Impacts of Save Energy Now (SEN) Program

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ABSTRACT

The need for energy efficiency captured the attention of all sectors of our society in the 1970s when energy supplies dwindled and prices increased. Interest in energy efficiency continued during the 1980s primarily due to environmental concerns and secondarily because of economic and industrial competitiveness issues. Energy supply disruptions caused by hurricanes Katrina and Rita, and recent hikes in energy prices, have generated a renewed interest in energy efficiency.

In the past, the industrial sector responded to energy shortages and price increases with varying effectiveness, but small and medium-sized plants generally lacked the resources to cope effectively. One of the U.S. government's responses to this situation was to offer these small and medium-sized plants technical assistance such as industrial assessment center (IAC) programs. The IAC program has been successfully functioning during the past three decades. However, large energy users (LEUs) were not included in this program.

Two years back, the U.S. Department of Energy (DOE) launched the SAVE ENERGY NOW initiative to help American businesses, factories, and manufacturing facilities save energy and continue to thrive during the time of diminished supplies and rising energy costs. Energy supply disruptions caused by hurricanes Katrina and Rita, and recent hikes in energy prices, are impacting everyone in the United States, including the nation's industrial sector.

Save Energy Now was a part of the national campaign called Easy Ways to Save Energy unveiled by the Secretary of Energy Samuel W.

Bodman. As a key element of Save Energy Now, the DOE sent teams of qualified efficiency experts to the nation's most energy-intensive manufacturing facilities to conduct 200 energy savings assessments (ESAs) in 2006, and a similar number during 2007. The purpose of the assessments was to identify immediate opportunities to save energy and money, primarily by focusing on steam and process heating systems.

The SEN program has been effective and successful mainly because it was based upon the applications of some software tools coming out of the Best Practices Program of the DOE, specifically two tools viz: steam system assessment tool (SSAT) and process heating assessment and survey tool (PHAST). This article describes some of the applications of PHAST to LEUs and explains the outcomes of these applications.

INTRODUCTION

The U.S. Department of Energy (DOE) launched the Save Energy Now (SEN) initiative in 2006, to help American businesses, factories, and manufacturing facilities save energy and continue to thrive during this time of diminished supplied and rising energy costs. Energy supply disruptions caused by hurricanes Katrina and Rita, and recent hikes in energy prices, are impacting everyone in the United States, including the nation's industrial sector.

Save Energy Now was part of the national campaign called Easy Ways to Save Energy unveiled by the Secretary of Energy Samuel W. Bodman to highlight easy ways for Americans to save energy now and throughout the coming years, when prices are expected to remain high. As a key element of Save Energy Now, the DOE is sending teams of qualified efficiency experts to the nation's most energy-intensive manufacturing facilities. Two hundred energy savings assessments (ESAs) were conducted during 2006, and the program has continued since then. The purpose of the assessments is to identify immediate opportunities to save energy and money. During 2006, the focus was on steam and process heating systems. Air systems, pumping systems, and other energy-consuming systems in manufacturing facilities were added later. These processes consume nearly 90 percent of the energy used by the U. S. industry.

The SEN program has been successful simply because the DOE developed several software packages (tools) under its best practices program and trained technical experts who were qualified to use the tools developed in Best Practices program. The objective of this article is to describe some of these tools and show their application to successfully carry out SEN assessments.

BEST PRACTICES TOOLS (1)

The industrial technologies program (ITP) of the US Department of Energy (DOE) has developed several "best practices tools" during the past decade. These tools are software packages which can be used to analyze various energy-consuming equipment and processes used by the manufacturers; some examples are Quick PEP, PHAST, SSST, Motor Master, PSAT, FSAT etc. These software packages can be downloaded from the DOE website, *www.eere.energy.gov/indistry/best-practices/*and used free of charge. Fact sheets on some of these software packages are shown below.

Quick PEP
Facts & Figures

- About a third of the nation's total energy use is consumed in U.S. industries.
- Even plants with energy management programs can often save 10 to 15 percent more using best practices to increase their energy efficiency.

The quick plant energy profiler, or Quick PEP, is an online software tool designed to help manufacturers quickly understand how their industrial plant is using energy and what they can do to begin saving energy and money now. Developed under the US Department of Energy (DOE) Industrial Technologies Program (ITP), Quick PEP is a good "first step" that U. S. industrial plants can take to identify excellent opportunities for savings, improve their company's bottom line, and help reduce the environmental emissions associated with energy production and use.

