Implementation of ISO50001 Energy Management System

An Experience of a Copper Industry in Malaysia

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Abstract- **This paper contain the experience of implementing the ISO50001 Energy Management System (EnMS) standard in a copper industry in Malaysia. It is implemented through PDCA approach and able to show an energy saving of up to 3% in June 2013. Although, the company is not ready to go for certification of EnMS, the saving achieved is the push-factor for the management to stay committed with the improvement activities.**

Keywords—ISO50001, Energy Management System, Energy)

I. Introduction

Energy is embedded in any type of goods and is needed to produce any kind of service. Currently, the world's growing thirst for energy amounts to almost 96,000 meter^3 of natural gas, 1,000 barrels of oil and 222 tonnes of coal a second (BP2009) (Setti & Balzani, 2011). Looking into the statistics, the world electricity consumption is quantified as 42.6% in the industrial sector (International Energy Agency, 2013) Thus, the increase in carbon dioxide causes the greenhouse effect that, in turn, causes climate change (Setti & Balzani, 2011). The climate change is the main cause of natural disasters such as floods, droughts and tornadoes, which have a tendency to reduce the impact if protection of the climate is done globally through a sum of local contributions by adapting efficient EnMS(Fiedler & Mircea, 2012). Although industrial development is relied on in reducing poverty and improving the quality of life, particularly in developing countries in present century, the industries must therefore, become sustainable (United Nations Industrial Development Organization, 2011).

This make obvious reason for United Nations Industrial Development Organization (UNIDO) to recognize the industry's need to enhance competitiveness while responding effectively to climate change and to the proliferation of national energy management standards. The manuscript documented by Mc Kane clearly dictates the story behind the ISO50001 standard launching. In March 2007, UNIDO hosted a meeting of experts from developing countries and emerging economies, nations that had adopted or were developing national energy management standards and representatives from the ISO Central Secretariat. That meeting led to submission of a formal recommendation to the ISO Central Secretariat to consider undertaking work on an international energy management standard. Responding to the recommendation, in February 2008, the Technical Management Board of ISO approved the establishment of a new project committee (PC 242 –Energy Management) to develop the new ISO Management System Standard for Energy Management. Close coordination of the planned activities lead to the first meeting of ISO PC 242 in September 2008 at Washington with participation by delegates from 25 countries from all regions of the world, as well as representation from UNIDO, which has liaison status. The goal of ISO PC 242 is to develop the new management system ISO 50001 on an accelerated schedule. Between the first meeting in September 2008 and the second meeting in March 2009 in Rio de Janeiro, Brazil, ISO PC 242 produced two working drafts for expert review and comment by member countries. At the March meeting, a decision was made to go to Committee Draft in June 2009, following additional expert review and input. This puts development of ISO 50001 on track for publication in early 2011(McKane et al., 2010).

Industries have strongly supported the release of ISO50001. This is obviously reflected from the certification result to ISO50001, which marks the significance. A number of 461 certificates of ISO50001 Energy Management System (EnMS) were released to 32 countries

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within the 6 months of launching in year 2011(ISO Survey, 2012).

Having explained the strong support to the newly released ISO50001 standard, the remainder of this paper l presents the experience of a copper factory in Malaysia, in implementing ISO50001. It starts with participation of the factory in a UNIDO Energy Management System implementation program in Malaysia.

This paper will discuss:

i) how EnMS is applied through the Plan-Do-Check-Act (PDCA) cycle throughout the company
ii) the energy performance improvement achieved through the implementation of EnMS in the factory.

II. Literature Review

A. What is ISO50001?

ISO50001is a standard designed to manage energy across the entire international commercial sector, including industry plants and commercial facilities, as well as most other organizations, which applies to all factors affecting energy use that can be monitored and influenced by an organization (Eccleston, March, & Cohen, 2012). The purpose of ISO50001 Energy Management System (EnMS) standard is to enable organizations to establish the systems and processes necessary to improve energy performance, including energy efficiency, use and consumption. With the implementation of this International Standard, it is intended to lead to reduction in greenhouse gas emissions and other related environmental impacts and energy cost through systematic management of energy (Project Committee ISO/PC 242 Energy Management, 2011). The EnMS implementation model also applies Plan-Do-Check-Act (PDCA) cycle which consist of five clauses i.e. Energy Policy, Planning, Implementation, Monitoring and Corrective Action and Management Review (Eccleston et al., 2012).

