Persistence and measure life: Lessons from the next front in measurement and evaluation

John C. Jeppesen and Michael J. King,
Synergic Resources Corporation International

1. SYNOPSIS

This project was a study of research methods in the area of savings persistence, with special focus on issues of effective measure life. Both retrospective and prospective research designs were explored.

2. INTRODUCTION

2.1. Overview

The current research project, entitled the "Effective Measure Life and Other Persistence Issues In DSM Programs Project", was commissioned by the California Conservation Inventory Group (CCIG), a consortium of investor-owned utilities, regulatory agencies and other interested parties; the goal was to conduct a study on how to approach research in the area of savings persistence, with special focus on issues of effective measure life.

The study developed as a response to the need for reliable and accurate predictions of the persistence of program savings and the durability of program measures in demand-side programs. Most agencies have accepted that program savings will decline from initial installation levels due to a combination of natural, operational, and behavioral effects influencing measure savings. Currently, research efforts are focused on determining the significant factors that may limit the effective life of conservation program measures.

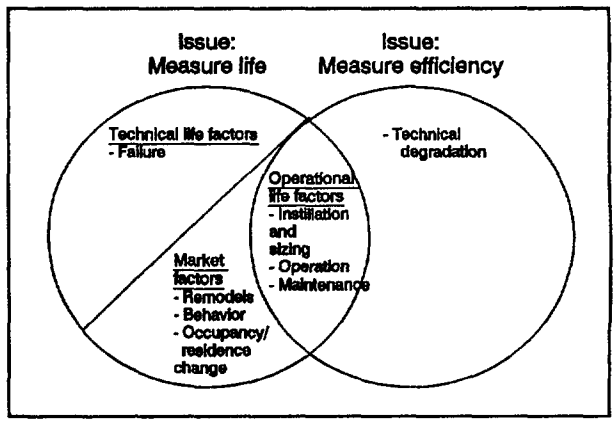

Figure 1. ***Measure-specific savings persistence issues***

First, the study reviewed the current research and reports relevant to the issues of DSM program savings and effective measure lives. Second, with the conceptual framework provided by the literature review, the feasibility of retrospective research on effective measure life (e.g., using post-program records to determine whether the measures were still in place) was investigated. Key issues in this retrospective research included whether program records were "robust" enough to use for examining measure life issues and whether the presence or absence of the measure could be reliably observed, given the information available on each participant. Third, the study explored the specific opportunities for prospective research. In this phase, detailed panel research designs were conceived, discussed and refined.

2.2. Conceptual Framework

A review of current literature on effective measure life and other savings persistence issues produced a refinement of key concepts and an overview of the previous research findings. From these sources, a definition for effective measure life was derived: the length of time over which a DSM measure produces

savings. However, effective measure life is only one influence on savings persistence. The other major influence is technical degradation (decline in efficiency) of the measure. Figure 1 illustrates the factors included in each realm of influence:

2.3. Current Findings

Recent research has addressed selected aspects of savings persistence, but relatively few studies have focussed on effective measure life. Research has highlighted that commercial sector building changes and renovations frequently affect high energy uses such as lighting and heating/air conditioning. Some business types have high renovation and turnover rates, such as restaurants. These changes obviously limit the savings expected from removed or replaced equipment. These studies have only begun to explore major factors limiting commercial measure life.

Post-program commercial sector surveys and site visits discovered significant performance declines and removal rates due to weakness in operation and maintenance. And in the residential sector, studies reveal that customer dissatisfaction is a primary threat to measure life, driving short-term removal rates of 10% - 20% for some conservation measures.

In summary, the following points were made: (1) major factors affecting measure life have been identified but research is in the early stages of development, (2) emphasis is needed on research that provides more accurate estimates for effective measure life, (3) further measure life research should focus on evaluating field impacts of specific conservation measures, and (4) research on declining measure efficiency is also warranted.

3. RESEARCH DESIGN ISSUES

The exploration of how to best design research to study and estimate effective measure life was conducted in two additional phases. The role of retrospective studies (visiting sites on the basis of samples pulled from program records) and prospective studies (forming panels of current program participants and following them through time) were examined.

3.1. Retrospective Research

The retrospective approach was field-tested with both residential and non-residential measures sampled from four large utility's historic program records. Results indicated that (1) program record data is often insufficient, (2) data on participating customers and installed measures is only reliably available where data has been routinely kept in a central computer file, and (3) retrospective research is implicitly time-constrained; measure installation and operation frequently cannot be accurately measured in the ex post facto situation.

3.2. Design of Prospective Studies

Prospective research designs were determined by some key factors. The first factor was the ultimate use of the research findings. The research results may be used in the calculations of DSM achievements, demand-side forecasting adjustments, and shareholder earnings. In addition, findings will be used to guide DSM program designs and planning priorities. Given these important uses, the accuracy of measure life estimates and an understanding of the influence of causal factors on measure life are important design considerations. The second factor was cost. Clearly, the research designs need to be cost-effective. Third, research results need to be available relatively soon in the multi-year research period. Decisionmakers will need estimates in the first few years in order to justify continuing the research.

4. RECOMMENDATIONS

The recommended approach for the estimation of measure life uses a *survival function*. A survival function describes the time pattern of removals of devices from the stock of devices. It can be empirically derived and can relate the causes of failure to the degree of removal. This approach requires much of the same type of data identified in the retrospective analysis, but ongoing data collection is a much more thorough and reliable method.

Data collection methods were carefully considered. The on-site survey method is recommended as the foundation for the data collection plan based on experience with several end-use survey and measure verification research projects. This method is recommended for its strengths in actual observations at customer sites and associated survey data collection. Telephone surveys are also used as a supplement to the on-site collections. Finally, since hours of operation, duty cycles and loads are important factors in the measure life of dynamic measures, equipment metering is strongly recommended.

Sample design strategy takes into account the assumption of survival function modelling for measure life estimation. The sampling unit of choice is the measure rather than the customer site or building. The recommended data collection period is five years or less, regardless of the assumed measure life of selected measures; the only exception is measures with assumed measure lives of less than five years. This approach to sampling assumes that even for measures with long measure life (e.g., 20 years), the function for estimating average measure life could be estimated in fewer years.

Separate design options for the recommended prospective designs include: (1) the number of measures to be included per site (sampling overlap efficiency issue), (2) the extent of metering (full sample metering, partial sample metering, and no metering), (3) and type of metering included (loads included, loads not included).

REFERENCES

Jeppesen, J.C., and M. J. King. 1993. *Effective Measure Life and Other Persistence Issues In DSM Programs: Final Report.* California Conservation Inventory Group, c/o California Energy Commission, Sacramento, California.

Skumatz, L.A., Lorberau, K.M., Moe, R.J., Bordner, R.D., and R. D. Chandler. 1991. *Bonneville Measure Life Study: Effect on Energy Using Equipment.* Bonneville Power Administration, Portland, Oregon.