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DEVELOPING GREEN OPERATIONS TO MINIMIZE ENERGY CONSUMPTION BY PDCA CYCLE OF ISO 50001. A CASE STUDY WITH DELPHI METHOD APPROACH

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Abstract. The purpose of this research is to explore the green operations activities, especially in energy consumption, and to develop a PDCA cycle framework that can be used to minimize energy consumption, by using Delphi Method approach. Research design and methodology: The PDCA cycle ISO 50001 framework is developed through (1) Identifying risks using Delphi method and mean score ranking from the activities found in existing empirical case study in beauty clinic. (2) Analyse the most crucial risks founded in the field. (3) Developing the the PDCA cycle to minimize the energy consumption. Finding: The research found eleven (12) risks, and find the crucial risk. PDCA cycle ISO 50001 developed, and found that the most crucial risk is in the act of PDCA cycle, which indicate that there was no follow through in order to solve the problem of energy usage in the business process. Practical implication: This research provide a simple practical guideline PDCA cycle ISO 50001 template as a critical thinking to make a continuous improvement process.

Keywords: PDCA cycle; ISO 50001; Delphi Method; Mean score ranking; Green operations

1. Introduction

Environmental management is a topic of mutual concern for the business community, government and consumers, in line with the increasing industrialization (New, Green & Morton, 2002; Azzone & Manzini, 1994; Azzone & Bertele, 1994; Azzone & Noci, 1996; Rezk, Radwan, Salem, Sakr, & Tvaronavičienė, 2019). Growing concerns in global markets over "green" issues and the scarcity of natural resources are forcing executives to look at business strategies from an environmental perspective.Increased energy use in general has a broad impact on all sectors of life, therefore it needs to build awareness of the importance of an energy management system.The International Organization for Standardization (ISO) cares about the importance of energy for life, thus issuing standards for energy management systems contained in the ISO 50001: 2011 standard - Energy Management System (ENMs).This study aims to build a PDCA template based on ISO 50001 to solve the energy management problems of a company. The research object is a clinic of health and beauty, which is facing the problem of waste in the use of electric energy. Electricity consumption is increasing from time to time that is not in line with business growth.

An important part attached to this research that might involve substantial biases that must be recognized and must be minimized, this can use the Delphi Technique. The Delphi technique was originally developed by Rand Corporation which functions to study Rand Corporation to study the impact of technology on warfare. The Delph method is a systematic and interactive research technique for obtaining judgments from independent panels on a particular topic. So there are individual elections according to predetermined guidelines and asked to participate in

two or more structured survey rounds. Each round, the facilitator provides an anonymous conclusion from expert input from a survey that was previously conducted as part of the next survey. At each subsequent stage, participants are encouraged to review the opinions of other anonymous panelists and make considerations to revise their previous responses. This goal is to reduce the presence of scale variability and to get group concessions. This research method differs from the traditional simple survey method where respondents are certified as experts according to the guidelines that have been determined before the survey process begins. The Delphi method is very useful when objective data cannot be reached, there is a lack of empirical evidence, experimental research is unrealistic or unethical, or when heterogeneity.

Not all studies can use the Delphi method, some previous research suggestions suggest that researchers are always encouraged to explore all reasonable and objective options for data collection before deciding to use qualitative research methods such as Delphi.

The existence of ISO 50001 energy management system is an opportunity for companies in creating energy efficiency to increase their income.Based on the above reasons it is necessary to conduct research on Improvement of energy management through the PDCA cycle in accordance with ISO 50001 which aims to improve the operation process so as to improve clinical performance to improve efficiency in the use of electrical energy.

ISO 50001 is designed to help an organization or company to better manage its assets, especially its energy assets, as an evaluation material and prioritize the use of energy efficient, and to encourage more efficiency in the supply chain. The success of the implementation of ISO 50001 lies in the agreement of all that is in an organization or levels of the organization, which is more dominant, namely top management. Top management must give orders to existing management representatives, who can ensure the management system has complied with the requirements of ISO 50001. Some of the benefits of ISO 50001 include a significant increase in energy performance, the approach used is PDCA which is more directed at increasing energy efficiency. sustainable. Thus ISO 50001 allows organizations to develop policies for more efficient use of energy, meet the conditions that have been made, decisions on energy consumption, measure the results of improvements in energy efficiency, energy policy effectiveness, energy management, support energy contributions to the structure of energy plans in achieving targets, as a facilitation of engagement (agreement) from management, strengthening the competitiveness of the organization, enabling the benchmarking process to occur.

