed or recommended while executing a project. Also a service performed.
Measure Calculation	Calculation of eligibility, savings and incentive value that results from the measures on a project. One project can have many measure calculations. Measure calculations can have zero savings.
Measure Configuration	Set of formulas, lookup tables and data points. Measure calculation data is an input to the measure calculation.
Measure Template	A relationship among measure configurations including common elements, calculations and naming conventions. Savings and incentive performance across Programs, Utilities and States can be compared by aligning measure templates.
Other Calc. Data	Information about the Location, Contact, Account or other Entity that has an impact on the eligibility, savings or incentive calculation.

(CLEAResult. 2012)

The Measure relationship chart below is intended to minimize and standardize use of the word “Measure”. Often “Measure” represents a complex and changing set of information. Instead Measure Calculation should be used to include the product or service, the conditions under which they are performed and the resulting savings and incentive payments. Using this structure allows setting rules and formulas for Measure Calculations through Measure Configurations. This approach allows for inclusion of data about Base and Efficient Measures and does not limit definition of the transaction to the product or service performed. Lastly this structure allows grouping of Measure Configurations together across Energy Efficiency Programs operated by an administrator or across Jurisdictions using Measure Templates. The Measure Templates will serve as a platform for standardization across Energy Efficiency Program Administrators and Evaluators.

Measure Relationship Chart



(CLEAResult. 2012)

Sample Measure Calculation

The concept of a measure calculation as the central point for data about a measure is new and complex. The images below present data that is necessary to define the measure calculation. The example describes a Central AC Replacement. This measure is for the replacement on burn out of an existing residential central AC unit. The baseline is always 13 SEER. The savings are based on the efficiency and size of the unit installed.

The Measure Calculation has three distinct parts: Eligibility, Savings and Incentive. Eligibility in this case is assessed using inputs form the application form. The inputs are highlighted in yellow below followed by the Calculation rules. Next to the Eligibility and Calculation Rules are three Examples showing the Eligibility inputs in yellow.

Sample Measure Calculation – Eligibility

Eligibility		
Inputs Needed for reference from Application form		
SEER of Efficient measure		
EER of Efficient Measure		
Tonnage of Efficient Measure		
Installation Date		
Calculations		**Example:**
		Example 1
Eligible if:		System is 10 tons
		Savings = 0
SEER of new system	> 14	**Example 2**
AND		System is 4 tons
EER of new system	> 11.5	SEER = 15
AND		Therefore move on the check EER
Tonnage	< 5 tons	EER = 11.0 = Fail
AND		Savings = 0
Installation Date is not blank		**Example 3**
		Tonnage = 3.5
Source:Deemed Savings, Installation & Efficiency Standards		SEER = 16
		EER = 12.5
		Installation Date = 1/5/2012
		System is eligible

(CLEAResult. 2012)

Savings in this example take inputs from the application form and reference a set of look-up tables to identify the resulting kW and kWh savings values. Data structures need to be able to accommodate and track changes to the values look-up tables. Look-up references and sources should be incorporated into the data structure for evaluation and program optimization.

The savings inputs are highlighted in yellow below followed by the Calculation rules. The Calculation Rules in this case are limited to the look-up table. Next to the Savings rules is an example showing the inputs in yellow followed by the results from the look-up.

Sample Measure Calculation - Savings

Savings						
Inputs needed from Application form						
SEER of new system						
Tonnage			**Example:**			
Calculations			SEER 16			
Look-up table cross references:			Tonnage = 4			
SEER of new system			kWh Savings =	1,945		
Tonnage			kW Savings =	0.63		
Savings = look up table value						

	Size (in Tons)	14.0-14.5	14.5-14.99 SEER	15 - 15.99 SEER	16-16.99 SEER	17-17.99 SEER	18 and above SEER
kWh Savings	**1.5**	344	485	626	729	1,001	1,068
	2	459	647	834	973	1,335	1,424
	2.5	574	808	1,043	1,216	1,669	1,780
	3	688	970	1,252	1,459	2,003	2,136
	3.5	803	1,132	1,460	1,702	2,337	2,492
	4	918	1,293	1,669	1,945	2,670	2,848
	5	1147	1,616	2,086	2,432	3,338	3,560
	Size (in Tons)	**14.0-14.5**	**14.5-14.99**	**15 - 15.99**	**16-16.99**	**17-17.99**	**18 and above**
kW Savings	1.5	0.13	0.16	0.19	0.24	0.31	0.32
	2	0.17	0.21	0.25	0.31	0.41	0.42
	2.5	0.21	0.26	0.31	0.39	0.52	0.53
	3	0.25	0.31	0.37	0.47	0.62	0.64
	3.5	0.3	0.36	0.43	0.55	0.72	0.74
	4	0.34	0.42	0.49	0.63	0.83	0.85
	5	0.42	0.52	0.62	0.79	1.04	1.06

(CLEAResult. 2012)

The Incentive inputs are highlighted in yellow below followed by the Calculation rules. The Calculation Rules in this case are limited to the look-up table and a limit of Project cost. Next to the Incentive rules is an example showing the inputs in yellow followed by the results from the look-up.

