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ENERGY MANAGEMENT CULTURES ASSESSMENT AND ITS IMPACT ON THE QUALITY OF SERVICE IN POWER PLANTS A RESEARCH GAP FOR FUTURE STUDIES

Noor Shakir Mahmood[1],Ahmed Ali Ajmi[2],ShamsulSarip[3], Hazilah Mad Kaidi[4], KhairurRijalJamaludin[5], HayatiHabibah Abdul Talib[6]

[1,2,3,4,5,6]University Technology Malaysia (UTM), Razak Faculty of Technology and Informatics ,54100 Kuala Lumpur, Malaysia

[1,2]University of Technology Baghdad, Ministry of Electricity / State Company of Electricity Production Middle Region, Iraq, Baghdad

Noor Shakir Mahmood[1],Ahmed Ali Ajmi[2],Shamsulsarip[3], Hazilah Mad Kaidi[4], Khairurrijaljamaludin[5], Hayatihabibah Abdul Talib[6] Energy Management Cultures Assessment And Its Impact On The Quality Of Service In Power Plants A Research Gap For Future Studies– Palarch's Journal of Archaeology of Egypt/Egyptology 17(7) ISSN 1567-214X.

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Abstract: Background: The power generation in the power plants is liable to diminish with the continuing losses in the quantity and quality of the electricity produced, as the power system exhibits critical deviations due to the lack of clear policies to adopt energy management programs in the power plants compared with other industries sector. **Aim:** This article presents the energy management system cultures assessment and its impact on service quality in power plants with two objectives. Firstly, an analytical study evaluating the worthiness of A learning management system (LMS) in various organizations, including the power production industry. Secondly, identify the popularity of LMS standards in the production and distribution of electricity sectors. **Methods:** In this paper, an analytical study has been performed to evaluate a learning management system (LMS) worthiness in various organizations, including the power production industry, and analysis the benefits, challenges, and motivation of adopting ISO 50001in the power plants. Data of ISO enlighten LMS in various global organizations are obtained from Clean Energy Ministerial (CEM). **Results and Discussion**: Results found that only 7.69 % have been adopting EMs in the power plants. The rest, 92.31% in other industries. The results indicated a lack of awareness in the organization's culture and top management support in adopting energy management programs in power plants, as they represent the two most significant challenges facing the implementation of energy management programs in the power plants. **Conclusions:** This research contributes to strengthening and filling the literary gap by investigating quality restrictions and energy management standards ISO 50001, representing a major challenge facing electricity production and distribution. Thus, intensive study to analyze the level of energy management in power plants is highly recommended as future work and further investigations about the role of top management support and the organization's culture in facilitating the implementation of energy management programs.

1. Introduction

Energy management and conservation is a difficult job in many regions of the world. Many variables, including fiscal, environmental, and policy, impact energy management activities significantly and contribute to several reservations in effective decision-making. EMS provides a systematic blueprint for operational performance, efficiency, and profitability (Jiang & Tan, 2020). Energy is generated by means of power systems, which involves two essential domains: Power plants that depend on fossil fuels (e.g., steam turbines, gas turbines, nuclear reactors, etc.) and green energy harvesting power plants (e.g., wind turbines and photovoltaics) (Katsaprakakis, 2020). A power system is susceptible to various performance degradations, which eventually increase the total cost by raising more path losses (Ayodeji Olalekan Salau, 2020). Loses can take place at any sector of the power system ore likely at generation, distribution, and load. Generation stations /power plants are encountered losses due to emission and equipment faults(Hofmann, 2020). Gas emissions in gas power plants are a symptom of error/fault at the turbine compressor; it influences the gas power, reducing the mechanical torque that rotates the turbine blades(Jake Airey, 2019).

On the other hand, most energy losses occur at the distribution system and transmission lines (Wang *et al*., 2020). Faults in distribution systems are among major losses influencing the power system. Since the inductive loads increase the reactive power (VAR), which increases the power losses, the load nature also impacts the power system's performance (Kamel, 2020). Power grid involves connecting a set of generation plants with loads in particular topology ensures optimum power flow. The grid topology is disturbing due to events like fault or fails in a particular busbar. The power grid needs to be updated according to power system fluctuation, such as changing the load nature or equipment failure (Zimann, Batschauer, Mezaroba, & Neves, 2019). Considering that power generation is limited by several constraints such as fuel availability and cost-related matters, supplementary systems are required for facilitating the power generation and distribution. Energy management system (EMS) has come into the picture after the energy demand increased, and energy generation is restricted. Paris calamite agreement has restricted the level of emissions from industries like power plants, which influenced the amount of generated power from such plants (Development, 2019). Besides, fossil fuel dependency has its limitations, too, as fossil fuel is expected to exhaust within the next 60 years (Eia, 2019).