B. Why ISO50001?

An ISO50001 energy management system (EnMS) is applicable to all the activities under the control of the organization, which enables an organization to achieve its policy commitments, take action as needed to improve its energy performance and demonstrate the conformity of the system to the requirements of the International Standard (Ranky, 2012). It is also an instrument to quantify the energy use and consumption, and to plan energy efficient practice by fine-tuning the operational controls and organizational behavior in order to achieve optimum energy performance with existing resources, with minimum or low cost investment, prior to suggesting improvement with economic constraint (Fiedler & Mircea, 2012).

Based on a study done in Romania and Europe, T. Fiedler and P. M. Mircea have reported benefits of adopting to the ISO50001 standards as energy saving (Ranky, 2012) -with lower cost and more efficient processes-, tax incentives from government e.g. Germany allowing lower electricity and gases tax as well as fees of related energy price, reduction of impact of climate change that is causing frequent natural disasters and better company image and reputation ((Fiedler & Mircea, 2012). On the other hand, ISO50001 is also described as increasing energy efficiency and improving energy performance (Ranky, 2012).

Besides, the design of ISO50001 that is based on PDCA Cycle, is a proven method of other most successful management system in organizations' i.e. ISO9001 for Quality Management System and ISO14001 Environmental Management System (Fiedler & Mircea, 2012; Heras & Boiral, 2013).

Several initial adopters, including the Dahanu Thermal Power Station in India, Schneider Electric Porsche, Lamborghini and the municipality of Bad Eisenkappel in Europe and some others from Taiwan and China (Duglio, 2011).

C. Challenges in ISO50001 implementation

Despite valuable benefits, achieving and sustaining the EnMS and energy efficiency are challenging for organizations. A study at the Ford Production System records three major challenges i.e. lack of management commitment(Ghislain & McKane, 2006; Ranky, 2012), lack of communication and understanding at all levels(Ghislain & McKane, 2006; Ranky, 2012) and design error due to not prioritizing energy efficiency during the design stage(Ghislain & McKane, 2006). Thus, overcoming these challenges will land the organization in enjoying the benefits of the systems.

III. Methodology

The method applied in this study is Participant Observation, a method whereby the authorr takes part in the activities that is being described(Holmes, Dahan, & Ashari, 2005). Reason for applying this method is since the author participated in the activities and to answer the research questions as mentioned in the "Introduction" section. The sample chosen for this study is based on convenience sampling whereby the previous study that have been analyzed and recorded are being written for publication(Holmes et al., 2005). This experience were gained during the the implementation of ISO50001 EnMS as described in the "Introduction" section.

During the EnMS implementation, the EnMS Tool which was developed by the UNIDO International Experts - adapted from the tool developed by Georgia Tech Research Corporation and U.S. Department of Energy- are applied to guide and record the implementation activities throughout the factory(United Nations Industrial Development Organization, 2013). For the purpose of liaison between the appointed trainee consultant and EnMS team of the factory, as well as the UNIDO International Experts, a factory representative was appointed as the coordinator. The EnMS activities resumed since July-2012 and completed in August-2013. Status of implementation was reported to the UNIDO International consultants through monthly webinars. The factory was visited by the trainee consultant to perform observation at minimum frequency of once a month. All the data were collected and communicated using the EnMS Tool updated by the factory representative. . Results of the EnMS implementation are shown in the next section.

IV. Results and Discussion

This section elaborates the main results of the observation that were conducted at the selected factory. It starts with explaining the background of company and followed by the implementation of the EnMS using PDCA cycle and reviewing the energy performance result after the implementation of the system.

A. *Background of the Company*

The company is a leading international supplier of copper components for manufacturing and construction. Its solutions are used in industries such as power generation, architecture, automotive, transport, medicine, air-conditioning, industrial refrigeration, scientific research, consumer products and construction. The company is certified to ISO9001 Quality Management System, ISO14001 Environmental Management System (EMS) and OHSAS 18001 Occupational Health and Safety Management System (OHSMS).

B. *Self-assessment of EnMS*

In order to guide the planning of EnMS, self-assessment was performed. Questions were prompted to the Facilities Department. In Table 1, the result of self-assessment is recorded. Based on the result, it is summarized that though the management is concerned and committed about the energy cost reduction, there is no energy management system approach that have been adopted by the factory.

