

## **Integrating Computerized Maintenance Management System And Energy Efficiency Management System A New Modified Approach**

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**Abstract:-** Integrating maintenance management and energy efficiency management computerized systems by restructuring an organization's maintenance enterprise information system to include energy usage data can save time and money that would be spent on creating and operating a separate electronic enterprise information system for energy usage. This paper proposes to add more modules necessary for energy efficiency management to an organization's existing computerized maintenance management system to be more efficient and effective. The main objective of the maintenance department can be restructured to change from being cost focused to profit focused. Since energy utility bills and life of equipment directly affect an organization's profits, the maintenance management department can be enabled to function as a profit saving center instead of a cost center. Increasing equipment life through effective maintenance and reducing energy utility bills directly increases the profits of an organization.

**Keywords:-** Computerized Maintenance Management System CMMS, Computer Aided Energy Restorability and Reliability System (CAERRS), Energy Efficiency Management System EEMS, M&T Monitoring and Targeting

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### **I. INTRODUCTION**

Energy management and maintenance management are often modeled as separated systems despite that a strong link exists between these two systems.

In the face of current international competition and increasing demands from stakeholders there is a basic demand to improve and integrate both these important activities performance

The definition provided by the DoE, USA for EMS energy management system

**“An energy management system is a series of processes that enables an organization to use data and information to maintain and improve energy performance, while improving operational efficiencies, decreasing energy intensity, and reducing environmental impacts.”**

*While MMS maintenance* management system is a series of processes that enable an organization to the planning, scheduling and, control of daily maintenance, and to assure the higher quality of equipment condition and output by providing fault and causes analysis, and keeping records on downtime analysis to improve assuring the higher quality of equipment condition and output, as well as assisting administration and management in increasing production and overall efficiency.

The rising energy prices have placed greater focus on minimizing energy usage in organizations today. Collecting the correct data and successfully converting the data into useful information is a difficult task to undertake. It is known that an organization can operate more efficiently and effectively by installing or improving their electronic enterprise information system(s). This paper proposes that organizations can also operate more efficiently and effectively by improving communication with the maintenance management and energy efficiency management systems to eliminate duplication in collecting and analyzing their energy usage data.

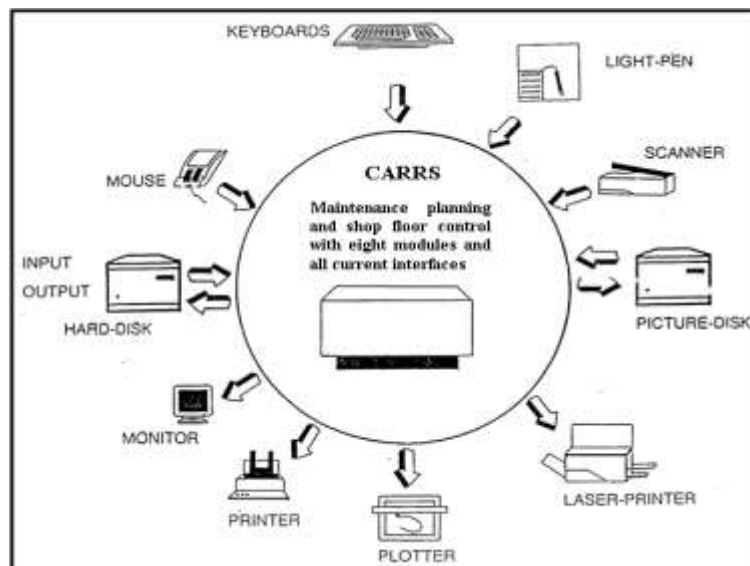
### **II. MAINTENANCE MANAGEMENT SYSTEM (MMS)**

A maintenance management system (MMS) refers to a system in an organization to achieve efficient and effective maintenance of an organization's equipment to maximize the life of the equipment. The term maintenance management system can also refer to a software package that maintains a computer database of information about an organization's maintenance operations – a computerized maintenance management information system (CMMIS) system configuration as shown in fig(1)[1]. This information is intended to enable maintenance workers to perform their jobs more effectively and to enable management to make well informed decisions leading to better allocation of resources. The data in an MMS may also be used to verify regulatory

compliance. To provide maximum benefit to an organization an MMS has to be efficient, address a wide range of demands and be able to expand with evolving needs.