Knowing that energy demand is a function of the human population, and since the population keeps expanding, the demand is highly increased in current years compared to the last decade. Energy resource optimization is the key solution for balancing the load and generation in energy sectors. Robust EMS is in charge of maintaining energy generation and energy demand in equilibrium. EMS involves service alike cost minimization and optimum resource allocation.

This research contributes to strengthening and filling the literary gap by investigating quality restrictions and energy management standards ISO 50001, representing a major challenge facing electricity production and distribution. This research has engaged in a case study to analytical performed for evaluating the worthiness of a learning management system (LMS) in various organizations, including the power production industry.

This paper aims to answer the following questions: 1) What are the quality constraints and problems faced in power production and electricity distribution from the energy management system's point of view? 2)What is the level of popularity of LMS standards in the production and distribution of electricity sectors?

This research presented two specific objectives. 1) To an analytical study evaluating the worthiness of A learning management system (LMS) in various organizations, including the power production industry. 2) To identify the popularity of LMS standards in the production and distribution of electricity sectors.

2. Materials

Enhancing the performance of energy management and efficiency is an essential issue in the various work sites, and this measure requires regulations and protocols to ensure its good performance. International standards origination (ISO) has taken responsibility for drafting the standards regulating the operations of various systems and technologies, including power generation plants. Furthermore, it saves natural resources and protects the mother earth by limiting the fossil fuel-based industries' poisonous emissions (Cihon, 2019).

2.1 ISO 50001

ISO 50001 standard (which will be termed hereafter as "the standard"); has formed as an energy management system for enhancing the power consumption efficiency at organizational level ISO (including generation stations and the end-users). In a comprehensive power management process, ISO 50001 aims to help companies continually increase their energy efficiency. The specification defines specifications for an energy management system (EnMS) that helps any company deepen and maintain energy efficiency changes (Brem, Cusack, Adrita, O'Sullivan, & Bruton, 2020). Any organization can implement the standard represented by a set/bunch of regulations and roles, i.e., residential compounds, hospitality buildings, power plants, etc. according to (Secretariat, 2018), the largest hospitality company; the Hilton has minimized their power cost as well as carbon emissions by 20.6 % and 30% respectively after implementing the standard. Another example can be reviewed about the national Ireland police force, which reduced energy consumption and saved 11307142 USD after implementing the standard (ISO). However, organizations following the standard must have reviewed by ISO auditors to verify the same, and accordingly, the organization is granting ISO certification of "the standard" adaptation. The following section explains the benefits, challenges, and motivation of ISO 50001 in the electricity sector.

2.1.1 Analysis of advantages adopting ISO 50001

Many of the advantages of introducing ISO 50001 energy management in enterprises in general and the electricity industry, in particular, include cost reduction, efficiency, and organizational changes. Figure 1 indicates that 71 % of companies achieved cost reduction, 54 obtained on environmental sustainability, productivity increased by 40%, and organizational culture enhanced by 41% because of adoption of energy management ISO50001(Fuchs, Aghajanzadeh, &Therkelsen, 2020; Marimon& Casadesus, 2017).

A better organizational culture increased competitiveness, and a business's enhanced reputation was among the most commonly reported benefits in the case of studies, with 40%–54% of cases noted. Increased productivity may result from reduced plant stopped increased plant capacity, enhanced resource savings from automated processes, time, and energy saving. Case studies are more often referred to as environmental protection as regards pollution reduction. One of the key advantages is improved morale for workers, improved organizational culture, and a culture of continual change listed by almost half of the organizations.

The promotion of an energy efficiency culture has been described as a critical challenge for management and the company in 47 percent of case studies promoting ISO 50001 energy management (Agüera, 2020; Ferrari, Bruni, &Bramonti, 2020; Fuchs et al., 2020; Isensee, Teuteberg, Griese, & Topi, 2020; Kamat, Mahmood, &Ajmi, 2016).