2. Conceptual background

The energy management system (ENMs) ISO 50001 is a tool that can help create energy efficiency improvements in the organization, in the operations process of the business.ISO 50001 is intended to avoid wasteful use of energy and provide precise instructions for building more efficient and economical operations and organizational processes.Energy Management System ISO 50001: 2001 is an international standard energy management system issued by the International Standardization Agency.In Indonesia the standard is adopted to SNI ISO 50001: 2011.The management model of EnMS ISO 50001 is P-D-C-A-Continual Improvement with emphasis on significant Energy Uses and how its management to keep energy performance always increase continuously.The following figures illustrate the PDCA ISO 50001 process.
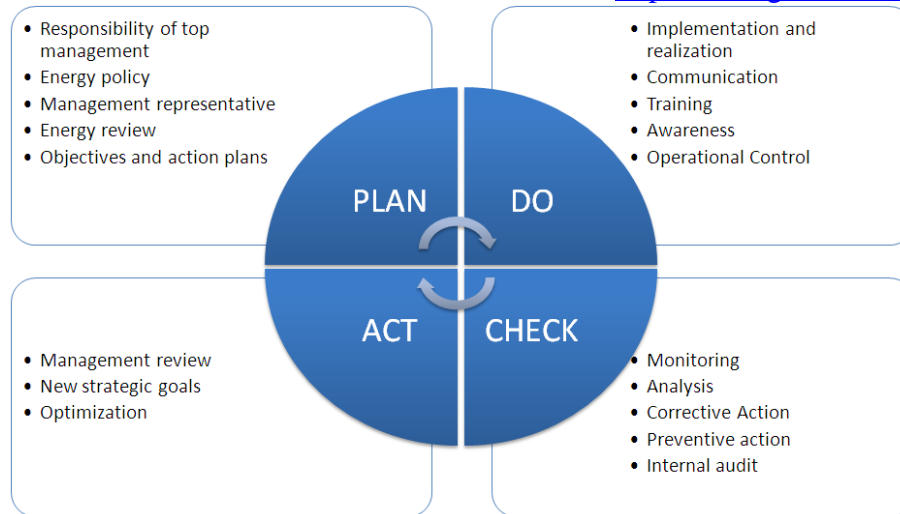
Figure 1. Proses PDCA ISO 50001
Source: Paeger Consulting

Given the issue of energy costs, it is important for companies to implement energy management systems.With the implementation of such systems then energy efficiency efforts can produce optimal results. Implementing this system means that all elements of the organization must be concerned and play a role in energy management.

The cycle of PDCA starts from several steps. The cycle of the PDCA is also known as the Deming cycle or the Shewhart cycle. Having an identification goal or objective or problem, formulating a theory, defining the success of the metric and implementing the plan, this process is included in the steps of the DO, where the components of the plan are implemented, such as making a product. The next step is examination (study), where the results of that are monitored to further check the validity of the plan for progress and success that is there, it can be said there is a problem or not, so it needs to be improved.

PDCA cycle steps
Plan: which in this case combines the definition of the problem. A thorough analysis of the existing problem will be carried out to identify the origin of the problem. So we get a solution that is able to answer the problem which is then formulated and evaluated to get identification of the most profitable solution. In this case the research team found several problems, or opportunities for quality improvement will be seen when the program or process is discovered. Existing data can discuss such as time, people, movement, space, costs, events, customer satisfaction. Many tools are available for gathering and interpreting data in the process for example pareto charts, histograms, run charts, plots and control charts. Existing data collected must be harmonized with the steps listed in the statement of purpose, identification of possible causes.

This brainstorming is done which means to identify possible causes and cause and effect diagrams of fish bones and 3 (three) useful ways to determine the root of the problem that actually occurs.

1. Identify probable improvement: Overcoming the main causes, agreeing which ones will be tested, after the improvement has been done
2. Develop an improvement theory: The theory of improvement is a declaration that articulates the expected influence
3. Develop an action plan: Indicates what needs to be done, who is responsible and when it must be completed.

Do: where after this situation is fully understood and improvements have been made, the "do" phase is the plan to be implemented for the first time. This phase is not a trial phase. This phase is a reality that can be implemented from what the research team believes is a substantial improvement over the current situation.

