Factors affecting performance of standard application and indicator for greenhouse gas emission in green office, Thailand

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Abstract

The objectives of this research were to study the factors affecting the efficiency of the standard application of green office and indicators for measuring resources use. It was found that there were 12 factors that affected the efficiency of the standard application of green office. The indicators for greenhouse gas usage per head of private organization they were found to be 263.96 $kg_{eq}CO_2$ per head per month. For state enterprise, governmental and educational organizations they were found to be 190.05, 643.75 and 278.57 $kg_{eq}CO_2$ per person per month respectively. Indicators for greenhouse gas emission per area of private organizations were 8.74 $kg_{eq}CO_2$ per m^2 per month. For state enterprise, governmental and educational organizations were 6.63, 21.90 and 8.59 $kg_{eq}CO_2$ per m^2 per month respectively. Greenhouse gas emission were found to be an uncontrollable activity because external factors were involved such as the damage to instruments and service organization accessing the area to increased greenhouse gas emission. However, it was found that if an organization is determined to operate the green office Project by following the operation manual and applying all related factors and indicators into the operation system, CO_2 and greenhouse gas can be decreased. This is beneficial for the environment.

Keywords: green office, greenhouse gas emission, efficiency of resources usage, indicator

1. Introduction

Economic growth and technology development has led to a rise in consumption of energy and natural resource. The demands of the human population have increased while natural resources are limited. The current needs of the human population does not match the amount of natural resource available. There is therefore a limitation due to increasing manufacturers and production process. This has led to climate change and the global warming. The operation of several institutions, including governmental sectors, private sectors, state enterprises and many departments in universities provided benefits issues towards society however, they also create impacts to society in terms of consuming natural resource and energy. They also generate sewage and pollution such as air pollution, noise pollution and water pollution. It can be stated that the environment could be destroyed due to the above mentioned impacts. Moreover, it also leads to an increase in the level of greenhouse gas in the atmosphere that causes the climate change and the greenhouse effect [1].

The effect of burning fossil fuels in many factories will causes the climate to change faster. It can be argued that the rapid change in climate is caused from the high level of greenhouse gas in the air. Global warming or climate change can be defined as an increase in average temperature of earth's atmosphere that causes climate change, the change in rainfall, and rising sea level. Moreover, it also affects many living organism such as plants, animals and human beings.

Global warming or climate change is mainly caused by human activities that create CO_2 and greenhouse gas. If the level of CO_2 in the air is very high, it will increase the temperature [2].

A green office project has been carried out by the Faculty of Environment and Resource Studies, Mahidol University with Department of Environment Quality Promotion. Green office refers to any activities in the office that reduce its environmental impact. This can be done by using resource and energy wisely, having effective waste management, using office equipment that is environmental friendly, and releasing the lowest quantity of greenhouse gas emission possible. This project has been operating since 2014 [1].

There are now several corporations that focus on how to manage the environment effectively. A green office is one of the solutions that will enhance the potential of the corporations to be able to manage all the resources available, and the environment in the workplace. The

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objectives of this research were to study the factors affecting the efficiency of the standard application of green office and to develop indicators for measuring greenhouse gas emission in green the offices of Thailand.

This study will be a guideline for other corporations which will help them to implement their strategic greenhouse gases reduction objectives.

2. Methodology

2.1 Method

All the participants were selected from corporations or institutions that were registered as a member of the green office project, This project is run by the Faculty of Environment and Resource Studies of Mahidol University and Department of Environment Quality Promotion cooperating, In total 55 corporations are part of the project in Thailand. The study applied the purposive sampling technique by selecting committees whose works were related to the green office project.

2.2 Tools

The tools used to collect data, was divided into two parts.

First, this research used the survey method in collecting all the data from the offices engaged in the project. In order to design the questionnaire d, the researcher reviewed documents, researches, theories, and concepts related to this project. This process assisted in designing questions effectively and covered all the main issues. The survey was divided further into three parts.