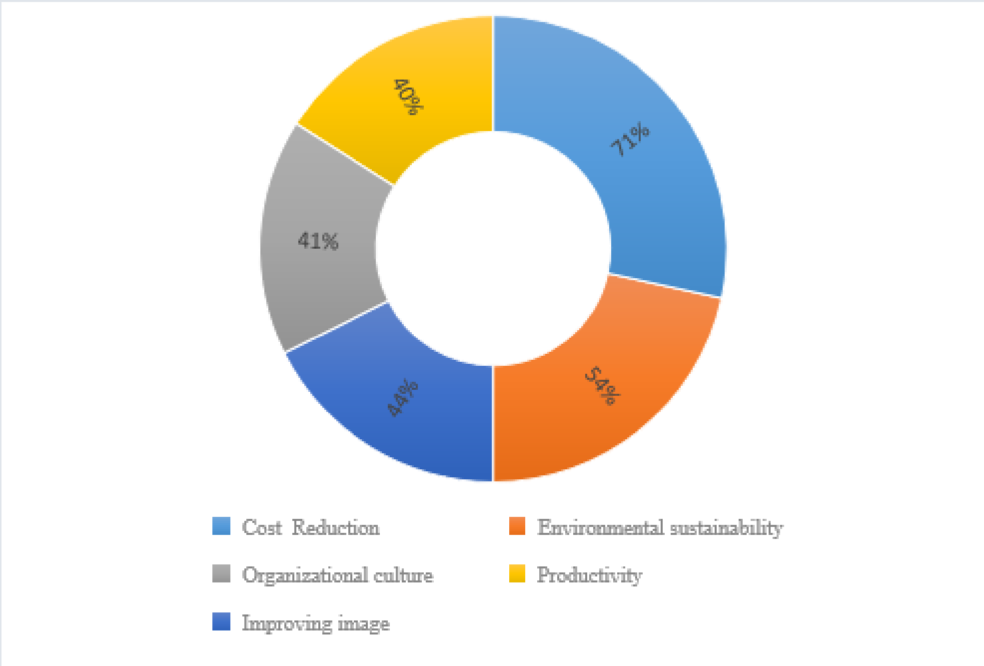


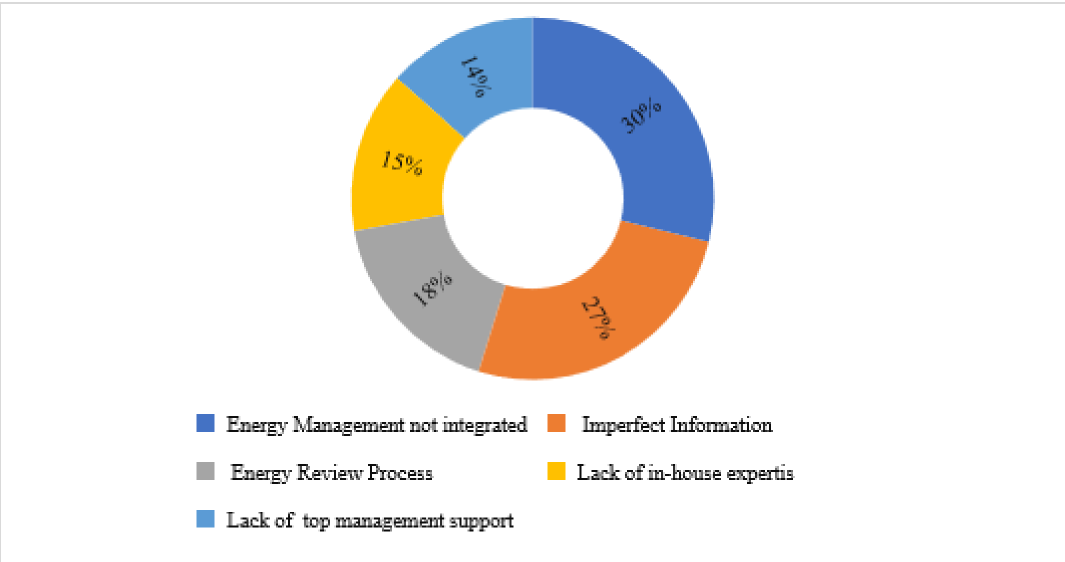
Figure 1. Analysis benefits of adopting EM ISO 50001

