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A Practical Research Methodology for Implementation of the Ems in Iraqi Enterprises

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Abstract: ***In practice, energy management encompasses several activities that give objective data on the principal users of fuel and energy, the energy efficiency of various developments and certain types of products, and energy conservation reserves. This research investigates the benefits and stages of EMS that must be adopted in Iraq. The work considers the significance of using EMS technology at Baghdad International Airport. Airport infrastructure necessitates much energy due to its vast size and particular design. Annually, the airport consumes nearly 9.2M KWh, costing 1.2 billion Iraqi Dinars/KWh. As Iraq's current energy crisis is massive, the energy audit will show an accurate picture of the energy consumption. EMS aims to increase the organisation's stability (including financial) and improve its competitive position by reducing costs and increasing management efficiency. The work has accomplished that Iraqi companies need a modern management strategy-energy consumption management. Traditional heads of departments must be updated to be active in fixing the organisation's energy issues. The EMS technology can identify conflicts and re-document structures. The technique also enables addressing any safety issues in the design phase. Therefore, this paper contributes to enhancing and developing the traditional Energy Management System in Iraq***.

Keywords: Energy Management System, Smart Energy System, Planning, Sustainable Development.

I. INTRODUCTION

The energy management system (EMS) is a complex of interconnected and interacting structural elements of the organisation, based on the energy policy formulated by the organisation, the goals and objectives of energy saving and energy efficiency activities, as well as a mechanism (unique processes and procedures) that allows achieving the set goals. An EMS is a comprehensive tool that enables organisations of any type and size, regardless of geographical, cultural or social conditions, to develop the systems and procedures required to increase energy performance, such as energy productivity (energy efficiency), energy usage and consumption [1,2].

Energy management should be considered a set of managerial methods to improve the organisation's energy efficiency, in contrast to engineering, technical, technological, and others. Highlighting the managerial (organisational, administrative) ways of influencing energy efficiency is necessary to understand a specific conditionality of such a division. Only various managerial and subsequent technical measures selected for each case will provide optimally [1,2]. Engineering solutions and technical innovations will also lead to more efficient energy resources. However, their subordination to the management system built in the organisation will make both the process of improving energy efficiency and the functioning of the organisation itself sustainable. It has been repeatedly noted how huge and inexpensive the organisational potential of energy saving is to implement.

The intentions of EMS implementation are [1, 3]:

- Confirming the integration of energy-saving and energy efficiency activities into the overall structure.
- Safeguarding more efficient use of energy resources.
- Improving comparative analysis, documentation, and reporting.
- Reduction of industrial waste.
- Transparency and knowledge sharing in the field of energy management.
- Stimulating the introduction of innovations, assessing, and prioritising the introduction of new energy-efficient technologies.
- Iraq endures chronic energy shortages for the 30th consecutive year, a genuinely perplexing scenario given the country's vast oil and gas reserves. The rising electrical shortages exacerbate the situation. Therefore, Iraq gets almost 40% of its power from neighbouring Iran. Due to corruption and terrorism, the people suffer from a massive energy crisis. The average temperatures in the summer reach 52°C. Thus, this manuscript shows the importance of implementing the EMS in Iraq to add stability, including financial and improving the power consumption. The energy audit will provide an accurate picture of what is happening in energy consumption. Most of the Iraqi heads of the departments have traditional knowledge; the idea of the EMS is still absent in Iraq despite the several research papers published [4].

Due to the unrest, particularly in Baghdad, there have been few changes in existing infrastructures regarding sustainability. Baghdad International Airport, Iraq's central hub, was built in the 1970s. The airport has never been upgraded or enlarged. The 20th century's technology is still in use. Airports are vital components of the global transportation system that supports and promotes passenger, freight, and tourist transit. Therefore, airports must be socially and ecologically responsible. All the mentioned above proves that the energy management sector in Iraq needs modernisation due to a lack of government effort, a reluctance to change, and an inadequate understanding of EMS advantages. Therefore, this paper contributes to enhancing and developing the Energy Management System in Iraq.

