Strategic Energy Management – It's time to grow up!
A maturity model for SEM implementation

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ABSTRACT

Strategic Energy Management (SEM) is a systematic approach to delivering persistent energy savings in organizations by integrating energy management into regular business practices. SEM activity is beginning to take off in North America, but there is little consensus of what components to include, or the level of maturity of the components end-users implemented. This confusion prevents everyone in the SEM "market" from realizing maximum benefit:

- Utilities are "reinventing the wheel" in programs, or unable to find best practices in different types of programs.
- Utility planners do not have a framework for assessing market potential.
- Regulators are challenged to accept delivered savings due to the lack of consistency between programs.
- Utility program implementers cannot fully leverage their investment in previous programs.
- Evaluators find that each study requires new approaches.
- Commercial firms don't see a clear implementation path with a series of achievable steps.

With the breadth and depth of the challenges hindering broad scale SEM adoption, a critical first step is agreement on a comprehensive definition of SEM. A capability maturity model of SEM components (Model) enables everyone to start down the path with common understanding. The Model provides a tool that can be used for regional and program planning, program design and implementation, and program evaluation. This paper describes the elements of the model, how it was developed, and some possible applications. Finally, we suggest next steps for application of the SEM maturity model.

Introduction

Strategic Energy Management

In the past ten years, utilities and their customers have recognized that there is a significant opportunity to gain savings by integrating energy management into customer business practices. Broadly speaking, this approach is called Strategic Energy Management (SEM). SEM is a management system that uses a continuous improvement approach to managing energy performance, using classic Plan-Do-Check-Act methodologies.

Utilities across North America are rolling out a variety of programs to encourage organizational changes that result in increased energy efficiency at the facilities of their commercial, institutional, and industrial (C&I) customers. For purposes of this paper, we use the term Strategic Energy Management as an overarching label for this program category. These

programs encourage a broad set of activities, such as management commitment, recruitment of energy managers, target setting, energy monitoring, implementation of planned activities and employee/occupant engagement. In most cases, these programs are in the early stages of development, reaching a limited set of the possible customers to whom these initiatives might apply. A few programs have successfully completed four to five years of deployment (Kolwey, 2013).

This paper does not address program implementation questions such as: market segmentation, market sizing, deployment models, or incentive structures. Rather, it establishes some initial foundational concepts, from which those program implementation questions can be answered and programs can be designed.

Capability Maturity Models

The use of capability maturity models is a process improvement approach in which processes are rated according to defined maturity levels in the Model. The Model is used to (i) appraise the maturity of an organization's functions and (ii) guide development and process improvements to meet established goals. An early application of capability maturity models was software development, where it contrasts the development process for simple software programs like mobile games with the process for mission-critical software such as space station control systems. It's appropriate for any process to have different levels of maturity, without making any judgments on those levels. Since SEM has been proven effective in commercial, institutional and industrial organizations, the SEM maturity model framework also applies across all three sectors.

It is important to note that Energy Management Assessments (EMA) are built on the concept of a capability maturity model. EMAs are commonly used to support SEM programs to appraise a company's energy management business practices before and after an intervention to guide SEM coaching and show impact of program implementation. However, the models are typically kept out of the public realm as intellectual property, not refined to a level that accounts for industry markers, or lack support for the challenges this paper outlines.

We sought to develop a taxonomy of SEM component maturity that program administrators and other stakeholders can test in the marketplace with data. Most notably we believe the results of the tests can impact SEM program evaluation, provide measurement of market adoption, and support utility program evolution.

The Role of Northwest Energy Efficiency Alliance

The Northwest Energy Efficiency Alliance (NEEA) is a non-profit organization working to maximize energy efficiency to meet our future energy needs. NEEA is supported by and works in collaboration with Bonneville Power Administration, Energy Trust of Oregon and more than 100 Northwest utilities on behalf of more than 12 million energy consumers. NEEA uses the market power of the region to accelerate the innovation and adoption of energy-efficient products, services and practices.