2.1.2 Analysis of difficulties adopting ISO 50001

80 % of the literature reported at least one obstacle they encountered in introducing ISO 50001 in organizations. At the same time, a third of the studies concentrated more on the obstacles than the advantages they could achieve in enforcing the standard ISO 50001 (Rampasso *et al*., 2019). About one-third of the case studies have described the lack of an organizational energy management culture as a significant obstacle. The difficultiesof engaging factory workers adequately to inspire them to look after resources, institutionalization, synergy, and engagement throughout were largely based on culture. Next, 30% of all cases showed that energy management is not yet integrated, and 27% have imperfect information, and 15% lack in-house expertise (Batlle *et al*., 2020). The literature reviews indicated that 14 % of all case studies cited to the lack in the top management support as a challenge and gap in research on tried adoption of energy management; the emphasis has been on the rise in productivity, profits, sustainability, and the lack of understandng of the advantages of energy efficiency against these objectives. In addition to previous literature, the lack of expertise was described as one of the essential success factors in professional energy management expertise, knowledge of ISO 50001 energy management criteria, and specifics of energy management systems (Batlle et al., 2020; Gardas, Raut, & Narkhede, 2019; Rampasso et al., 2019; Rouvinen, 2020; Yuriev & Boiral, 2018). Figure .2. Refers to an analysis of challenges that are facing adopting Energy Management ISO 50001.

Figure 2. Analysis Challenges of adopting EM ISO 50001

2.1.3 Analysis of reasons to adopt ISO 50001



The organization objective, the sustainability of the environment, improved company image, and cost reduction are among the most significant motivations for adopting ISO 50001 energy management systems. The most common drivers in terms of the absolute number of references and the number of case studies (72%) are existing energy objectives, and 72 % of the literature indicated organizations seek to implement energy management standards, while government legislation contributes 48%. Improving the company's reputation when energy management standards are approved will contribute by 37%, and energy management programs will reduce work costs by 54%.

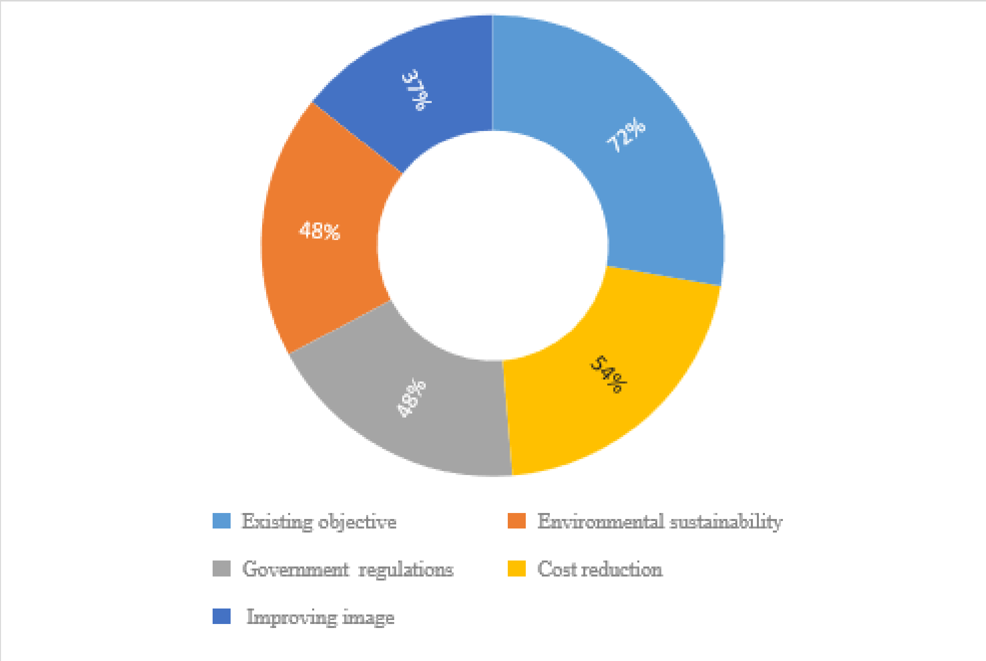


Figure 3. Analysis of motivations to adopting Energy Management ISO 50001.

Finally, company reputation has also been related to improving competitiveness in the body of case studies. These experiences can reassure businesses that advertising the implementation of ISO 50001 energy management systems will strategically place accredited organizations above their competitors. Figure .3. Refers to an analysis of motivations to adopting Energy Management ISO 50001. (Fuchs, Aghajanzadeh, & Therkelsen, 2020; Jekabsone, Kamenders, & Rosa, 2020; Pelser, Vosloo, & Mathews, 2018; Rampasso et al., 2019; Rouvinen, 2020)