Benefits of Quick PEP

- Helps you quickly understand your plant's energy use.
- Identifies your plant's major energy-consuming systems.

- Provides an overview of your plant's energy purchases.
- Is a good first step in identifying potential energy and money savings.
- Describes typical next steps to take to insure savings.

If your plant could use a boost in energy efficiency, try Quick PEP… and find out how to start saving energy and money today!

Resources

For more information, to obtain DOE's assessment and decision tools, and to learn more about DOE qualified specialists and training opportunities, visit the Best Practices website, www.eere.energy.gov/industry/bestpractuces and see the "resources" section.

Additionally, you can contact the EERE Information Center at 1-877-337-3463, or via the web at www.eere.energy.gov/informationcenter.

What Does Quick PEP Do?

This software tool helps plants quickly "diagnose" their energy use and begin identifying opportunities for savings. It does this by providing an overview of the amount of energy your plant purchases and generates, identifying the major industrial systems that consume that energy, describing your plant's savings potential, and pointing out some specific resources and tools you can use to realize savings.

Quick PEP is like a road map that directs you to specific, targeted ways to save energy and money at your plant. Using Quick PEP and information about your practical plant, you can complete a plant profile in about an hour. An online tutorial explains the information you will need to complete the profile. You will then receive a customized, printable report that includes details about your plant's energy purchases, how your plant consumes energy, potential energy and cost savings, and the steps you can take to begin saving.

Who Can Use Quick PEP?

This software tool was designed for industrial plant managers and personnel who have access to basic information about major energy-consuming systems at their industrial plants. This information can include the average amount of electricity consumed or generated at the plant on a monthly, quarterly, or annual basis. An online tutorial takes you through Quick PEP process step by step. Quick PEP can even help you select the major energy-consuming systems at your plant, and it provides default energy-use information and worksheets, as well.

Where Can You Obtain Quick PEP?

This software tool is available online free of charge. You can access it on the ITP Best Practices website by visiting www.eere.energy.gov/industry/bestpractices and selecting "Software Tools" from the list of quick links. For more information, you can contact the EERE information center by calling 1-877-337-3463 or by going to:
www.eere.energy.gov/informationcenter/on the web.

Then What?

The Quick PEP results report contains tables and graphs that show you how much energy your plant is purchasing and how much it costs, how your plant is consuming that energy, and how much energy and money you might be able to save. The results report also includes a customized list of suggested next steps that can help you begin implementing energy-saving measures. These next steps could include using more targeted tools to identify specific savings opportunities or obtaining an energy assessment from one of DOE's experts in analyzing industrial systems. For example, if Quick PEP shows that your plant's process heating equipment is consuming a considerable amount of energy, you might want to select the DOE process heating assessment and survey tool (PHAST) to find specific energy- and money-saving opportunities. Or you might want to consult with a DOE qualified specialist in the use of PHAST, or sign up for a special training session.

Other software tools are also available on the Industrial Technologies Program (ITP) site. They can show you how to save energy and money by making efficiency improvements in your steam, motor, pumping, fan, and other industrial systems. Whatever you choose, you will be well on the way to boosting your plant's energy efficiency and improving your bottom line.

To access DOE software tools, see www.eere.energy.gov/industry/bestpractuces/.

To find out more about DOE qualified specialists, see www.eere.energy.gov/industry/bestpractuces/qualifid_specialists.html.

To learn about training opportunities, see www.eere.energy.gov/industry/bestpractices/training.html.

ITP provides U.S. industries with software assessment tools, training, technical information, and assistance. These resources and energy management practices help plants improve the energy efficiency of their process heating, steam, pumps, compressed air, and other systems; reduce operating costs; and improve their bottom line.

PHAST FUNCTIONS

Use the process heating assessment and survey tool (PHAST) to survey all process heating equipment within a facility, select the equipment that uses the most energy, and identify ways to increase efficiency. Also use it to assess equipment performance under various operating conditions and "what-if" scenarios.

The software provides instructions on how to obtain the data for each step with commonly available instruments, without affecting production. It also supplies data on the thermal properties of commonly processed materials.