NEEA has been developing and supporting SEM programs for over a decade, starting in 2003 in the healthcare sector with the High Performance Hospital Partnership. In 2006 NEEA took SEM into commercial leased office space with the High Performance Portfolio Framework and the industrial sector with Continuous Energy Improvement. This long tenure of SEM experience in collaboration with our northwest regional stakeholders provides NEEA with

firsthand experience of the knowledge gaps and challenges related to regional planning, program design, program implementation and program impact evaluation. NEEA believes applying capability maturity model theory to SEM provides an innovative and versatile tool to enable the next phase of SEM evolution.

The Need for a Maturity Model for SEM Programs

Lack of Clarity on SEM Components and Definitions

Despite the activity to date, the relative newness of SEM programming results in widely varying ideas of what specifically constitutes an SEM implementation at a C&I facility or organization. Historically, there were no standards or definitions to support implementing SEM programs. Over the past three years a growing collection of disparate standards and definitions evolved to address specific needs and these provide some clarity to support SEM programs. The most widely recognized of these is the International Organization of Standardization (ISO) Standard 50001 (ISO 2011), which is based on a continuous improvement model similar to other ISO standards for quality improvement and environmental management. However, this standard sets a high bar for many facilities and has not yet seen widespread adoption in North America. Other existing definitions do not describe expected actions in sufficient detail or lack any relation to the concept of organizational development that forms the foundation of management systems.

In some ways, the situation is analogous to the way in which the term “energy audit” was inconsistently used prior to 2004, when the American Society of Heating, Refrigeration, and Air Conditioning Engineers stepped in to create a formal definition of three audit levels based on audit depth and rigor (ASHRAE 2011). Having these standardized definitions available has reduced confusion within the industry so that all of the various players (building and facility owners, utility program implementers, audit practitioners, and regulators) can understand what will be delivered by each of the audit levels.

Resulting Problems

For SEM, the lack of agreed-upon definitions and levels leads to the following problems:

- Regional planners are unable to clearly understand the extent to which the SEM market is being transformed
- Utility program planners are frequently "reinventing the wheel" because there is no ready-made list of SEM components
- Program designers cannot leverage best practices from their colleagues because programs are so different that it is hard to benchmark success
- Utilities pay higher implementation costs because service providers cannot fully leverage their investment in previous programs
- Utilities pay higher evaluation costs because each program is unique
- Market actors face a lack of clarity on the state of SEM market adoption and what future opportunities might exist
- Customers with facilities across multiple utility service areas are encouraged to practice wholly different elements of SEM within the same organization with no cohesion behind these elements

- Regulators have less faith in delivered energy savings due to the lack of consistency between programs across jurisdictions. (Compare the relative ease with which residential behavior programs have spread based on common elements of paper reports, web-based tools, and programmable thermostats)

With the breadth and depth of these challenges hindering broad scale SEM adoption, a critical first step is agreement on a comprehensive definition of SEM. By doing so, all parties involved in developing solutions to the challenges can start down the path with common understanding. This is where a capability maturity model of SEM components comes in: the Model provides a tool that can be used for regional and program planning, program design and implementation, and program evaluation.

The balance of this paper describes the SEM components and recommended set of levels for implementation, how it was developed, some possible applications, and suggested next steps. Interested parties can determine which components they are implementing, whether this forms a comprehensive set of activities, and what level they are trying to reach. This leads to significantly reduced confusion in the SEM "market" and helps maximize the effectiveness of SEM implementation. Ultimately, the structure defined by the maturity model has the potential to provide the foundation necessary to transform the market of SEM programs.

Methodology and Overview

Constructing the Maturity Model

The model is based on (1) research into SEM programs; (2) research on other frameworks or matrices used to gauge levels of engagement or maturity of process; and (3) experience of how C&I organizations implement SEM within their own facilities.

The SEM Maturity Model references two significant efforts to establish definitions of SEM components:

- The ISO 50001 Standard mentioned above which describes a fully functioning organizational energy management system.
- The Minimum Elements of Strategic Energy Management for the industrial sector, laid out by the Consortium for Energy Efficiency (CEE 2014). The CEE document was finalized in Q1 of 2014.