Once CMMIS is implemented, several benefits should be obvious [2] [3]:

- Standardized work order will reduce maintenance time, paper work time.
- All information combined into one central location, decrease work time.
- Permanent, accurate records will help reduce equipment downtime.
- Standardized format aids organization and collection of information.
- Long- term benefit should be apparent through weekly and monthly production reports. These include:
  - Parts and materials availability will increase.
  - More regulated preventive maintenance will increase equipment life and help reduce emergency maintenance costs.
  - Production saving will increase as unscheduled down time decreases.
  - Purchase costs of parts and materials will be reduced.
  - Regular reports give a more effective and up to data record of inventory, stores reports, work orders and physical maintenance reports, which will reduce the cost of parts, inventory and labor. Reports also help increase management control.



**Fig. (1) System configuration**

### **III. ENERGY EFFICIENCY MANAGEMENT SYSTEM (EEMS)**

As an example of the prominence of Energy Efficiency Management System (EEMS)

Nearly 40% of total U.S. energy consumption in 2012 was consumed in residential and commercial buildings[4]also a similar figures was indicated in the European union[5] .

An energy efficiency management system (EEMS) refers to a system in an organization to achieve energy efficiency and to achieve the following goals [6]

- Integrated plant condition-based maintenance tools
- Plant output and emissions monitoring
- Integrated energy (gas, steam and electricity) and emissions optimization
- Plant portfolio management tools

Through well laid out procedures and methods, data collection, and continual improvement which will spread awareness of energy efficiency throughout an entire organization.

The term energy efficiency management system can also refer to a computer system which is designed specifically for the automated control and monitoring of those electromechanical facilities in a building which yield significant energy consumption such as heating, ventilation and lighting[7] .The scope may span from of a single building to a group of buildings such as university campuses, office buildings, retail stores networks or factories. Most of these energy management systems also provide facilities for the reading of electricity, gas and water meters

The signification of these systems is due to the fact that In the United States, the buildings sector accounted for about 41% of primary energy consumption in 2014, 44% more than the transportation sector and 36% more than the industrial sector. Also In the USA alone, buildings account for[4]:

- 72% of electricity consumption,
- 39% of energy use,
- 38% of all carbon dioxide (CO<sub>2</sub>) emissions,
- 40% of raw materials use,
- 30% of waste output (136 million tons annually), and
- 14% of potable water consumption.

Similar figures also show that the trends in other countries show an increasing use of energy by nations with emerging economies like (Southeast Asia, Middle east, South America and Africa) at an average of 3.2% annually and will exceed by 2020 that of (North America, Japan, New Zealand, Austria, And Europe) [8]

These figures should be a utilized to better planning to implement a more efficient energy management system. In 2011 the standard ISO 50001 was launched by ISO International standard organization to [9] [10]:

- Helping to achieve energy use reduction and carbon emissions in a systematic way;
- Creating a clear picture of current energy use status, based on which new goals and targets can be set;
- Evaluating and prioritizing the implementation of new energy-efficient technologies and measures;
- Providing a framework to promote energy efficiency;
- Providing guidance on how to benchmark, measure, document and report corporate energy use;
- Making better use of energy-consuming assets, thus categorizing potential to reduce maintenance costs or expand capacity;
- Proving to the stakeholder's commitment to comply with their best practice to protect the environment; and fulfilling the related regulatory requirements

Energy management is a critical procedure of energy efficiency, since it is vital for the effective operation of a country energy sector, for the environment's protection as well as for the justification of currency outflow from the national economy. Furthermore, energy management is considered as a significant factor to the energy saving of an operational unit of production. The basic concept of energy management is the continuous, systematic and well-organized audit of energy consumption, aiming at energy cost optimization with respect to energy demands, user characteristics, funding opportunities, financing ability and emission reductions achieved.