PHAST serves three specific purposes:

- PHAST provides easy-to-use tools to calculate the potential saving that a plant can achieve by applying various energy-saving measures. Based on user-supplied equipment parameters, the tools, or "calculators," compare the energy performance of individual pieces of equipment under various operating conditions.
- PHAST surveys all equipment that uses fuel, steam, or electricity for heating. Based on facility-specific heat input and furnace operating data, the tool reports how much fuel, electricity, and steam each piece of equipment uses annually plus the estimated annual energy costs. Energy-efficiency improvements can thus focus on the pieces of equipment that use the most energy.
- PHAST constructs a detailed heat balance for selected pieces of process heating equipment. The process considers all areas of the equipment in which energy is used, lost, or wasted. Results of the heat balance pinpoint areas of the equipment in which energy is wasted or used unproductively.
- PHAST produces a summary report on energy use in specific pieces of equipment and throughout the process heating system. The tool suggests methods to save energy in each area where energy is used or wasted, and offers a list of additional resources. The report is

valuable in identifying and prioritizing major opportunities for energy savings.

PHAST Gets Results

Process heating accounts for more direct energy use than any other process in U.S. manufacturing. The thermal efficiency of process heating equipment currently varies from 15 to 80 percent. At the lower efficiency levels in particular, PHAST technology offers the potential for significant energy savings.

Steel Reheating Furnace Example

At one steel mill, PHAST identified significant potential savings in a steel-reheating furnace. The furnace had a firing capacity of 135 million MMBtu per hour for the heating zone and 32 MMBtu per hour for the soak zone. PHAST indicated that the furnace's fuel use could be reduced by approximately 30MMBtu per hour for the heating zone and 5MMBtu per hour for the soak zone. Reducing losses through openings could save another 2MMBtu per hour. Total potential savings identified for the unit were 37 MMBtu per hour, or 22 percent of all energy used by the furnace.

Suggested low-cost improvements included better control of the air-fuel ratio and installation of radiation shields (curtains that eliminate radiation heat loss).

Aluminum Extrusions Example

PHAST software was used to identify seven effective opportunities to save energy and boost productivity at the Alcoa North America Extrusions facility in Plant City, Florida.

The PHAST assessment identified the pieces of process heating equipment that were the largest energy consumers, collectively consuming more than 80 percent of all process heating energy at the facility. PHAST analysis revealed that recovery of waste heat from flu gases in both melters offered one of the best opportunities for reducing energy use. Potential annual savings totaled over $300,000 with a payback period of 6 to 24 months.

SSST

The steam system scoping tool (SSST) quickly evaluates your entire steam system operation and spots the areas that are the best opportunities for improvement. The tool suggests a range of ways to save steam energy and boost productivity. It also compares your system against identified best practices and the self-evaluations of similar facilities.

The software asks 26 questions about different areas of your steam system, including system profiling, steam system operating practices, boiler plant operating practices, and distribution and recovery operation practices. Based on your responses, it provides a score indicating opportunities for improvement. The software is available in Microsoft Excel or Visual Basic formats.

Learn about Steam System Strategies

The *Steam System Survey Guide* explains many of the opportunities available for improving your steam system. It is particularly helpful for learning more about the improvement options available or the calculations required to determine savings opportunities.

The guide addresses five areas: steam system profiling, steam properties, boiler operations, resource utilization, and steam distribution. It can help in assessing fuel costs, the combustion efficiency of various boiler fuels, boiler lowdown, vent steam, back pressure turbines versus pressure-reducing valves, condensing turbines, steam leaks, insulation, and condensate recovery.

The 3E Plus software tool allows steam users to calculate how much insulation is needed to conserve energy and avoid the expense of over-insulation.

Steam system improvements can save 20 percent in fuel costs at a typical industrial facility. If such improvements were adopted industry-wide, benefits would include:

- $4 billion reduction in fuel costs.
- 32 million metric ton reduction in emissions.

Explore Your Options with System Modeling

The steam system assessment tool models various improvement scenarios and provides energy bill estimates. The tool contains all the key features of typical steam systems: boilers, backpressure turbines, condensing turbines, deaerators, letdowns, flash vessels, and feed water heat exchangers.

The model analyzes boiler efficiency, boiler blow down, cogeneration, steam cost, condensate recovery, heat recovery, vent steam, insulation efficiency, alternative fuels, backpressure turbines, steam traps, steam quality, and steam leaks.

Steam Tools Get Results

Steam System Scoping Tool

In 2001, six of the Department of Energy (DOE) Industrial Assessment Centers used the steam system scoping tool to assess steam systems at 18 small and mid-sized facilities. Those assessments successfully identified 89 steam system improvements with an average payback of seven months and an average fuel bill savings of 12.5 percent. Collectively, the improvements yielded a total savings of $2,800,000 per year.