We also reviewed maturity models from a wide variety of sources including the Carbon Trust (CT 2013), US EPA (EPA 2013), US DOE (DOE 2013), Carnegie-Mellon's Capability Maturity Model (CMMI 2013) Integration, and the Colorado Department of Public Health (CDPH 2013). These sources helped us determine a useful number of categories and levels. Lastly, a review of the model concepts was generously conducted by staff from BC Hydro, the Northwest Power and Conservation Council, and the CEE.

SEM Maturity Levels

The Model itself is visually displayed as a grid or matrix, as shown in Table 1. The columns show the level of SEM engagement, while the rows include the components of energy

management. As one moves across the table from left to right, the level of engagement in the SEM process increases, as indicated by the column labels:

- 0 Unengaged — the organization has not paid serious attention to its energy use and has no established energy policies or formal processes
- 1 Engaged — the organization is more seriously engaged with energy management: formal processes are emerging and basic measurement is in place
- 2 Systematic — the organization has made a formal commitment to energy management; this level corresponds well to the minimum SEM guidance of CEE
- 3 Sustaining — the organization has a comprehensive system and is demonstrating improvement in energy management practices
- 4 Integrated — the organization integrates a management system that supports continuous improvement; this level corresponds well to the requirements of ISO 50001
- 5 World Class — the organization goes beyond the minimum requirements of existing standards to incorporate all elements of SEM best practices, such as setting stretch goals and communicating performance broadly

Note that energy management is often applied at the organizational level, across multiple facilities or buildings, or across specific parts of a facility as well.

SEM Maturity Components

The energy management components are as follows:

- Management Commitment — the involvement of executives and senior managers in promoting and deploying energy management
- Resources (financial, human) — the organizational resources that are engaged with energy management, such as budgets, energy leaders, energy teams
- Energy Review and Analysis — the regular assessment of energy consuming activities across the organization or in the facility
- Energy Key Performance Indicators (KPIs) and Targets — the definition and use of strategically relevant metrics of energy consumption and waste
- Action Plans — specific plans related to energy management
- Operations and Maintenance — the ongoing attention to energy during regular business operations
- Monitoring and Analysis — the monitoring of energy consumption at the appropriate level and the continuing analysis of data
- Employee Engagement — the degree to which employees across the organization concern themselves with energy consumption
- Regular Reporting, Review, and Reassessment — the information flow across the organization and the periodic adjustments in response to new strategy or new information
- Procurement and Design — the inclusion of energy consumption as a criterion in the purchasing of equipment and supplies, and in the design of new facilities, equipment, or processes
- Documentation and Records —the documentation of operational processes, the management system; evidence of results or activities performed

- Energy Management System Audits — the periodic assessment of the entire management system for energy

Consider for example the first program component, Management Commitment, which appears in the first row of Table 1. At the 0 - Unengaged maturity level, the organization has no energy policy whatsoever. The 1- Engaged level would apply when an organization has an informal energy policy, perhaps at the facility level, but upper management has not been involved in creating a policy that applies across the entire corporation or institution. As we look across the columns, we see increasing high-level management involvement in creating, prioritizing, monitoring, evaluating, and regularly revising the energy policy.

Table 1. Layout of maturity model

Component	0 Unengaged	1 Engaged	2 Systematic	3 Sustaining	4 Integrated	5 World Class
Management Commitment						
…						
Energy management system audits						

SEM Maturity Model Example

The complete model would fill most of this paper so a section excerpt is included to articulate the structure and content. Table 2 below shows levels two through four of the 'Operations & Maintenance' component.