1.1. Quality Constraints

Power can be generated with respect to load requirements; considering that power demand is continuously increasing due to population expansion or any other circumstances, the generation stations could maintain standby mode for fulfilling the demand. Future prediction of load/demand is not a tough task(Ali Reza Sobbouhi, 2020). It can be evaluated using traditional analytical and statistical methods (Yang Wang, 2020). The power system's practical situation is farther than predicting the future; it is actually suffering from several performance degradations linked to the production and distribution systems. Most of the reported losses in power systems occur in the distribution network, where power is carried through transmission lines towards end-users. The assumption mentioned above of using analytical and statistical methods for determining future load status cannot stand with the uncertainty of load fluctuations. On the other hand, load may suddenly increase over particular nodes in the distribution network and may sharply drop over other nodes, resulting in the so-called loading imbalance. Load congestion over particular nodes in the system triggers more significant problems such as transformer short circuits or dropping at the busbar voltage profile(Amirreza Naderipour, 2020). This can occur during a transmission line fault where the faulty sector's load is fed from other feeders. Hence, feeders may themselves experiencing a high load, which poses a loading imbalance issue. Such events are highly probable during seasonal loads, e.g. (air conditioners are active during summer more than in winter).

The imbalance loading problem can be tackled using advanced monitoring systems that capable of detecting the fault rapidly. Intelligent monitoring systems are presented in (M. Talaat, 2020) where proactive monitoring is performed, which predicts the event of errors before it has actually occurred. Load fluctuation due to other aspects such as demand increasing over particular node/busbar in the network is also addressed using optimization algorithms such as artificial bee colony (ABC)(Liling Sun, 2020), genetic algorithm (GA)(Inès Hilali-Jaghdam, 2020), particle swarm optimization (PSO)(Gretel Bernal Baró, 2020), etc. Such algorithms are searching the optimum feeders and diverting the loads amongst them for balancing the network. Instantaneous error addressing procedure is required for maintaining the high quality of power transmission. Such procedures are folded under EMS, which helps power companies as well as the end-users/consumers in both quality and economic aspects.

1.2. Industrial Energy Management

EMS is high needs in intensive power consumer industries such as cement and petrochemical factories. Energy management in such industries has largely improved during the last 30 years as effects of EMSs incorporation. This indicates that the potential amount of energy can still be utilized. The general formulation of EMS definition can be stated as optimizing energy efficiency in the organization, including industries and service appliances. A finding of the energy efficiency gap is vital for successful EMS. The difference between the optimum efficiency (during the design process) and real-life efficiency (monitored during the practical situation) is termed as a gap of efficiency (Schulze, 2016).

The value efficiency gap can be used to measure future targets of energy enhancement achievable through EMS. As stated by (Backlund, 2012), management of energy is an adaptation of all procedures during the planning phases and all routines during the operation phases, which participates in energy efficiency improvement. Such planning strategies and operations routines are cited from experiments and empirical models which were in use during the previous attempts for efficiency improvement. In order to compile those strategies, five systematic stages are proposed by (Fortin, 2006), namely planning strategies, operations strategies, controlling strategies, management (human resources) strategies, and cultural strategies. Compiling of those stages may help in bringing the MSE into practice. Thus, EMS's five strategical stages mentioned above are specified by special bodies, namely, committees taking different posts (in private or governmental sectors and formed officially under the so-called standards. The instructions/roles of energy management are varying in accordance with the provisions of governments. International standardizations are generally enforcing maximum energy efficiency, and safety was formulated by organizations such as the international standard organization (ISO).The European parliament and industrial emission directive council have formulated a document called 2008/1/EC that enforces particular roles for efficient energy management in the industries(Commission). Power industries have witnessed large developments in terms of capacity and size. The control systems have drastically developed as new technologies came into light, e.g. (artificial intelligence and machine learning). The international standard organization has come with respective norms in order to regulate the overwhelming development of technology. ISO has drafted 50001 first in 1995; hereafter, several developments rely on the mentioned standard called ISO 50001: 2008 (ISO) and ISO 50001: 2011. Emerging of new technologies and tools in power systems had motivated the periodical editions of the standards.

1.3. Standards Correlations

In preceding sections of this paper, it was discussed that standards involve efficient regulations and procedures formed by specialized organizations/bodies for energy enhancement interest (it can also be formed for other technologies apart from the energy sector, e.g., communications and spectrum allocation ISO/IEC 15961-2:2019). However, it is formulated by originations such as ISO, international communication union (ITU), etc. Governmental agents may also formulate local/country-wise norms/standards of EMSs. For adopting any standard in real-life, a correlation process is mandatory. At (Gonc□alves, 2019), the quantitative methodology is prosed in order to evaluate the correlation of ISO 50001: 2011 with the situation of practical power generation plants.