### **Why Integrate the MMS and EEMS**

With technology exploding throughout the computerized information system market, planning that maximizes organization system is imperative. According to McKinsey Global Institute, approximately one to three million nodes upload energy data from companies to the internet. [12] It is becoming increasingly more important for organizations to collect the correct information and not waste time collecting and analyzing information that is not necessary. Organizing efficiently and effectively the vast amounts of data being collected today are imperative to convert it into information that can be analyzed. Efficient and effective organization of the enterprise information system software is imperative to succeed in today's competitive market [13]. Integrating the MMS and EEMS gives an organization the correct data that is needed for energy savings and monitoring by modifying the assets register and the preventative maintenance (PM) work order system to allow an organization to gather the necessary data for this goal which mean less time on repeated activities and also the same work force which they collect regular information about the status of the equipment monitor and follow up the registered data about equipment energy conception. The data obtained from these systems can then be used to perform self-diagnostic and optimization routines on a frequent basis and to produce trend analysis and annual consumption forecasts. This can be achieved by adding another module to an existing computerized maintenance management system (CMMS) also known as enterprise asset management and computerized maintenance management information system (CMMIS) to achieve this goal].

### **Energy Efficiency Technique**

Using an energy monitoring and targeting (M & T), which is an energy efficiency technique based on the standard management axiom stating that "you cannot manage what you cannot measure". M&T techniques provide managers with feedback on operating practices, results of energy management projects, and guidance on the level of energy use that is expected in a certain period [14][15][16].

### **Goal and Benefits of Using M & T**

The following methodology is derived from the "Energy Monitoring And Targeting" chapter published by Dr. Ambedkar. [17] the goal of using M&T to determine the relationship of energy use to key performance indicators (production, weather, etc.) is to help business managers do the following:

- Identify and explain increase or decrease in energy use.
- Draw energy consumption trends (weekly, seasonal, operational...).
- Determine future energy use when planning changes in the business.
- Diagnose specific areas of wasted energy.
- Observe how the business reacted to changes in the past.
- Develop performance targets for energy management programs.
- Manage their energy consumption, rather than accept it as a fixed cost that they have no control over.
- Provide the necessary information for energy auditing and ISO50001:2011 certification.

The ultimate goal is to reduce energy costs through improved energy efficiency and energy management control. Other benefits generally include increased resource efficiency, improved production budgeting and reduction of greenhouse gas emissions.

### **Data Loggers**

The Energy Efficiency technique reutilizes data logger (also data logger or data recorder) devices which is an electronic device that records data over time or in relation to location either with a built-in instrument or sensor or via external instruments and sensors. Increasingly, but not entirely, they are based on a digital processor (or computer). They generally are small, battery powered, portable, and equipped with a microprocessor, internal memory for data storage, and sensors. The world leader in data loggers is claimed by Onset Hobo at [www.onsetcomp.com](http://www.onsetcomp.com). Some data loggers interface with a personal computer and utilize software to activate the data logger and view and analyze the collected data, while others have a local interface device (keypad, LCD) and can be used as a stand-alone device.

Data loggers vary between general purpose types for a range of measurement applications to very specific devices for measuring in one environment or application type only. It is common for general purpose types to be programmable; however, many remain as static machines with only a limited number or no changeable parameters. Electronic dataloggers have replaced chart recorders in many applications. One of the primary benefits of using data loggers is the ability to automatically collect data on a 24-hour basis. Upon activation, data loggers are typically installed and left unattended to measure and record information for the duration of the monitoring period. This allows for a comprehensive, accurate picture of the energy resources being monitored, such as ampere and voltage[18].

The recorded measurements can be used to prepare many reports and a basis for energy management audits, also it can be used to highlight the area in plant of highest energy consumption, and bad maintained and faulty machines consume more energy.