Table 2. Maturity model example

Component	2 Systematic	3 Sustaining	4 Integrated
Operations & Maintenance (O&M)	• Changes made to standard operating procedures (SOPs) to ensure that operational changes to reduce energy waste are persistent • O&M activities included in action plans • Operational controls are communicated to relevant personnel	• All Level 2 components + Energy related O&M activities are assigned to a group of personnel (e.g. maintenance), but not to larger employee base	• All Level 3 components + • Champion determines criteria and methods to ensure effective energy management system operation and control • O&M activities related to significant energy uses are identified, planned and carried out by: ○ establishing and setting criteria for effective O&M of significant energy uses, where lack could lead to significant energy performance deviation;

Applications for SEM Maturity Model

There are numerous opportunities to apply the Model to SEM. As a way to guide the application, we reference NEEA's regional work in the NW Industrial SEM Collaborative where it acts in a role of "regional planner." In this role NEEA focuses on the following activities:

- Build awareness and knowledge
- Increase program impact and measurability
- Offer new or enabling programs
- Evolve the regional strategic plan

Through these activities there is an opportunity to impact many aspects of SEM implementation; some aspects of high interest are:

- Achievement of program goals
- Help optimize cost-effectiveness
- Persistence of savings
- Verification of savings and evaluation control
- Consistency of implementation and results - benchmarking

With the commonality of SEM application across sectors, the same regional planning role is well-suited to impact SEM in the institutional or commercial sectors. Each activity is discussed below in relation to NEEA's primary activities.

Build Awareness and Knowledge

Awareness and knowledge of SEM in the market continues to be low. For instance, a recent market characterization commissioned by NEEA identified only 50% of surveyed commercial real estate professionals are aware of SEM (Cadmus 2014). Publishing and sharing the Model with the market, including program administrators and their customers, can increase awareness and knowledge of SEM. Bringing a comprehensive definition into the public realm adds clarity to those involved with or considering SEM programs. Program designers can clearly choose which actions a program is targeting to impact at a customer, the coaching or consulting can be efficient in its instruction and organizations will have a better understanding of the organization development continuum they are travelling down. Understanding will continue to grow as the Model is used in collaboration with regional partners for pilot projects, evaluation work or other possibilities discussed in this paper.

It likely is not appropriate to put the level of detail in the Model in front of organizations early in the process; it may be too much information. However, for organizations on the path to a systematic or sustaining level it may be just the right knowledge tool to enable them to chart a path to deeper implementation with minimal support; i.e. low cost to the provider. In this scenario, when the relationship with the provider is well established and benefits are understood and valued, the stage has been set for highly cost-effective program delivery.

Increase Program Impact and Measurability

Strategic Energy Management programs can be very effective at establishing long-term relationships between program providers and their customers, resulting in a consistent pipeline of energy savings. From the measurability perspective there is growing consistency of a statistical approach to measuring the energy savings impact at the organization or building level. However, the statistical approach is complex for organizations and costly for providers. Additionally, it does not address the program level effectiveness or the organizational impact. Evaluation attempts to measure the program effectiveness and organizational impact of SEM practices are difficult to interpret because little is understood of the measurement tools or of the program and customer attributes that most impact the results. There are many interesting questions to pose regarding program impact and measurability and the program administrator's actions in response to the answers could significantly increase program cost-effectiveness. Here are examples of research questions to consider:

- How much SEM is in place before program participation?
- Which actions cause persistence of actions and savings following a program?
- How much does each component contribute to savings?
- How does that savings contribution change as you climb the levels of maturity?
- Is the rate of change the same for each component? If not, why not?
- How can a program affect the amount of savings and the rate of change?
- What is the market or market segment savings potential from SEM implementation?

- How can SEM program offerings be more closely matched to the market or specific market segments?

To answer these questions with high confidence it is necessary to use a consistent methodology to benchmark SEM programs and individual organizations' maturity in adopting SEM. However, there is no consistent data collection methodology or tool from which data can be sourced to perform the analysis.

One approach is through a standardized EMA at a regional or national level. EMAs can serve many purposes such as outreach tools for program providers to engage with customers, to build relationships between utilities and their customers, help identify the best customers for SEM programs, and measure their progress as the result of an intervention. Currently EMA content, transparency, delivery, and therefore the value to utilities and customers vary widely. They are typically either proprietary and costly or less refined and under leveraged. Using the Model to build a standardized EMA tool for public use could provide a more cost effective, transparent solution with consistent results for utilities and SEM program providers and participants. It also has the potential to facilitate a centralized warehouse of results for analysis and evaluation purposes.