The study has been established by formation a number of questionnaires according to the hypothesis and subsequently testing those hypotheses according to the results obtained from questionaries' analysis. (Gonc□alves, 2019)proposed modifications on some clauses of the existing standard and adding other clauses to the said standard for increasing power efficiency. Basically, proposing any modifications in existing standards requires feedback and opinions of the specialist committee who may accept or reject the proposed idea. Hence, after the committee approved the proposed ideas, a pilot study could be initiated to understand those modifications' applicability on real-life projects. Proposed modification might be assessed under several constraints, alike cost, time, cultural aspects, manpower, local (geographical) authorities' regulations, etc.

2. Results and Discussion

In this article, a case study has been done to the analytical the various applications, fields, and sites that had adopted the ISO 50001 standards. ISO has wide varieties of standards that regulating energy use for improving efficiency. In other words, EMS available standards are aimed to fill the gap between designated/theoretical and practical efficiency. They do so by governing the ways of energy generation, power system control and monitoring, manpower and safety, and energy-efficient consumption. Taking the example of energy rationing at consuming stations, energy-saving light bulbs include light-emitting diodes (LED) based lighting; have been widely populated according to ISO 50001. Like energy-saving lights, all the electrical home appliances are today manufactured to save energy. Today, machineries are integrated with smart control systems (using electronic chips) for energy harvesting to recognize the impact of robust EMS standards on energy efficiency. This paper is demonstrating various applications, fields, and sites that had adopted the ISO 50001 standards. United Nations for industrial development organization (UNIDO) has approved and ISO 50001 and promoted using this standard after witnessing the organizations' enormous success that implemented that standard (UNIDO). According to ISO official web portal, the energy management system has a core standard termed as 50001; all the relevant standards that mentioned in Table 1, as well as on the ISO web portal are commentaries are established for supporting the core one. Depending on the data obtained from(Misnterial), Clean Energy Ministerial (CEM) is found to promote clean energy through the conduction of a high-level international award representing the leading organizations in energy management proficiency. In the following table, ISO standards that developed up to date are demonstrated in Table 1.

Table 1. ISO EMS related standards summaries.

ISO Standard	Description
50001:2011	EMS (the requirements and how to use) first edition
50001:2018	EMS (the requirements and how to use) second edition
50002	States about auditing of energy and released in 2014.
50004	Released in 2020 and involved the guidelines of improving the existed standard 50001.
50005	Involved phase-wise implementation of existing standard 50001.
50006	Released in 2014 and stated about energy performance monitoring using performance indicators.
50015	Released in 2014 and stated about energy performance validation and measurements.
52120	Stating about building EMSs.

CEM forum is commenced in 2016 and involved 28 members by the date when this paper was written.In 2018, 50 organizations from global had involved with CEM when excellence award in energy management was granted for three members: The Russian, PJSC Magnitogorsk Iron and Steel Works (MMK)(Works), the Ireland, A Garda Síochána (AGS) and the Indonesian PT. PembangkitanJawa-Bali Gresik(PT PJB)(PJB)).

However, CEM is working on promoting the benefits of investing in energy efficiency technologies. It keeps analyzing and validating ISO 50001 LMS standards by collecting annual energy costs reports from its members. It also focuses on the determination of yearly carbon emission reductions. As per the current CEM report, total cost reduction of 383 million dollars and 4.3 metric tons of CO_2 has been reduced by CEM members after accurately implementing ISO 50001 (e.g., the standard).

The profiles of top CEM awarded members can be summarized as follows:

1> AGS at Ireland: this origination is representing the national police force in Ireland. It is considered as first police in the world, which is certified with ISO 50001. AGS has applied 50001 norms on the vehicles fleeting over two of the largest Ireland cities. By the whole, AGS could harvest a sum of 11.3 million dollars and eliminate 70,340 metric tons of vehicles Carbonic emissions for eight years.

2> MMK in Russia is the biggest steel manufacturing company in Russia. It has adopted the norms of 50001 and subsequently harvested 20.5 million dollars (for one year) and a total of 698,186 metric tons of CO_2 elimination for three years.

3> PT PJB at Indonesia is a steam power plant that supplies east Java with electricity; it has implemented the 50001 norms for three years and could successfully achieve the government budget goal of harvesting a sum of 9.69 million dollars and eliminating 2.72 metric tons of CO_2. In the study, some global projects recognized by CEM as active partners of green energy harvesting are listed in Table 2.However, from virtual inspection of this paper's aforementioned information, one can understand that total originations/samples collected from CEM are 26, out of it, only two by 7.69 % in the power plants, and the rest 92.31% in other industries are varying under different applications.