Check: is something significant that can occur in this phase which is by observing the newly implemented process. From this, the research partners can understand what happened well, new learning what has happened so that adjustments can be found what needs to be done, plans that are better than what could previously be imagined can be developed. This phase is a comprehensive face to increase the level to a higher level or above. This phase is not just a phase that only fixes what is not right but rather leads to what must be done to get the best out of this process.
Existing circumstances after implementation is then carried out an analysis to obtain verification of a solution. In this phase if negative conditions are found, it is necessary to carry out repairs starting from zero or beginning at the planning stage. If the researcher does not need any improvement, then the researcher can carry out the next process to the action phase.

Actually: this phase is a cycle after improvement, so it is necessary to prepare a solution for the final implementation with standardization and may spread to other parts of an organization. So to maintain this, it is necessary to repeat the cycle better to get a higher level of money. Some choices occur including consisting of:

1. Adoption: which is an increase standardization if the measurable goals in the statement of objectives were previously met. This involves establishing mechanisms for researchers who will undertake new processes to measure and monitor benchmarks regularly to get certainty that improvements need to be maintained. In this case the need for a control chart or run chart tool is used to monitor this performance.
2. Abandon: If changes made to the process do not result in improvements, then consider the lessons learned previously and then return to the "plan" phase. The cycle of the PDCA (deming diagram) is a tool that has good quality, the PDCA cycle is a concept of continuous improvement that is embedded in the culture within the organization, because it is easily understood by many people in a company.

1.2. Delphi Method and Mean Score Ranking

The Delphi method is a "systematic, intuitive" forecasting procedure (Rayens and Hahn, 2000), based on expert judgment, derived from a series of questionnaires, and interspersed with feedback. This method requires the knowledge and contributions of individual experts to respond to questions and send the results to the coordinating center.Delphi method also has the characteristics of anonymity and iteration. Experts are given freedom of association and freedom of participation (Kher et al., 2010).To achieve this goal requires experienced practitioners and experts who are experienced in energy management and have a good understanding of the company's operational managerial concepts.In addition, to ensure reliable quality and information, the tools used to collect data openly to obtain diverse opinions from experts and to seek topic-based feedback are most appropriate (Schmidt et al., 2001).

The Delphi technique, designed in such a way that unbiased results from experts through statistics are repeated and controlled feedback (Kher et al., 2010; Roespinoedji, Faritzal, Sudrajat, Ahmed, & Oktari, 2019), adopted as a primary data collection tool. The feedback gathered from the delphi survey was analyzed using the mean score ranking methods.Average score is used because it is a measure of central tendency and is widely used in construction management studies (Ke et al., 2010; Cheung and Chan, 2001) to determine the significance of the variable list.Using such an analysis allows to determine the relative significance of each risk factor.

The process of implementing the Delphi method commonly done now consists of two method / version (Linstone and Turoff, 2002): "Paper and Pencil Version", where on this method a team is formed for design a questionnaire that will be later will be submitted to experts (respondents group). After all the answers from the questionnaire obtained, each respondent was given opportunity to re-evaluate their answer. After that, the team summarize the results of the answers obtained the. Based on these conclusions, the team re-designed the stage questionnaire then to be submitted again group of respondents. Delphi method like this is also known as "Conventional Delphi".

Delphi technique is a way or method to organize an idea or ideas among researchers that aims to improve the condition of the institution in the future (Weaver, 1971: 267). Meanwhile, according to Lewis 1984: 89, the Delphi technique is a process that is useful for gathering the results of one's thoughts or opinions among researchers related to social phenomena that will ultimately affect the situation of the institution. The Delphi technique itself according to Witkins (1984) as a way to determine the consensus opinion (deliberation roundness) among researchers about the goals and things that need from an organization. From some understanding of the Delphi technique it can be said that the Delphi Technique is a systematic way to obtain an agreement of opinion among researchers who have an interest and are relevant to what is desired by the researcher ie a decision, clear objectives of the organization, priorities of program activities and determine what the plans for an upcoming program are. According to Stufflebeam, et al 1985 to get good criteria in the development of the future needs to meet several conditions as an example of suitability, usefulness, feasibility, and prospects for improvement in the future.

There are 3 (three) assumptions in the Delphi technique to get a joint agreement, namely first according to Weaver, 1971 opinions of some people obtained by consensus are better and more comprehensive than the opinions of one person. Secondly according to Witkin, 1984 which states that accurate data is obtained from the right choice of people who have a broad view of the future and know the problems associated with the goals to be achieved while the third according to Weaver, 1971 which mentions to get Good data is not biased, responses are anonymous with no communication. There are 6 (six) stages in the systematic development of the Delphi technique according to Witkin, 1984 which includes: Identification of researchers who will be involved in the process, asking researchers about future trends related to the objectives, developing questionnaires existing, sending questionnaires to panel groups to provide existing responses, administering responses from researchers and confirming existing and final responses using information on consensus among them.