Data from a standardized source would enable analysis of attributes of success as leading and lagging indicators using the Model. Leading indicators measure inputs (such as number of energy projects, or energy suggestions from employees), while lagging indicators measure results (such as dollars saved or unit energy intensity). This analysis puts the data needs of potential solutions into meaningful context and aides in wide-ranging analysis opportunities attempting to answer the research questions above.

In the absence of standardized data source, NEEA is taking actions to assemble a data set to start to answer the questions posed above. In NEEA's work to evaluate the presence of SEM in commercial real estate market we are using the Model with an evaluation contractor to develop survey questions that result in targeted information gathering. This enables more effective use of the results by correlating the presence of specific markers of SEM adoption to levels of energy savings within an organization to determine if more mature practices lead to greater or more persistent savings. Additionally, we hope to build the data set through collaboration with regional partners. Initial results will be available in Q3 of 2014.

Offer New or Enabling Programs

Insights into program evolution naturally flow from the results of the leading and lagging indicator analysis mentioned earlier. Access to meaningful data can lead to new program deployment methods, more effective implementation approaches, and cost-effective complementary programs. In addition to the questions above that provide insight to new or enabling programs; consider the following example research questions:

- How would the small commercial market benefit from an SEM program whose intent is to get a large number of participants to level 1of SEM adoption as defined by the Model? Would they naturally progress from level 1 to higher levels of SEM maturity?
- Based on capital budgeting time frames how can a follow- up or SEM maintenance program most effectively enable capital project implementation?

Initially, the Model enables more effective program design through clear definition of SEM. Effective application of management systems occurs when the components of the system operate at a similar level of maturity. When this is not the case imbalance occurs because components do not interact effectively. A good rule of thumb for program designers is the intended level of achievement for a given program phase of a component included in a program design should not vary by more than about one level from one component to another. Under this assumption program design could follow a staged delivery approach with time between provider interventions to master the SEM practices and ensure readiness to advance to the next level.

Good data and analysis provides an opportunity to offer SEM programs targeted at specific market segments. Market segment specific SEM program results together with market characterization data provides an opportunity to fine-tune the intended organizational implementation actions to maximize energy savings, persistence and non-energy benefits for the organization.

Evolve the Regional Strategic Plan

The Model provides high potential for solving individual challenges laid out above. However, the full market transformation potential of the model lies in approaching it as a system-based solution. The answers to many of the above research questions will act as enabling solutions, meaning strategic opportunities will likely benefit from or build upon one another. The results of this approach will help guide NEEA's future SEM strategy.

To best illustrate the potential we theorize how many of the challenges and solutions play off of and support advancing a solution to another challenge that exists. Consider the following two examples:

- The use of a standardized EMA leads to improved measurement of SEM adoption, which supports better understanding of persistence issues, which leads to refined program design and ultimately more effective delivery; i.e. increasing cost effectiveness and increasing understanding so others will offer SEM programs.
- The increase in data availability and analysis and improved confidence of savings related to SEM directly support regional planning efforts. For example using the results from NEEA's evaluation of SEM presence and related savings in the commercial real estate market supports the development of commercial market SEM adoption curves for use by planners to estimate and track progress in achieving the energy savings potential.

Potential Pitfalls to Consider and Avoid

The use of capability maturity models has encountered problems in the past. Applying them to the SEM concepts described in this paper may not prove effective in the end. However, their application to SEM implementation can avoid potential pitfalls by considering prior research on the subject. Here are some examples and what SEM can learn from them:

- The application of the Model may be interpreted within an organization as a fixed process and regarded as a series of laws, expecting the organization's existing business process to be discarded or unduly change under the banner of the Model. However, it is well understood by management system practitioners the most effective implementation is one

that integrates new process needs into existing practice with minimal disruption. Despite this understanding, effective integration can be difficult in practice and therefore is an important consideration (Ataker).