TABLE 1: SELF- ASSESSMENT OF THE EnMS

No.	Questions	Status
i.	Is the top management committed to energy cost reduction?	Yes
ii.	Is there an approved energy policy in place?	No
iii.	Have roles, responsibility and authority been identified for all persons having an influence on significant energy use and is this documented?	No
iv.	Have the significant energy uses been quantified and documented?	No
v.	Has a baseline of energy performance been established against which progress can be measured?	No
vi.	Have indicator(s) or metrics been identified to use in measuring progress against your baseline?	No
vii.	Have the organization's energy objectives and targets been identified and documented?	No
viii.	Have energy action plans been established?	No
ix.	Is the energy management system evaluated at least once a year and are improvements made based on the results of the evaluation.	No

Source: (United Nations Industrial Development Organization, 2013)

C. *Management Commitment*

The Top Management gladly accepted the idea of EnMS and expected improvements. Thus, the top management defined the scope and boundary of EnMS implementation as, saving of electrical energy use and consumption at the copper manufacturing factory.

As to demonstrate the commitment, the top management formulated an energy policy, according to the ISO50001 requirement and approved by the top management. Upon approval, it has been communicated throughout the organization through management meeting, awareness training, intranet and banners.

Besides, an Energy Management Representative, a Certified Energy Manager and an EnMS Team were appointed. The EnMS Team consists of multi-disciplinary members that represent each department of the company, along with three UNIDO appointed trainee consultants. Their roles and responsibilities are defined, documented and communicated too.

In addition, there are two barriers of EnMS -within the organization- identified during the self-assessment i.e. low priority on energy management and energy elements are not integrated into operation, procurement, maintenance etc.

D. *Planning of EnMS*

Based on the self-assessment result, Energy review is performed. Based on the review, electricity is found to be the most significantly used energy source i.e. 98% of the energy usage. Thus, the electricity bills since January-2010 were compiled.

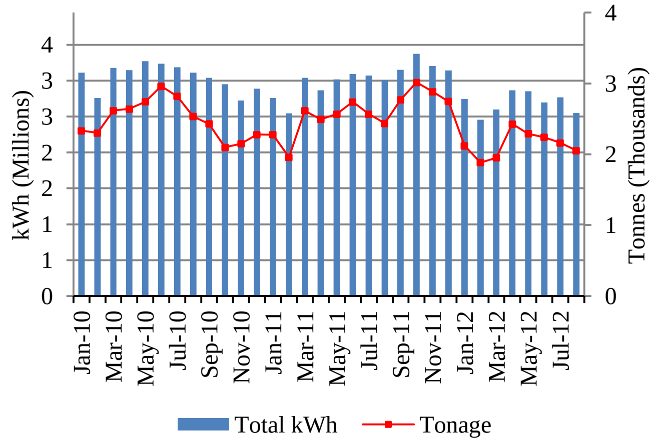

Fig. 1. Electricity (kWh) vs production output (tonnes)

Fig. 1 plots the trend of the energy consumption (kWh) against the quantity of production output (tonnes). Also, based on the trend analysis shown in Fig.1, energy users are listed and the rate of electrical energy consumption was estimated based on the nameplate and equipments manual. Thus, fig. 2 derived.

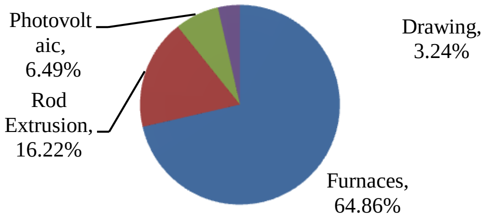

Fig. 2. Significant Energy User (SEU)

With the list and consumption rate, the list re-arranged with a range of maximum to minimum energy consumption rate.

After identifying the SEU, the energy drivers are recognized in order to understand the variables that drive the energy use e.g. production output, production order etc. Simultaneously, a regression analysis was performed using the same data that was used to plot the Fig.1 and a scatter diagram were generated as per Fig.3 to visualize the baseload of the present energy consumption i.e. year Jan-2011 to Dec-2012 and to obtain the linear equation of the compiled data. Meanwhile, regression analysis were also performed to develop a model that accurately describes the relationship between the X variables and Y variables, the correlation between the X and Y, the p-Value and the intercept in order to calculate the energy base load.