The first part of these consisted of closed ended questions including personal details of the applicants such as gender, age, and position. The second part contained questionsasking for general information of the firm such as firm's name, the number of employees in a firm. The third part was questions that enabled knowledge about the green office project to be measured, This part also included a study of factors affecting the efficiency of the standard application of green office. For this part, the questions were divided into two further parts.

▪ The first part contained question relating the respondent's overall knowledge about the green office project.

▪ The second part contained a study of factors affecting the efficiency of the standard application of green office, and further suggestion on factors affecting the standard application. The questions in this part were closed ended covering the areas of personal factors, organizational factors, and environmental factors. A rating scale of 5 levels was used in this part. The class interval was 0.80 and the reliability was 0.946.

The data was collected in 2015. During the process of data collection, the respondents were questioned on

greenhouse gas emissions in order to find indicators of green office, Indicators of the green office are calculated in terms of greenhouse gas emission in the office per head and per m^2.

The formula used in calculating the greenhouse gas emissions is as follows:

$$GHG_{CO_2e} = AxEF \text{ [7]} \qquad (1)$$

GHG = Amount of carbon dioxide equivalent (CO_2e)

A = Activities causing to greenhouse gas

EF = Coefficient of greenhouse gas emissions or Emission factor (in kg-CO_2e/unit)

2.3 Data analysis

The data was entered into a computer for a further analysis. For the questions relating to applicants' biography and firms' information, the descriptive statistics were used, including frequency, percentage, mean, and standard deviation. For the questions relating to factors affecting the efficiency of standard application of green office, they were analyzed by using factor analysis, a technique of grouping all the similar factors and variables.

3. Results and Discussion

3.1 Results of analysis of general information

There were a total of 474 respondents, There were 232 male respondents, making up 48.9 percent of the population and 242 female respondents making up, 51.1 percent. Most of the employees were found to be within the 30 - 39 years, 45.1%, and 40 - 49 years 25.1% age bracket. 47.0 percent of the respondents had completed bachelor degree, and 43.5 percent of them had completed education at a level higher than bachelor degree. 44.9 percent of the respondents were from governmental organization, and 41.4 were from state enterprise. Of the remaining respondents 10.1 percent were from private organizations, and the final 3.6 percent came from educational organizations.

3.2 Results of factor analysis

Fifty-one (51) factors were studied and analyzed in order to find the factors affecting the efficiency of standard application of the green office. Of these 51 factors, only 12 factors could be used in factor analysis. The detail of all 12 factors can be seen in Table 1.

From the research, the results and discussion were as follows:

There were a total of 474 respondents, as has already been mentioned, most of the respondents were female consisting of 242 female respondents. Most of the respondents were at the age group between 30-39 years old. The majority of the respondents had completed bachelor degree. This group was considered as possessing high level of factors affecting performance in education, communication, working position, participation,

Table 1 The factors affecting the efficiency of standard application of green office

	Factors	% of Variance	% of Cumulative
Factor 1	Support and cooperation in green office project by the executives, and their intention in operating the project	30.934	30.934
Factor 2	Communication and good relationship among the executives of the organization and colleagues	7.122	38.055
Factor 3	Document preparation for the procurement relating to the project, and identifying approaches to convince employees to use energy safely, reduce waste, and encourage recycling	5.253	43.309
Factor 4	Examining, monitoring, and recording for writing a report on the operation of the environmental project and the participation of the executives	4.735	48.044
Factor 5	Skills and abilities in operating the project, and having specialists from outside assisting in developing innovation in the organization	3.941	51.984
Factor 6	Preparing manuals to support the green office project such as creating environment and atmosphere in workplaces in order to make employees interest in developing the project	3.616	55.601
Factor 7	Range of period that the employees occupying in the office contributing to the sense of unity and team working, and understanding the green office project by learning from the manual	3.166	58.767
Factor 8	Types and management within an organization	3.021	61.788
Factor 9	System of information technology within an organization	2.846	64.634
Factor 10	Recruitment of new employees who have potential to carry on the green office project	2.677	67.311
Factor 11	A period of time that each employee has been working with an organization	2.426	69.737
Factor 12	Changes of technology	2.193	71.931

organization's structure and size and type of the organization, technology and equipment, environment in the office. In addition, this group possessed very high level of skills affecting the performance in policy making and planning. From the interviews with the respondents on the efficiency of standard office applications, it was found that they were using resources environmentally friendly manner. Moreover, the respondents were having knowledge of standard application of green office, understood the performance, and have skills in the green office. It is important to have education of the manual operation of the green office as it will make operations more efficient and. Imparting education is therefore essential to the efficiency of an organization for many reasons.