The histograms plotted in Figure .4. and Figure .5. are made according to the obtained data (Table 2). According to the obtained results, it can be said that most of those who are using EMS standard (i.e., ISO 50001) are considered as power consumers from a power analysis point of view.

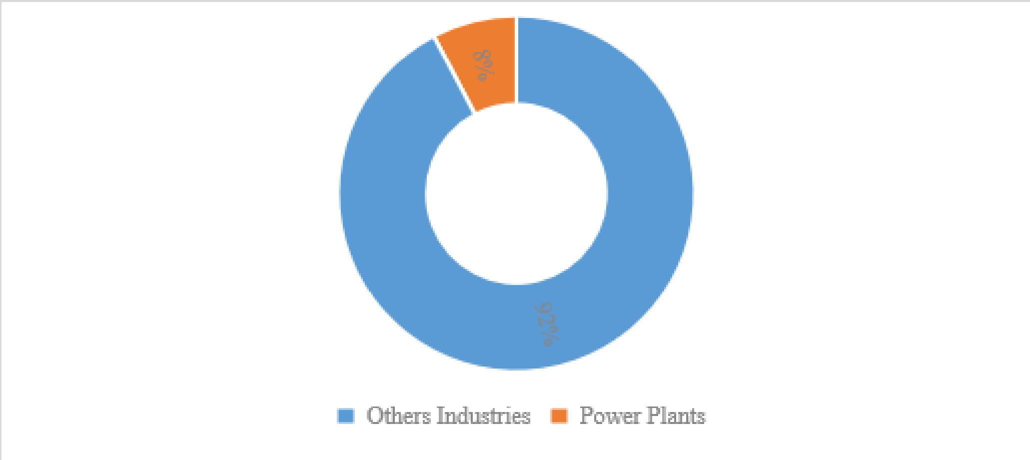


Figure 4.EMS ISO 50001 deployment in power plants as compared to other fields.

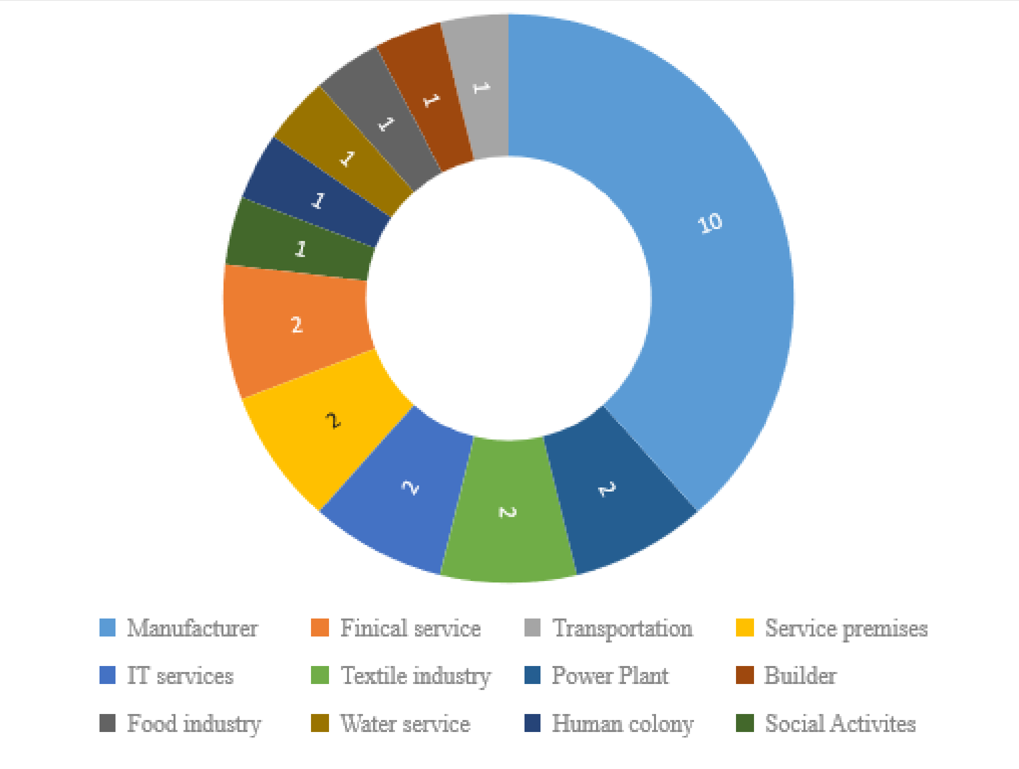
The retails have found the best way for cost-cutting is the implementation of the standard at their own organizations. Fewer efforts were performed in the adoption of the standard over power plants.