Sample Measure Calculation – Incentive

Incentive Calulation		
Inputs needed from Application form		
SEER of Efficient measure		**Example:**
Tonnage of Efficient Measure		SEER 16
Measure Cost		Tonnage = 4
Calculations		Project Cost = $3000
Look-up table cross references:		Incentive = P26 = $500 < $3000
SEER of Efficient measure		Incentive = $500
Tonnage of Efficient Measure		
Incentive = look up table value		
AND		
Incentive < Project Cost		

Size (in Tons)	14.5-14.99	15 - 15.99	16-16.99	17-17.99	18 and above
1.5	$ 150.00	$ 175.00	$ 200.00	$ 250.00	$ 300.00
2	$ 175.00	$ 225.00	$ 250.00	$ 350.00	$ 375.00
2.5	$ 200.00	$ 275.00	$ 325.00	$ 450.00	$ 475.00
3	$ 250.00	$ 325.00	$ 400.00	$ 525.00	$ 575.00
3.5	$ 300.00	$ 400.00	$ 450.00	$ 625.00	$ 675.00
4	$ 350.00	$ 450.00	$ 500.00	$ 700.00	$ 750.00
5	$ 425.00	$ 550.00	$ 650.00	$ 900.00	$ 950.00

(CLEAResult. 2012)

Example

In Michigan, the Michigan Energy Measures Database (MEMD) is used for Energy Efficiency Program Administration. The MEMD defines a Measure as the combination of a Base Measure, Efficient Measure and the conditions of the installation such as the type of building and the attributes of the building (LARA. 2012). The Data structure used to support this approach requires a new record for every eligible combination. For example installation of a Heat Pump Water Heater from 10 to 50 MBH would include the Base Measure electric water heater, the Efficient Measure heat pump water heater, and data about each water heater. It would also include the hours of building operation, coincidence factor and other data based on facility type. A new Measure in the data structure would exist for each size range of heat pump water heater. The MEMD approach has advantages including that it provides clear, consistent rules for implementation across Utilities and Energy Efficiency Program Administrators. The approach presented in this analysis would separate the attributes of a MEMD Measure into its components. Each MEMD Measure would become a combination of Base Measure, Efficient Measure and Other Calculation Data.

Conclusion

Administrators often make energy efficiency program design decisions without considering the implications of managing program operational data. The authors recommend that administrators not only consider data management when designing the program logic model, but also allow the cost of collecting and managing data to influence the model. This approach requires a recast not just of the database but all of design and operation.

The terminology structure and relationship recommendations made in this paper will streamline and make comparable program operations for many administrators. Aligning structure and relationship will not resolve complex evaluation challenges. However, aligning will make comparisons possible to better inform the analysis, improve cost effectiveness and drive additional energy efficiency.

References

American Society of Heating, Refrigerating and Air-Conditioning Engineers. 2011. *Procedures for Commercial Building Energy Audits*, 2nd Ed. Atlanta.

CLEAResult Consulting. 2012. *Pulse Logic Model (Draft).* Austin.

Energy Center of Wisconsin. 2009. *Energy Efficiency Guidebook for Public Power Communities*. Madison.

Feblowitz, J. 2010. *Making Energy Efficiency Even More Efficient*. Framingham: IDC Energy Insights.

Han, J., Kamber, M., & Pei, J. 2012. *Data Mining: Concepts and Techniques*. Waltham, Massachusetts: Morgan Kaufman Publishers.

Itron, Inc. 2008. *National Energy Efficiency Best Practices Study: Volume P1 - Portfolio Best Practices Report*. Oakland.

LARA Public Service Commission Department of Licensing and Regulatory Affairs. 2012. Michigan Energy Measures Database. http://www.michigan.gov/mpsc/0,1607,7-159-52495_55129---,00.html.

Loshin, D. 2009. *Master Data Management*. Burlington, Mass: Morgan Kaufman Pub.

EE Programs. 2012. Commercial and Industrial Lighting Savings Calculator LSF_2012. http://www.eeprograms.net/docs/LSF_2012.xls.

Richards, L. 2009. *Handling Qualitative Date: A Practical Guide (Second ed.).* Thousand Oaks, Cal.: SAGE Publications, Inc.