Steam System Survey Guide

The *Steam System Survey Guide* is used as the technical basis for DOE's targeted steam assessments, and steam end user training program. As of January 2003, DOE had conducted 13 targeted steam assessments in large industrial plants.

The assessments revealed opportunities for large plant improvements, including:

- Improved blowdown heat recovery.
- Use of backpressure turbines for power production.
- Recovery of thermal energy from wastewater systems.
- Replacement of missing insulation on piping systems.
- Reduction of steam leaks resulting from failed steam traps and pipes.

These improvements offered potential for significant cost savings, as shown in Table 1.

Table 1. Steam system savings identified by industry.

Industry (No. of assessments)	*Average Energy Savings (Million Btu/year)*	*Average $ Saving (Annual)*
Chemicals(1)	330,000	$1,565,000
Forest Products(5)	199,500	366,000
Mining(2)	20,100	$102,500
Petroleum(3)	98,500	$466,000
Steel(2)	226,700	$690,000

Steam System Assessment Tool

Within three months after its release in December, 2002, over 1,000 steam users and service providers downloaded or obtained a copy of the *Steam System Assessment Tool*.

MotorMaster+ (Version 4.0) Software Aids Replace/Rewind Decisions

Whether you are a novice or an expert at managing motor systems, MotorMaster+ is designed for you. The separate but communicating modules make the software exceptionally flexible and easy to learn and use. This software tool handles everything from calculating payback on a single motor purchase to comprehensive, integrated motor system management.

Version 4.0 has the same look and feel as the popular Version 3.0 and is available as an easy-to-install upgrade. It quickly identifies inefficient or oversized facility motors and computes the savings that can be achieved with more energy-efficient models. The software runs on local or wide-area networks for access by multiple users.

In response to comments and suggestions from diverse industrial facilities, MotorMaster+ 4.0 carries expanded capabilities for inventory management, maintenance logging, lifecycle costing, savings tracking and trending, conservation analysis, savings evaluation energy accounting, and environmental reporting. It continues to serve as a respected, nonbiased source for motor data.

Helpful Features

- Expanded list of over 25,000 motors from 18 manufacturers, including NEMA premium medium-voltage (>6,600 volts) motors.
- Improved predictive maintenance testing facilitates rapid data entry, sorting by condition, and rewind/replace recommendations.
- Enhanced user manual, new reporting methods, and efficient predictive maintenance practices.
- Technical data to help optimize drive systems, such as data on motor part-load efficiency and power factor; full-load speed; and locked-rotor, breakdown, and full-load torque.
- Motor purchasing information, including list prices, warranty periods, catalog numbers, motor weights, and manufacturer addresses.
- Capability to calculate energy savings, dollar savings, simple

payback, cash flows, and the after-taxes rate of return-on-investment for energy program—taking into account such variables as load factor, motor efficiency, purchase price, energy costs, hours of operation, and utility rebates.

MotorMaster+ Gets Results

MotorMaster+ is a popular tool with thousands of industrial end users, vendors, and consultants. They use it for a variety of reasons:

- To create lists of motors that meet user-specific requirements.
- To calculate the savings and simple payback period for premium-efficiency motors versus standard-efficiency units.
- To optimize the motor repair-versus-replace decision.
- To manage motor systems comprehensively.

A large motor repair shop uses MotorMaster+ to assist customers in making sound motor purchase and replacement decisions One of these applications at a large facility in Indiana led to the replacement of 125 motors with premium-efficiency motors, saving the plant approximately $80,000 per year. MotorMaster+ also specified premium-efficiency motors on new OEM equipment at the facility for another $128,000 in annual savings.

In 2001, the Ellensburg Wastewater Treatment Plant in Washington State had to decide whether to replace or rewind two large 50-horsepower aerator motors. Initial use of the MotorMaster+ software indicated that it would be more cost effective to purchase new motors than to rewind the existing motors. In a second run, MotorMaster+ compared the cost effectiveness and simple payback periods of various new 50-horsepower motors and helped justify the purchase of new standard-efficiency units.

Pumping System Assessment Tool (PSAT) Saves Energy

PSAT software uses data that are typically available or easily obtained in the field (e.g., pump head, flow rate, and motor power) to estimate potential energy and dollar savings in industrial pump systems. The software is available without charge from the US Department of Energy for evaluating industrial pump systems.