- The Model should not be applied as a one size fits all organizations. The size and market sector of an organization needs to be considered in how most effectively to implement SEM. Some key considerations relative to size include human resources, economies of scale and technical capacities to support SEM (e.g. systems sophistication). Some key considerations relative to the market include organizational structure, business drivers and project opportunities. Fortunately, these considerations have made it into many early program designs (Ataker).

Next Steps

The SEM Maturity model is currently being vetted with regional, national and international experts and the input will be integrated into the next draft of the model that will be published. Concurrently, it is influencing work underway by NEEA in several areas including developing commercial and industrial SEM infrastructure elements for the Northwest region and aiding in the development of evaluation studies for NEEA SEM initiatives.

Additional research and collaboration areas of consideration include:

- Developing a road-map for the Model through collaboration with NEEA's northwest regional stakeholders.
- Leveraging it in working with Northwest Power and Conservation Council in 7th plan development regarding regional SEM market potential and adoption.
- Building value-add tools to support and influence SEM program evolution.
- Working with the NW Industrial SEM Collaborative Energy Tracking and Savings Protocol workgroup to identify how the model can add value to evaluation, verification and measurement work.

The SEM Maturity Model is posted to the Conduit (Conduit) website at www.conduitnw.org; we welcome input and comment through Conduit to improve the Model.

This model pertaining to implementation has the potential to provide solutions to aide in SEM program design, implementation, and evaluation. Similar models could be developed specific to program design and program evaluation to provide targeted analysis and solutions to those key areas of SEM evolution. Additionally, capability maturity models can be developed for other behavior based energy efficiency programs to provide similar benefits to those presented in this paper.

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References

ISO (International Standards Organization), 2011. ISO 50001:2011 Energy management systems – Requirements with guidance for use. http://www.iso.org/iso/home/standards/management-standards/iso50001.htm

Kolwey, N. 2013. *Utility Strategic Energy Management Programs*. Boulder: Southwest Energy Efficiency Project. http://swenergy.org/publications/documents/Utility_SEM_programs_03-2013.pdf

ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers), 2011, *2011 ASHRAE Handbook – HVAC Applications*.

CEE (Consortium for Energy Efficiency), 2014, CEE Strategic Energy Management Minimum Elements. http://library.cee1.org/content/cee-strategic-energy-management-minimum-elements/

CT (Carbon Trust), 2013. Energy Management Matrix and Energy Management Assessment. http://www.carbontrust.com/media/13187/ctg054_energy_management.pdf http://www.carbontrust.com/media/226647/ctx614-em-self-assessment-tools.xlsx

ES (ENERGY STAR), 2013. Energy Management Matrix. http://www.energystar.gov/buildings/tools-and-resources/energy-star-guidelines-energy-management http://www.energystar.gov/buildings/sites/default/uploads/tools/Energy_Assessment_Matrix_06022011.xls

EPA (U.S. Environmental Protection Agency), 2013. Assessment of Current Energy Management System. http://www.epa.gov/region6/water/energymgt/assessment_current_energy_mgt_system.pdf

DOE (US Department of Energy), 2013. Superior Energy Performance. http://www.superiorenergyperformance.net/index.html

CMMI (Capability Maturity Model Integration), 2013. http://cmmiinstitute.com/

CDPH (Colorado Department of Public Health), 2013. Hazard Analysis Toolkit and Environment Risk Assessment Planning Matrix. http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheadername1=Content-Disposition&blobheadername2=ContentType&blobheadervalue1=inline%3B+filename%3D%22Hazard+Analysis+Toolkit.doc%22&blobheadervalue2=application%2Fmsword&blobkey=id&blobtable=MungoBlobs&blobwhere=1251810096774&ssbinary=true

Cadmus (Cadmus Group), January 2014, Establishing the Market Baseline for the Commercial Real Estate Initiative. NEEA

Ataker, Kerime; 2009, Aspects of the Capability Maturity Model (CMM) in Organizations.

Conduit (Conduit), 2014. www.conduitnw.org