All of the results that were consistent with Yotsamun [3], who studied the relationship between personal factors of nurses to performance. The results showed that the performance of individuals relates to environmental factors of the workplace and are dependent on the duties or responsibilities of the position. The placement was arranged for access to power and opportunity. It reinforces the behavior which is based on several factors such as better working conditions. The ability of individuals varies according to aptitude, interest, motivation, personality characteristics, age, gender, education, experience, beliefs and values. This is consistent with the theory of Phoemphon [4] who said

that for people to would go into operating system of an organization, the person should have knowledge which meets the organization's requirements. According to this theory, the efficiency and capability of people need to be developed by various institutions so that they are capable enough to enter the organization and to work effectively. Secondly, when a person enters the job, it was found to be the duty of the organization to develop personal efficiency and the ability to make them work productively for the organization and the improvement of their own so as to develop the performance of the overall organization. This study helps to understand they key to effective and efficient operations in the green office.

The type of organization, the structure and size of the organization, policy, planning, available technology were reviewed from literature Chamratsri [5] mentioned 3 factors in relation to this research as follows:

Factor 1: the effectiveness of an organizational structure is dependent on the appropriateness of the structure and also related to the other important factors, such as the policy covered, the factors determining the vision to define the mission that was consistent with the vision.

Factor 2: the second important factor is the human factor. As people were a group in an organization with a role to perform tasks in order to achieve the objective. The people comprises management personnel who are

responsible for a job in the organization's structure, covering individuals belonging to different strata from high levels to middle and lower levels. People's effectiveness would lead to the work effectiveness of the organization, which is further related to other characteristics and properties consisting of the number and characteristics of personnel in each group, such as basic knowledge relating to job duties, skills, leadership and communication skills in technology and management.

Factor 3: the third important factor is the technological factor which influences product design, management, tool, advanced equipment used in production process, control and quality inspection, preparation of system data link services for the distribution, and marketing. Moreover, Ashamas [6] discussed the factors that affected the efficiency of operations within organization. They found the following.

1. Policy and planning of the organization

Policy was considered as the first important step in the implementation of a green office , The putting of plan into practice of the plan requires senior management or agencies responsible for policy making has to be responsible and concern compliance with specific time intervals.

2. Organization structure

Organization structure must fit the style, and the size of the organization, as well as being clearly defined. This idea was not redundant and therefore it was treated as internal control which corresponded with the findings of Sakhan et al [7] and Duangphatta [8]. They found that the organizational structure was relevant to the procedure which was one of the factors affecting performance in prosecuting drug offenders.

3. Availability, service provision, and computer support

To increase performance efficiency of green office operations, the organization must plan and determine policy. There should be campaign of energy saving and the use of resources economically. The green office should be ready for technological changes with application of new technology and new scientific methods, which may be used in various factions within the organization in order to optimize its performance.

Monitoring was a key management control and required reporting, tracking and evaluation of the green office. Executives were responsible for clarification and explanation by indicating the reasons for difference between the estimated and actual plans, They were responsible for finding the causes, and identifying who was responsible for these causes. This responsibility would lead to corrections and improvements. This finding corresponds with the theory of Sakhakon et al [7].

3.3 Results of indicators for greenhouse gas emission for green office

The average of greenhouse gas emission per person per m^2 per month in 2015 was classified by the type of organization. On the basis of the greenhouse gas emission information, there were four main types of organizations that were identified, These were private organization, state enterprise, governmental and independent organization, and educational organization. Greenhouse gas emissions in 2015 for each of these types of organization can be seen in Figure 1 and Figure 2 respectively. Figure 1 gives the emissions per person and Figure 2 gives the emissions per m^2 of office area.