Pump Prescreening

Use the PSAT prescreening filter to identify areas that are likely to offer the greatest savings. Look for symptoms associated with inefficient energy consumption:

- Throttle-valve control for the system.
- Cavitation noise or damage in the system.
- Continuous pump operation to support a batch process.
- Constant number of parallel pumps supporting a process with changing demands.
- Bypass or recirculation line normally open.
- High system maintenance.
- Systems that have undergone change in function.

Quantifying Potential Savings

PSAT identifies energy savings opportunities in pumping systems and quantifies those opportunities in both dollars and electrical energy savings. Although PSAT does not tell how to improve systems, it does prioritize attractive opportunities and supports broader or narrower searches for improving efficiency.

PSAT assesses current pump system operating efficiency by comparing field measurements of the power delivered to the motor with the fluid work (flow and head) required by the application. It estimates a system's achievable efficiency based on pump efficiencies (from Hydraulic Institute standards) and performance characteristics of pumps and motors (based on the MotorMaster+ database). Subsequent comparison of the actual and achievable efficiencies distinguishes systems with lower levels of opportunity from those that warrant additional engineering analysis.

PSAT Gets Results

Large savings may come from one large application or process, but may also develop from multiple small applications that, when combined, keep total consumption low enough to avoid increased utility charges based on threshold demand.

At a gold mine, the PSAT prescreening filter identified three pumping systems for further analysis. Over \$170,000 per year (2,398,200 KWh) in potential savings were identified.

Prescreening at a paper mill identified one system that presented a significant energy savings opportunity. The identified potential savings of more than \$64,000 per year (2,252 MWh) were traced to inefficient

Table 2.

Industry (No. of assessments)	*Average Energy Savings (Million Btu/year)*	*Average $ Saving (Annual)*
Aluminum (2)	1,882,500	$ 74,400
Chemicals(1)	1,601,200	$ 106,000
Forest Products(7)	4,717,400	$ 186,500
Mining(7)	9.419,100	$ 410,700
Petroleum(2)	1,150,000	$ 46,000
Steel(2)	5,787,500	$ 231,500

operating practices rather than pump degradation.

Smaller facilities are not exempt from energy savings. An aluminum rolling mill applied PSAT to four related systems and identified over $38,000 per year (1,015,000 kWh) in potential savings.

A pumping system assessment for an Alcoa plant in Pennsylvania identified savings in three systems. After prescreening, a PSAT analysis of the three systems identified $110,000 per year in potential savings.

A USX steel mill employed PSAT to examine its hood spray application that used bypass flow control. The mill discovered an opportunity to save $41,700 per year and use 13 percent less energy. The bypass flow control set-up was replaced with a properly sized pump and energy-efficient motor that would be operated only when productive.

FSAT

Experience has shown that greater energy savings can be achieved through system optimization than through component optimization. The fan system assessment tool (FSAT) helps users quantify energy consumption and energy savings opportunities in industrial fan systems.

By reducing the engineering time associated with analyzing fan systems, it becomes easier to understand the economic and energy significance of changes in both system equipment and operating practices.

FSAT does not tell the user how to achieve the identified savings, but it is a simple and effective tool to help users understand how well their fan systems are operating, determine the economic benefit of system modifications, and help determine which options are most economically viable when multiple opportunities exist for system modification.

System Effects

The Air Movement and Control Association International, Inc. (AMCA) has documented that there is often a difference in performance between a tested fan configuration and an installed fan configuration. These differences are know as system effects. FSAT helps users quantify the difference between rated performance and installed performance due to such things as:

- High duct velocity.
- Discharge dampers locked in position.
- Obstructed inlets.
- Incorrectly sized fans.
- Poor duct geometry.

Tool Description

FSAT is simple and quick to use, and requires only basic information about fans and the motors that drive them. With FSAT, users can calculate the amount of energy used by a fan system; determine system efficiency; and quantify the savings potential of an upgraded system. The tool also provides a prescreening filter to identify fan systems that are likely to offer optimization opportunities based on the system's control, production and maintenance, and effect.

FSAT estimates the work done by the fan system and compares that to the estimated energy input into the system. Using generic typical performance characteristics for fans and motors, indications of potential savings (in energy and dollars) are developed.