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II. THE RESILIENCE OF IMPLEMENTING THE EMS

The EMS determines the state of the energy resources accounting system by developing a plan for its modernisation. It helps observe the distribution of energy resources within the organisation both in physical and value terms. The system also analyses power supply schemes to develop measures for their modernisation. The management system involves modern and reliable power equipment for operating efficiently. This also assists in obtaining a mechanism for solving problems associated with inefficient or unsustainable use of energy resources. Therefore, it reduces the total cost of energy resources. The system can also determine the state of the energy sector and technical systems in figures with the developed modernisation plan on an investment basis. Implementing the EMS may participate in developing plans to optimise energy supply systems. The system can bring mandatory documents relating to the energy sector in line with the current norms, rules, and standards to obtain a transparent, documented system. This will support distributing the responsibilities of the organisation's employees at all levels. Thus, it creates a modern mechanism for managing energy-saving processes in the organisation [1,3, 5].

Deming's closed cycle of continuous growth serves as the foundation for the EMS approach, which consists of four stages: planning, execution, verification, and adjustment. Deming's so-called PDCA cycle is illustrated in figure 1 as an algorithm of activities inside one cycle, "Plan – Do – Check – Act" [5, 6].

Figure 1. Deming closed circle

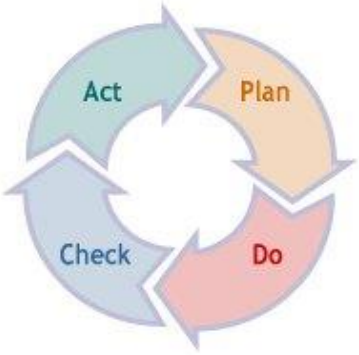

Figure 1. Deming closed circle

- ***The planning stage*:** involves conducting an energy survey (diagnostic audit of energy consumption), analysing the information attained, scheming the basic metrics of the organisation's energy usage, recognising zones of significant energy consumption (energy-intensive processes) in addition to other energy qualities, defining goals and intentions in the area of energy-saving and increasing energy economy, as well as designing plans of steps required to enhance energy saving in agreement with the organisation's energy policy [6, 7].
- ***The implementation stage:*** the planned actions are carried out during this stage. However, implementation infrequently proceeds in a linear path in the actual world [6].
- ***The verification phase:*** during this phase, mechanisms and characteristics of energy conservation and efficiency activities are monitored (along with measurements), compared to energy strategy, goals, and objectives. Non-conformities (non-compliance) are identified and documented, and the verification outcomes are reported.
- ***The adjustment stage:*** includes plan rectification and an examination of the implementation outcomes of steps to conserve energy, increase energy efficiency, and reduce the sources of non-compliance. Following that, constantly improving the organisation's energy efficiency and EMS is repeated.

III. APPLICATION OF PDCA SEQUENCE IN THE ENERGY MANAGEMENT SYSTEM

The development of EMS begins with [1, 3, 8 and 9]:

- The first fundamental point is developing and approving the organisation's energy policy. Energy Policy is the official report of the organisation's top management on the core goals and activities regarding energy performance. Energy policy should be communicated to every team member of the organisation.
- The second fundamental point is the formation of the general contours of the EMS. These are the application's boundaries, the representative's appointment, and the working group creation.
- The third fundamental point is to conduct an energy audit, identify problem areas in the consumption of energy resources, and determine and approve the baseline - the actual state of the processes associated with energy resources at a certain point in time. A baseline is needed to assess the impact of energy conservation activities.
- The fourth fundamental point is the preparation and implementation of action plans aimed at improving the energy and energy efficiency of the organisation, solving issues related to the identified problem areas of energy consumption, and forming a system aimed at continuously improving energy efficiency indicators.
- The fifth fundamental point is the interested participation of top management in monitoring and analysing the results of energy-saving and energy efficiency activities, EMS activities, making decisions aimed at the development of EMS and energy-saving activities and improving energy efficiency in general.