According to Figure 1, private organizations had average greenhouse gas emission during January to July, of 263.96 $kg_{eq}CO_2$. However, state enterprise, governmental and independent organizations, and educational organization had much lower emissions per person with an average of 190.05, 643.75, and 278.57 $kg_{eq}CO_2$ respectively. The result from analysis of the variance showed adifference of P-value < 0.0009. For each month, the average showed no difference and gave a P-value = 0.327.

According to Figure 2, private organizations had an average of greenhouse gas emission during January to July for 8.74 $kg_{eq}CO_2$. However, state enterprise, governmental and independent organization, and educational organizations had average of 6.63, 21.90, and 8.59 $kg_{eq}CO_2$ respectively. The result from analysis of the variance of information showed a difference of P-value < 0.0009. For each month, the average showed no differences from month to month and a P-value = 0.677.

It is suggested that the calculation of greenhouse gas emission per head should be used instead of calculating per area because, since the amount of space in each organization is not equal, calculating per area may causes high error. The Office of the Civil Service Commission (OCSC) [9] defined a measure that follows the guidelines of the SMART Objective. The SMARTS objectives are follow as: S (Specific) = specific indicators should be clear and meaningful commitment to what measures should be imposed. Providing clear indicators to avoid interpretation errors and communicating a consistent understanding across the enterprise; M (Measurable) = measurable indicators that can be used to measure performance data from actual measurements. A (Attainable)/(Achievable) = accomplishment of the organization; R (Realistic) = true, a more realistic indication of operating principles which are appropriate for the organization and not a cost. Temple exorbitant T (Time Bound) = under reasonable timeframe so that performance can be measured within a given time

4. Conclusions

In conclusion, factors which affected the efficiency of the standard application of the green office consist of the follow 12 factors:
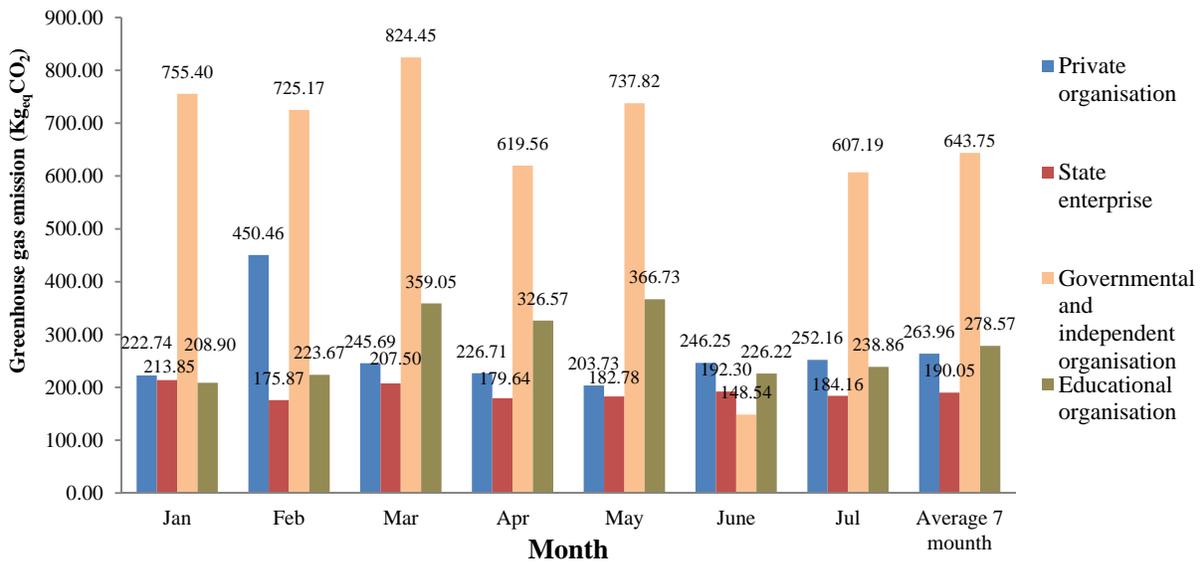
Figure 1 The average of greenhouse gas emission per head per month in each type of organization in 2015
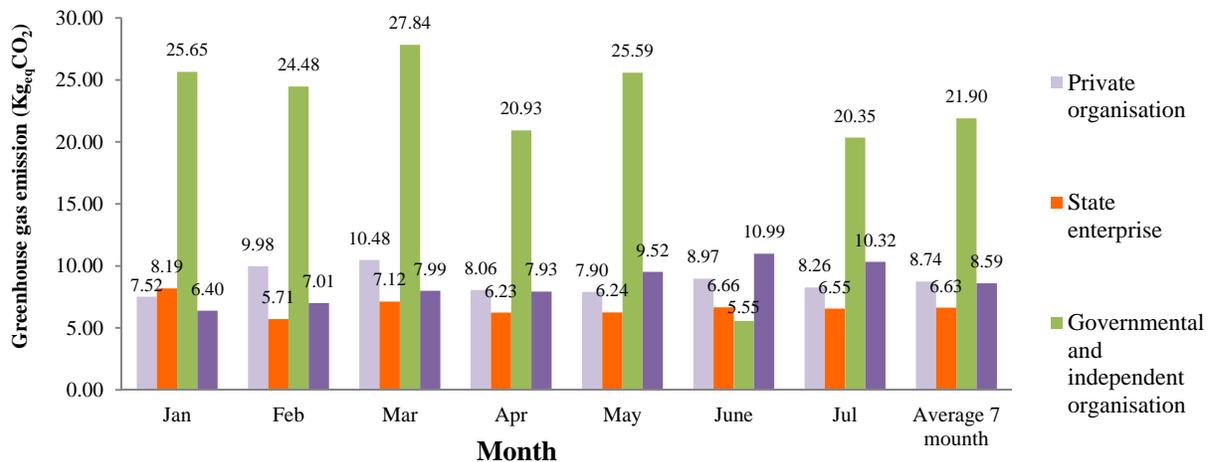