According to Stufflebeam 1985 in several agreements that can be achieved using the Delphi technique: determining the objectives to be achieved, the direction and types of questions in identifying needs by using analysis, basic requirements that must be met to achieve the goal. In contrast to Lewis 1983: 106 suggesting the use of the Delphi technique in the educational process, namely to carry out critical analysis, select indicators through environmental analysis that is expected to have an influence, form a panel group, apply the Delphi technique to review past events and study trends in the future. evaluating the effect of trends on institutions, predicting success in the future, preparing scenarios.

The Delphi process occurs or is modified from 2 rounds which use 34 pharmacisation panelists, where it involves professionals and the activities that inhibit it along with the characteristics of its activities (Aronso et al, 2012 (22)). and other findings state that the implications of the creation of learning experiences involving pharmacy students and suggest that the activity contains certain professional characteristics that have an important meaning than other activities, according to Bryne et al 2010 in his research stated that the Delphi method is modified 4 rounds to get consensus about statements for natural health products (NHP) in pharmacy students in Canada The results of this study are in the form of consensus on competency statements.

The Delphi technique is indeed widely used by previous researchers, but the Delphi Technique has strengths and weaknesses.

The advantage of the Delphi technique according to Helmer (1983), Linstone and Turoff (1975) and Dalkey (1972), that the Delphi method in groups is that the agreement will converge to reach an assessment agreement from the panelists. Here are 7 (seven) advantages of the Delphi method, namely:

1. The existing problems are solved subjectively collectively
2. It takes several people to contribute in assessing complex problems that represent differences in background
3. It takes a lot of people to be able to interact face to face
4. Do not allow time and money for regular meetings
5. Efficient is obtained because of group communication
6. There is a strong difference of opinion between individuals that is needed by the communication process
7. The heterogeneity of the participants must be ensured to guarantee the validity of the results, this is to avoid the dominance of certain parties in the panel.

The weakness of the Delphi Technique which is that the agreement that was obtained may not necessarily be the actual agreement, this could happen because it was a pseudo agreement. Pseudo-agreement is not a solid choice, because it is more of a compromise (Mitroff and Turoff, 1975). According to Linstone and Turoff (1976) there are five things that become weaknesses of the Delphi technique, namely 1. Delphi becomes the helper of all human communication 2. Mistakes in concluding and presenting the results of group responses and in interpreting evaluation evaluations given by respondents. 3. Forcing the views and views of an issue to the respondent from the structure created 4. Ignoring and not studying more in the presence of differences of opinion 5. Demand total participation should the respondent should be placed as a consultant where compensation should be given for the time for the commitment made.

2. Methodology

This research use case study approach, conducted in a health care and beauty clinic which have an energy usage problem.A case study is a research strategy, which is done through empirical review by investigating the symptoms of problems that occur in the object of research.This strategy can find qualitative evidence obtained from various sources and previous developments of theoretical propositions. The purpose of this case study is to understand the object under investigation. Nevertheless, case study research has a specific purpose for explaining and understanding the object it examines specifically as a 'case'.(Yin 2009) states that the purpose of using case study research is not just to explain what the object is being studied, but to explain how it exists and why it can occur.This research uses two tools in identifying risk and designing operational process (PDCA) for research object that is by Delphi method and mean score ranking.

2.1. Delphi
The identification of risk and design of the PDCA is based on the opinions of experts and referred to ISO 50001, conducted by interviewing and distributing questionnaires to 3 delphi from internal clinics as well as external clinics (operations management experts and business practitioners). The identification of risk and design of the PDCA is based on the opinions of experts and referred to ISO 50001, conducted by interviewing and distributing questionnaires to 3 delphi from internal clinics as well as external clinics (operations management experts and business practitioners). The stages of the cycle of PDCA according are as follows:

1. Develop a plan in this case detailing and setting the best process standards
2. Implement the existing plan which is the plans that have been proposed at the plan stage and implemente gradually, by making the best possible improvements to get the desired results
3. Checking the results that have been achieved which are the results of improvements with targets that have been set. If this target has been reached, the process stage can be continued at the next stage in the form of action.
4. Perform actions that are adjustments to the process if necessary which is based on the results of the analysis that has been done in the previous stages. This adjustment was made because to prevent the recurrence of the

problem that was solved as well as to raise the issue especially what would be done after fixing the problem on the previous problem.