IV. CRITICAL AREAS OF EMS IMPLEMENTATION IN THE ORGANISATIONS

- ***Institutional changes.*** First, it is necessary to change the organisation's management structure accordingly, depending on its size and complexity. To that end, those responsible for this work should be appointed, empowered and resourced. If resources are available, it is advisable to create a working group at the planning stage, which should coordinate the activities of various units (production, financial, commercial, etc.), develop the necessary procedures, and describe them with regulatory documents. Also, a mandatory element is the appointment of a special representative from among the top management, which provides the necessary organisational and administrative support for implementing the EMS and exercises control [5, 9].
- ***Staff training.*** Energy efficiency priority should be appropriately communicated to senior management, middle managers, and ordinary employees.

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As a result, each team member should clearly understand how this will affect the job duties, terms, and actions. Such information is not a one-time measure. It can take time, from the first announcement of the roll-out of energy efficiency work to a well-established mechanism and transparency in functions and responsibilities. It will be necessary to conduct education and training and develop instructions and regulations. Most likely, employees will need training that can be carried out about the need and economic effect of energy-saving, the work plan for this, and the expected results. At the next stage, when the work will unfold in individual departments, there will be a need for more highly specialised knowledge, such as new equipment, metering and regulatory devices, new technologies, etc. It is reasonable to involve professionals from the outside to implement such training [9].

- ***Incentives.*** A logical continuation of work with personnel uses motivational and incentive measures and even mechanisms for employees and departments with the best results in saving energy resources. The new legislation allows the saved funds to award bonuses to employees who contributed to such savings in budgetary organisations [1, 9].
- ***Mandatory energy examination.*** To avoid the energy passport becoming a formal document, its content must be accurate, i.e. areas where the organisation's significant energy-saving potential should be highlighted and suggestions for its implementation made. The energy passport should not include conventional advice available on specialised sites but rather recommendations tailored to the company's particular needs [1].

The objects of the energy survey should be both buildings and systems and technological processes. The energy audit will show an accurate picture of what is happening in energy consumption. The form of the energy passport of the organisation is typical and is approved by law, but the customer has the right, along with the energy passport, to ask the energy auditor to submit the identified information in the form of an energy balance and other forms suitable for the situation [1, 10 & 11].

According to the legislation, only a company consisting of one of the self-regulatory organisations of energy auditors has the right to conduct an energy audit (such a system has replaced the licensing of activities in this area and is designed to guarantee the quality of the service provided). The energy survey should also include an audit of contracts with suppliers of energy resources since there are reserves for optimisation.

- ***Installation of metering devices.*** As practice shows, only monitoring energy consumption and energy costs reduces energy consumption due to behavioural and psychological aspects. If regulation is added to energy consumption accounting, the effect increases significantly. The installation of metering devices is not only a technological measure; it also requires staff training and, in some cases, managerial restructuring of administrative and accounting processes. In addition, automation will provide the richest material for the analysis and development of recommendations to reduce energy consumption [10,11].

Thus, the introduction of an energy management system at the enterprise, built for its specific needs and conditions (as opposed to carrying out individual organisational and/or technical measures), will allow to get a multiplicative effect, i.e., not just to solve short-term tasks, but in the future to receive operational and adequate information from all involved units (horizontally) and levels of enterprise management (vertically) to changing external and internal tasks. At the same time, the financial costs of implementing an EMS are usually not as high as implementing engineering and technical measures [5].

V. A CASE STUDY – HEATHROW INTERNATIONAL AIRPORT

Airports utilise a lot of energy, which means they have much room to conserve energy. Airport operators have aimed to reduce CO2 emissions by half by 2050 compared to 2005 levels. They must develop the most innovative energy management approach available to do this. Airport energy consumption is roughly 70% for power and 30% for heat. This paper concentrates on power consumption and improving electrical efficiency in particular. Big airports, e.g., Heathrow, utilise up to 485 million kWh of power per year based on reports published in 2016, with terminals accounting for over 60% of this total. The remaining 40% is designated for airfield lights, hangars, vehicle decks, warehouses, and other auxiliary structures [12, 13].