Figure 2 The average of greenhouse gas emission per area per month in each type of organization in 2015

4.1 Support and cooperation in the green office project by the executives, and their commitment to the project

4.2 Good communication and relationships among the executives of the organization and colleagues;

4.3 Good document preparation for procurement active relating to the project. Identifying approaches to convince employees to use energy safely, reduce waste, and encourage recycling;

4.4 Good examining, monitoring, and recording of progress for writing reports on the operation of the environmental project and the participation of the executives;

4.5 Good skills and abilities in operating the project, and having specialists from outside assisting in developing innovation in the organization;

4.6 The preparation of manuals to support the green office project such as creating an environment and atmosphere in the workplaces in order to make employees interest in developing the project;

4.7 A period that the employees in the office can contribute to the sense of unity and team working, and understanding the implementation of the green office project by learning from the manual;

4.8 Adequate types of staff and management within an organization;

4.9 A suitable system of information technology within the organization;

4.10 The recruitment of new employees who have potential to continue the green office project;

4.11 Low staff turnover;

4.12 Adequate management of change relating to new technology.

Greenhouse gas emission are uncontrollable activities because external factors are involved such as the damage of instruments or of greenhouse gas emission in that time. It can be concluded that if an organization is determined to operate the green office Project in accordance with the operation manual and through applying all related factors into the operation system to project can be implemented successfully. This will lead to the use of resources being minimized or decreased or used more efficiently. Lastly, the calculation of performance indicators of greenhouse gas emission should be carry out per person instead of calculating per area of office.

5. Recommendation

5.1 Separation of the respondents into 4 groups will help to clarify more when comparing the difference in emission from companies based on the average individual in their organisations. However, some agencies have been combined together making this more of a challenge; for example, the Electricity Generating Authority of Thailand (EGAT), has become a state enterprise. Comparing the differences between emission per person in similar organisations will provide a clearer result.

5.2 Organization should collect the data continuously, and produce reports either monthly or annually so that they can keep track of their emissions.

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