2.2. Mean Score Ranking

After obtaining the risk list we have weighted by using a scale of 1-4 to calculate the mean score score ranking in order to find the crucial risk correlated with electrical energy cost issues. Furthermore, should be sought the solution to the problem.The solution will be given is the PDCA design that is contained in the form of PDCA templates.

2.3. Validation

The information generated from the Delphi method is very dependent on the expert panelists being seen in the panel. Thus, the composition of the panelists is related to the validity of the results research. Because in this method, the opinions and judgments of panelists taken and analyzed, then this is determined by how the selection of panel members the. The Delphi method identifies the reasons why there are differences in judgment between panelists and whether the difference is real or just a semantic problem. So convergence here will not adequately describe the validation of this method, because it should convergence uses real values. Even so, Dalkey and Helmer (1962) proved that statistically, the Delphi method was likely to be not only achieved convergence, but also convergence in the right direction.

3. Analysis and Result

The research process conducted interviews for risk identification through the Delphi method, in some beauty clinic experts and operations management experts.Implementation of identification is done through two stages.The first stage is by conducting interviews with experts and clinic practitioners to classify activities into the PDCA process.The second phase identifies the risk for each identified risk.The results of risk identification and analysis in PDCA ISO 50001 process obtained 12 risks spread over PDCA ISO 50001 process.There are four risks in the PLAN phase: Risk-1. the company's goal has not been fixed. Risk-2, no energy policy standard is used. Risk-3, error indicator in the energy assessment. Risk-4, the level of awareness to green operation has not been high.There are three risks in the DO stage, namely: Risk-5, standard Operating procedure is not yet complete, especially to handle energy problem. Risk-6, has no expertise. Risk-7, the implementation of staff training is minimal.There are three risks in the CHECK stage: Risk-8, the reference standard for monitoring is incomplete and less valid. Risk-9, monitoring to employees is less stringent. Risk-10, there is an error causing the bias (Haseeb et al., 2020). There are two risks in the ACT phase, namely: Risk-11, evaluation is too general. Risk-12, the feed back is not immediately followed up by the top leader.

The next step is weighted risk and mean score ranking to determine the most crucial risks that are the main cause of waste in the use of electrical energy.Each expert participant in delphi is asked to provide a score to determine the weight of each potential risk.Then calculate the mean score for each risk, to determine the highest weight, which is the most crucial risk. The following is the result of the mean score ranking for 12 identified risks and determines the mean score for each identified risk.Risk identification is done by involving beauty clinic experts and also operations management experts.The data was collected by semi structured interview and determination of mean score was done by distributing questionnaire to the experts in order to to determine the score (table 1).

Table1. Mean score ranking

Risk.no	1	2	3	4	5	6
M.Score	2.67	3.33	2.67	3.33	2.67	3

Risk.no	7	8	9	10	11	12
M.Score	2.33	2.67	3	2.67	2.67	4

Based on the result of weight calculation and the mean score ranking obtained one of the most crucial risk with the highest mean score score (4), that is risk-12, ie no immediate follow-up by top management on feedback. Two other risks considered crucial are risk-2 and risk-4.Further steps are taken to mitigate risks and their solutions in the form of PDCA templates. The process of preparing PDCA templates is done by involving four expert delphi participants. Delphi-1 focuses on the analysis of strategies on energy management.Delpi-2 Focus on increasing revenue with consideration of electricity utilization cost fix. Delphi-3 focuses on communication with top management.The design of operational processes presented in the form of PDCA templates is used to formulate the critical thinking process for the clinic related problems encountered by answering questions that are intended to facilitate the clinic in doing continuous improvement. Based on the successful set of PDCA templates, it is known that the clinic should start doing new things, such as starting a strategy analysis related to energy management to tackle the existing electrical energy cost issues.The analysis of the strategy includes new policies that must be made and taken either by the head of operations or by top management in terms of human resources, controlling, and clinical tactical strategies to increase revenue.

4. Conclusion

Based on the result of risk identification and weighting of mean score ranking, it is found risk in act stage, that is, there is no follow up of top management for the given feedback.This risk is considered very important by the delphi, because in fact top management has a great influence on the success or failure of the clinic.In the future, clinics need to communicate and change in managerial and clinical operations by applying critical thinking process through the application and use of PDCA templates.The first step to do is to immediately draft a strategy of energy management and controlling more tightly to the entire range of clinic employees either by giving rewards and controlling on the existing operational process.

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