Heathrow Airport plans to cut carbon emissions by 34% by 2020 compared to the 1990s. It also intends to recycle 85% of its garbage by 2020. The recycling rate in 2016 was 45%. According to reports released in 2016, 87% of Heathrow's energy comes from electricity, 9% from gas, 3% from biomass, and 1% from gas oil. Heathrow's power usage is falling year after year. It used 485 GWh of energy in 2016. Recognising that 1 GWh equals 1000 MWh of energy.

Therefore, in 2016, Heathrow airport consumed 485,000 MWh. Now, by breaking down this airport's energy input sources:

- Aggregate energy consumed = 485,000 MWh
- Energy derived from the power grid = 421,950 MWh
- Energy obtained from natural gas = 43,650 MWh
- Energy developed from biological waste = 14,550 MWh
- Energy obtained from fossil fuel = 485 MWh

The airport, by 2020, after applying the BMS, has had these improvements in zero-carbon emission development. During 2019, energy efficiency increased from 241 kWh/m2 to 248 KWh/m2. The airport replaced the operational power demand per passenger indication with an energy efficiency indicator part of the BMS and considers area rather than passenger count. This is a more reliable and stable measure of energy efficiency. In 2019, the airport installed new passenger bins, allowing passengers to better separate garbage at the source; thus, 70% of the operational waste was recycled. Also, by 2019, there was a 20% decrease in water usage since water consumption is connected to passenger numbers, which grew in 2019 compared to 2018. Data also suggests that potable water use will be reduced by 30% by 2022; the BMS delivers reliable metering measures. As a result, electricity and gas usage continues to fall [12, 13]. Regarding research and innovation, Heathrow led a group of aerospace industries, airlines, airports, and academics that won money from Innovate UK's Future Flight initiative in 2020 to explore what is required to deploy zero-carbon aircraft.

According to preliminary data from Project NAPKIN, Heathrow will need to be able to host these aircraft by the end of 2030. This proves that staff training, updating and incentives play a vital role in improving the EMS. To reap the benefits of Heathrow Airport, Baghdad International Airport consists of Nineveh, Babylon, and Samara Terminals. Airport buildings are among the highest energy users. Several studies on sustainable airport construction using EMS algorithms have been conducted despite Iraq's recent energy crisis. Table 1 demonstrates the total energy consumption by the three terminals. Assuming the size and capacity are unique. Figure 2 demonstrates the monthly energy consumption of the three terminals, fluctuating between 570-1224 MWh. However, the total electricity consumption is nearly 9154.5MWh per year. Figure 3 below shows roughly the consumption of energy for the three terminals. The analysis shows that the monthly energy cost is shifting between 69-147 Million Iraqi Dinars, considered one of Iraq's highest energy utilisations. The total energy cost is 1.2 billion Iraqi dinars per KWh for the three terminals per year, approximately $820,000. This value excludes the outside facilities in the airport vicinity, which will raise the total figure to over a million dollars per year.

Table 1. Monthly energy cost of three terminals

Month	Total Electrical Consumption	Electricity Cost ID/Kwh
Jan	408	49018236
Feb	291.5	34977480
Mar	296	35559588
Apr	243	29190312
May	212	25447752
Jun	198.7	23843712
Jul	190	22808376
Aug	195.6	23466912
Sep	190.3	22832640
Oct	207.6	24908520
Nov	266.8	32013060
Dec	352	42291036
Total	**3053**	**366357624**