Table 2. CEM data illustrating the applications (samples) using EMS standards.

SN.	Organization	Type	CEM reward	Country of origin
1	ABB SA.	Manufacturer	EM Insight Award	Argentina
2	Abu Dhabi City Municipality	Human colony	EM Insight Award	UAE
3	AguasAndinas	Water service	EM Insight Award	Chile
4	Allied Irish Bank	Finical service	EM Insight Award	Ireland
5	Banco de Crédito e Inversiones	Finical service	EM Insight Award	Chile
6	Beijing Capital International Airport Co., Ltd.	Transportation	EM Insight Award	China
7	Dubai Municipality	Service premises	EM Insight Award	UAE
8	El Araby Company for Trading and Manufacturing	Manufacturer	EM Insight Award	Egypt
9	Google	IT services	EM Insight Award	Belgium, Ireland, Singapore, Taiwan, USA,

				Canada
10	Grasim Industries Limited	Textile industry	EM Insight Award	India
11	JK Cement Ltd.	Manufacturer	EM Insight Award	India
12	Land T MHPS Turbine Generators Pvt. Ltd	Manufacturer	EM Insight Award	India
13	LG Electronics Inc., LG Digital Park	Manufacturer	EM Insight Award	Korea
14	Zhilkomservice	Builder	EM Insight Award	Russia
15	ViñaCono Sur	Food industry	EM Insight Award	Chile
16	Vardar DolomitDooel	Manufacturer	EM Insight Award	Macedonia
17	Sungshin Cement Co., Ltd.	Manufacturer	EM Insight Award	Korea
18	SIN PAR SA.	IT services	EM Insight Award	Argentina
19	Roads and Transport Authority Dubai (RTA)	Service premises	EM Insight Award	UAE
20	Raymond Limited	Textile industry	EM Insight Award	India
21	Puerto Ventanas SA.	Manufacturer	EM Insight Award	Chile
22	PT. PembangkitanJawa-Bali Paiton	Power plant	EM Insight Award	Indonesia
23	PT. CheilJedang Indonesia	Social Activities	EM Insight Award	Indonesia
24	MMK	Manufacturer	Award of Excellence in EM	Russia
25	PT PJB	Power plant	Award of Excellence in EM	Indonesia
26	AGS	Manufacturer	Award of Excellence in EM	Ireland

Figure 5. Demonstration of deployment rates of all applications enlisted in Table 2.



3. Conclusion

This research has engaged in a case study to analytical performed for evaluating the worthiness of a learning management system (LMS) in various organizations, including the power production industry. After analyzing data obtained from the CEM portal involves the worldwide ISO 50001 certified industries and CEM awarded companies. We referred to the CEM portal as it considers the majority of ISO 50001 implementors on a global scale. However, this portal may not include the entire data of whole ISO 50001 based organizations in the world. However, it provides sufficient insight into world-leading industries that are used the standard and granted the same advantages. There must be standalone organizations that are not CEM partners but still deployed the standard.

The results indicated a lack of awareness in the organization's culture and top management support in adopting energy management programs in power plants, as they represent the two most significant challenges facing the implementation of energy management programs in the power plants.

Thus, intensive study to analyze the level of energy management in power plants is highly recommended as future work and further investigations about the role of top management support and the organization's culture in facilitating the implementation of energy management programs in order to get insight into the power generation efficiency and for planning the methodology for tackling them.

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Noor Shakir Mahmood
University of Technology Baghdad, University Technology Malaysia (UTM), Razak Faculty, Ministry of Electricity, GCEP/ Middle Region, Iraq.
noor.utem@gmail.com

Ahmed Ali Ajmi
University of Technology Baghdad, University Technology Malaysia (UTM), Razak Faculty, Ministry of Electricity, GCEP/ Middle Region, Iraq.
ajme1900@gmail.com

Shamsul Sarip
University Technology Malaysia (UTM), Razak Faculty of Technology and Informatics, Malaysia
shamsuls.kl@utm.my

KAIDI, Hazilah Mad
University Technology Malaysia (UTM), Razak Faculty of Technology and Informatics, Malaysia
hazilah.kl@utm.my

KhairurRijal
University Technology Malaysia (UTM), Razak Faculty of Technology and Informatics, Malaysia
khairur.kl@utm.my

Hayati Abdul Talib
University Technology Malaysia (UTM), Razak Faculty of Technology and Informatics, Malaysia
hayati@utm.my