### **Modified Approach for Computer Aided Energy Restorability and Reliability System (CAERRS)**

The CARRS has been successfully implemented in the Dura refinery, Baghdad Iraq but with out

The suggested extra functions for the modified approach as follows:

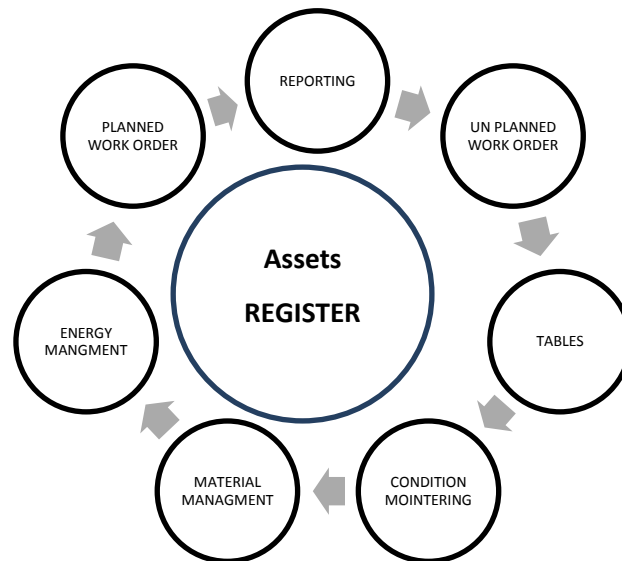
1. Assets Register incorporating a set of fields to take account of the energy data needed for energy management system. For example some basic equipment as follows:

- i) Electric Motors
  - (1) Amps (Full Load)
  - (2) Speed RPM (Full Load)
  - (3) Power Factor (Full Load)
  - (4) Efficiency (Full Load)
- ii) HVAC
  - (1) Cooling Capacity Btu (kW)
  - (2) Heating Input Btu (kW)
- iii) Air Compressor
  - (1) PSI
  - (2) Operating kW
  - (3) Load factor where max rated compressor load divided by average compressor load
  - (4) Efficiency of the compressor

More information can be found at the United States Department of Energy Manufacturing Office website.

- 2. Planned Work Order.
- 3. Unplanned Work Order.
- 4. Material Management.
- 5. Plant Condition Control Module.
- 6. Tables.

7. History.
8. Reporting.
9. Energy monitoring and targeting for standardization for energy performance and benchmarking EM&T or EMS module.as it shown in fig 2 below:



**Fig. (2) Computer Aided Energy Restorability and Reliability System (CAERRS) Modules Structure**

#### **Cost of Data Loggers**

The cost of data loggers has been declining over the years as technology improves and costs are reduced. Today many software programs are available to enable organizations to electronically collect and organize data. This has helped organizations by replacing paper methods and easily organizing the data into relevant information to be analyzed. Selecting the types of software programs and determining the number needed can be a daunting task for organizations. This has proven no different for the maintenance management systems and newly developing energy management systems. The hardware and software to collect and communicate the energy data can be found relatively cheap at sites such as the world leader in data loggers Onset Hobo, [www.onsetcomp.com](http://www.onsetcomp.com)[20]. For example basic data loggers start at prices of \$65, wireless sensors at \$169, and software at \$99. With HOBOWare software an organization can simply merge, import and export data files. With this ability an organization can use their existing maintenance management computerized systems to include the required data for their energy efficiency management computer system.

#### **IV. CONCLUSION**

As technology advances and both CMMS and EMM systems develop capabilities, opportunities for integration exist. IT professionals are more and more faced with information integration needs across traditional organizational limitations. However, many of the individual companies expansion prospects are difficult for utilities to justify on their individual merits, or to realize in the absence of readily available hardware and the need to raise the necessary funds to provide the suitable Data Loggers. A universal approach to providing integrated data enables the utilities to realize economic benefits in a similar universal way that they could not approach taken fragmentary. However, this requires planning projects that cross the old-fashioned organizational boundaries. Different business units may have to agree on the scope, budget and control of the technology

Beyond financial and operational benefits of systems integration, the need for better data management and controls is also becoming a driver for company level strategies. Increasingly, information is viewed as a company asset, which needs to be properly managed, controlled and made available to different company employers and uses.

Collecting the correct data and successfully converting the data into useful information can be greatly rewarding for an organization. The rising energy prices have encouraged more research to be conducted on how to minimize energy usage in organizations today. It has been found that focusing on reducing the energy we consume in the United States would have great results and help us become an energy independent nation. By improving communication with the maintenance management and energy efficiency management systems to eliminate duplication in collecting and analyzing their energy usage data, organizations can operate more

efficiently and effectively and help reduce the demand for energy as a whole the estimated costs will be pay able in only 5% reduction in energy cost targeted annually.

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