CASE STUDY

Energy Saving Assessment (ESA)

An ESA was conducted for Steel Company A at its plant in Illinois in June 2007. Company A has 12 steam boilers and two blast oven furnaces (BOF) to make iron using iron pellets; four hot strip furnaces to make carbon steel; two blast furnace stoves, and two coke oven batteries to convert coal to coke and produce coke oven gas; two BOF ladle dryers;

and several triple-G galvanizing furnaces. Blast furnaces make iron slabs, which are moved to hot strip furnaces for re-heating to make steel coils. Some coils are galvanized before shipping to the customers.

It is estimated that the Company A plant uses 20,686,000 kWh of electricity at a cost of $1199788 per year, and about 18,762,799 MMBtus of natural gas at a cost of $139,162,087 per year. The plant is more than 80 years old and is energy inefficient in several processes and pieces of equipment. The most energy-intensive pieces of equipment are the boilers 1-10 and 'B' blast oven furnace. The steam generated by the boilers is transported above ground to the galvanizing furnaces. Several energy-saving strategies were developed using the results of the process heating assessment and survey tool (PHAST) analysis of the plant.

Objective of ESA

The main objective of the ESA was to understand the energy consumption patterns of the direct-fired heating equipment at Company A.

Focus of Assessment

The focus was to apply PHAST to all the boilers, blast furnaces, stoves, hot strip furnaces, and galvanizing furnaces. The results from the PHAST analysis were used to develop several energy saving recommendations for the plant.

Approach for ESA

- Contacting the plant's process engineer.
- Visiting the plant.
- Review of plant policies and safety instructions.
- Review of plant layout, equipment, processes etc.
- Plant walk-through tour.
- Data collection for the various direct-fired equipments.
- Process heating basics and PHAST review with the plant personnel.
- Demonstration of the use of PHAST software to the plant personnel.
- PHAST analysis using the data collected.
- Discussing the potential performance and efficiency improvements.
- Discussion of commercially available and emerging technologies applicable to Company A.

- Wrap-up meeting and distribution of the DOE's literature on best practice and tools.

RESULTS

Table 3 shows the details of the energy saving opportunities identified as a result of the application of PHAST to the direct natural gas fired equipment.

CONCLUSION

Best Practices tools are an excellent free resource available to manufacturers. Their applications under the SEN program have produced impressive results. The use of these tools should be promoted aggressively.

Table 3. Energy savings opportunity summary information.

Identified Opportunity	*$*	*kWh*	*Savings/yr MMBtu*	*Fuel Type*	*N, M, L*
Control Air-to-Fuel ratio for Boilers 1-10	2,000,000		250,000	NG	N
Preheat Combustion air for Boilers 1-10	4,200,000		525,000	NG	N
Use more Efficient Burners at Boilers 1-10	1,100,000		137,500	NG	M
Insulate Hot Strip Furnaces	1,500,000		187,500	NG	N
Install Electric Combustion Controls on Boilers 1-10	2,100,000		262,500	NG	M
Install Electric Combustion Controls on HS Furnaces	2,700,000		337,500	NG	M
Install Electronic Combustion Controls on Triple G Furnace	350,000		43,750	NG	M
Implement Cogeneration	25,800,000		3,225,000	NG	L

N – Recommended for near-term implementation
M – Recommended for mid-term implementation
L – Recommended for long-term implementation
NG – Natural gas

References

www.eere.energy.gov/industry/bestpractices

ABOUT THE AUTHOR

D. Paul Mehta, Ph.D., is a professor in the Mechanical Engineering Department at Bradley University, as well as being the department chairman. He earned his Ph.D. in mechanical engineering from Iowa State University in 1979. He has more than 40 years of teaching experience and has initiated, developed, and taught several undergraduate and graduate courses in energy engineering. He directed the graduate program in mechanical engineering at Bradley University for the last 18 years. His research interests include applications of control theory to heating, ventilation, and air conditioning systems and to manufacturing processes for the purpose of reducing energy consumption. He has published numerous research papers in that area. Dr. Mehta has also directed the Industrial Assessment Center at Bradley University since 1993. Under this program, which is sponsored by the U. S. Department of Energy (DOE), Dr. Mehta has assessed about 350 small- and medium-sized manufacturing plants for energy efficiency waste minimization, and productivity enhancement. He has also assessed dozens of large energy users (LEUs) manufacturing plants under the Save Energy Now Program of the DOE. He is an active member of ASME, ASEE, ASHRAE, and AEE.