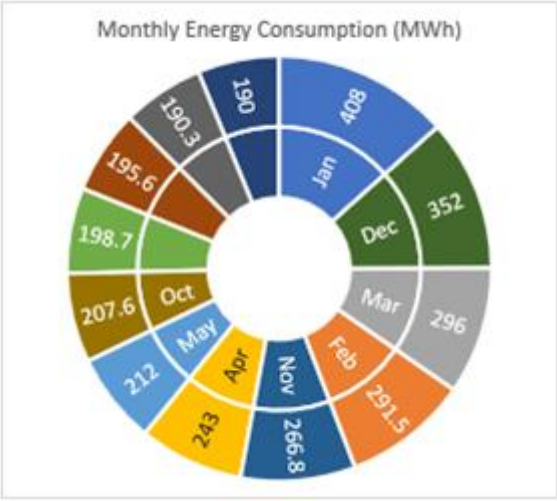

Figure 2. Monthly energy consumption analysis

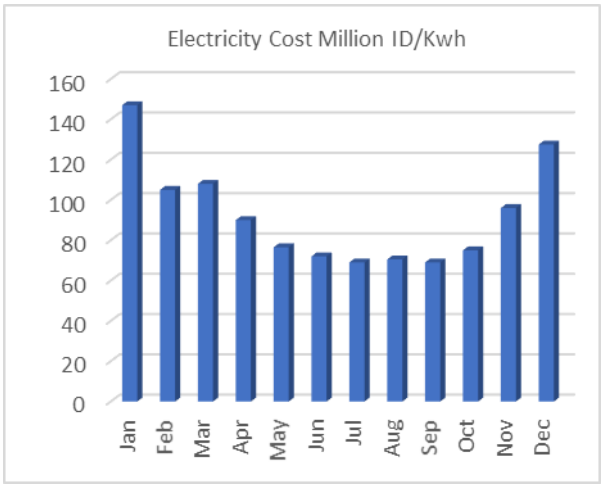

Figure 3. Monthly electricity cost

VI. COMMENT ON THE RESULTS

With increasing travel and airport power usage, creating a flexible system that can enable micro measurements is critical. As seen in the preceding case study, airports have many possibilities for branch-level monitoring. Heathrow Airport is one example of an airport that measures just a percentage of its power use but has had great success with comprehensive measurements.

More significantly, they now have a technology that can probe further into their electrical consumption when they are ready. The figures above show the importance of implementing the EMS technology and adopting a modern algorithm for energy saving [12]. The government can use the savings to update the facilities and expand the airport, especially when 35 million people live in Iraq, excluding Kurdistan, whereas Baghdad airport is the main airport for most of them.

All airport technologies have significant energy-saving capability. Most savings come from lighting and HVAC or connecting specialised electrical devices on timers [11, 12 & 13]. Baghdad airport terminals consume up to 70% of the total energy consumption of the airport buildings due to its old design.

Less than 30% is given to airfield lights and related facilities like hangars [14, 15]. Therefore, the annual electricity bill of the whole airport might reach $1.5 million, which considers massive for a three terminals airport. Thus, the introduction of an energy management system at the enterprise, built for its specific needs and conditions (as opposed to carrying out individual organisational and/or technical measures), will allow to get a multiplicative effect, i.e., not just to solve short-term tasks, but in the future to receive operational and adequate information from all involved units (horizontally) and levels of enterprise management (vertically) to changing external and internal tasks. At the same time, the financial costs of implementing an EMS are usually not as high as implementing engineering and technical measures [5].

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VII. CONCLUSION

This study aimed to investigate the advantages and phases of EMS to be implemented in Iraq. Consider updating Baghdad International Airport with EMS technology because airport infrastructure necessitates considerable energy due to its massive size.

EMS implementation aims to increase the organisation's stability (including financial) and improve its competitive position by reducing costs and increasing management efficiency. Therefore, the airport was taken as an example to reap the benefit of energy conservation. The study concludes that Iraqi enterprises need:

- The emergence of a new sector of organisation management - energy consumption management.
- Involvement in this process of heads of departments that are not traditionally involved in solving the energy problems of the organisation.
- Establishing an organisation's energy and cost management system through regulations, standards, and documented procedures will enable operational management decisions in a rapidly changing environment.
- The EMS technology can identify conflicts and re-document structures.
- Implementation of the PDCA provides the consistency of procedures and standards, adaptive management based on rapid feedback, and the feasibility of end-to-end process documentation, which considerably improves operational efficiency.
- The EMS technique enables addressing any safety issues in the design phase.

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