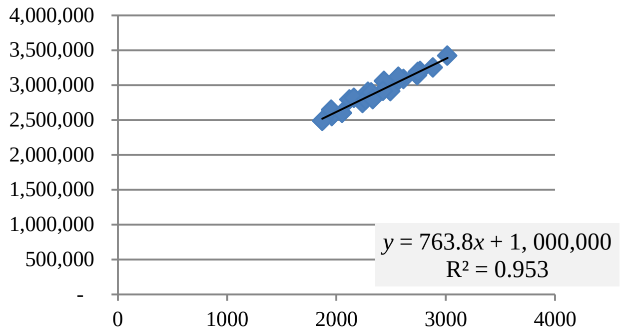

Fig. 3 Energy Consumption (kWh) vs Production Output (Tonnes)

Interpretation of scatter diagram in fig 3 starts with the linear equation i.e. (y= mx + b), whereby when Intercept X= 0.00125, substituting the x- value into the equation results with an indication of energy base load of 1,000,000kWh in the factory. The baseload means energy used when there is no activity driving its use(United Nations Industrial Development Organization, 2013). This is supported by the regression analysis, through the value of intercept and interpreted statistically. The "p-value" achieved is 2.46 x 10^{-7}, which is close to "zero" and "R^2" achieved is 0.953, which is close to "one". It is interpreted as good correlation between the model data being compared.

Note:

a) *if the p-value is less than 0.10, there is less than a 10% chance that the X and Y pair are not correlated. Therefore, the likelihood that these variables are correlated is very high; considered a statistically significant relationship.*

b) *The higher the R-squared, the better the model fits your data.*

For further details regarding interpretation of p-value and R^2 refer to http://blog.minitab.com/

Also, during the data and trend analysis, the Energy Performance Indicator (EnPI) had been determined as the energy usage unit i.e. the kWh and the production output i.e. the tones of output produced. The data gauged and compiled at monthly intervals.

E. *Implementation of EnMS*

With the results from activities of self-assessment, management commitment and trend analysis, the company began to implement the EnMS through the identified ECOs, Objectives and Targets settings and Action Plan including through revising the Operational Control procedures at relevant areas.

E1. *Energy Conservation Opportunities (ECOs)*

Prior to implementation, ECOs are categorized into "no cost", "low cost", "medium cost" and "high cost" opportunities. As to begin with EnMS implementation at the factory, the management decided to pursue with "no cost" and "low cost" opportunities.

"No cost" opportunities are housekeeping measures. Practice has shown that in many enterprises the amount of energy that can be saved by good housekeeping can be in the range of 25% to 50% of the total energy saving potential(United Nations Industrial Development Organization, 2013). Whilst, the "low cost" opportunities, as agreed by the management, are the ECOs that will cost the factory a maximum of MYR 20, 000.00.

E2. *Energy Objectives, Targetsand Action Plans*

Objectives and target set is "To reduce 5% of total electricity usage in the year 2013 as compared to 2012 usage".

This is set through estimation of saving that is achievable through "no cost" opportunities that is being tackled.

Examples of "no cost" action plans are employee awareness and operational controls i.e. reduce "open" time of induction furnace cover and reduce machine idling while the power is "on".

On the other hand, examples of the low cost opportunities are improvement of production yield and slag removal to maximize melting capacity.

In addition, the procurement of new energy consuming item must consider energy efficiency characteristic. Besides, energy efficient design must also be adapted during new design or any modification of system. Cost effects must be calculated as to justify the payback period of the investment.

F. *Checking of EnMS*

An internal audit was carried out by the UNIDO appointed trainee consultants to check the status of EnMS implementation. The audit findings are mainly highlighting insufficient documentation of the records relating to the implemented EnMS.

G. *Action- EnMS Management Review*

The factory continued the EnMS performance monitoring activities. But, the formal Management Review has not been performed. However, the Energy Management Representative updates the EnMS performance to the management team during the monthly management meeting.

H. Conclusion

The PDCA cycle was a great help for the company in systematically implementing the EnMS. The transition into this new management system implementation was carried out smoothly. However, only minimum documentation was done. This is due to the factory do not plan for immediate certification to ISO50001 EnMS. Instead, the factory wanted to observe the saving that are able to achieve through the EnMS implementation. Nevertheless, they are able to quantify a saving of cumulative sum (CUSUM) of 3% of energy -as recorded by June2013- which depicts that the action plan imposed are fruitful for the organization. The saving achieved is a worthy experience, which becomes a push-factor for the management to stay committed with the EnMS improvement activities. With the sub-meters installation and SCADA system in place since May2013, energy consumption data recording are improvised. Therefore, action plans shall be narrowed down further into significant areas. Those previously estimated areas may be re-looked and enhanced with better improvement actions.

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