

## Factors affecting the water usage performance of standard application of green office in Thailand

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### Abstract

The objectives of this study were to study factors affecting the efficiency of standard application of Green Office and to develop indicators for measuring resources usage. Factors which affected the efficiency of standard application of Green Office consist of 12 factors. Indicators for water usage per head of private organization were 4.91 cubic meters per person per month. For state enterprise, governmental and educational organizations were 3.19, 5.51 and 6.98 cubic meters per person per month respectively. Indicators for water usage per area of private organizations were 0.09 cubic meters per area per month. For state enterprise, governmental and educational organizations were 0.09, 0.37 and 0.12 cubic meters per area per month respectively. Water supply usage was an uncontrollable activity because external factors involved such as the damage of instruments and service organization accessing the area which increased the amount of water usage. However, if an organization insists to operate the Green Office Project by following the operation manual and applying all related factors and indicators into the operation system, the usage of water supply, CO<sub>2</sub> and greenhouse gas will be decreased and use purposefully.

**Keywords:** green office, water usage in office, efficiency of water usage, indicator

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### 1. Introduction

Due to economic growth and technology development at present, it makes an increased consumption of energy and natural resource. The needs of human's basic factors have increased while the natural resource is limited. Therefore, the need of human does not match with the amount of natural resource and there is limitation of manufacturing building resources. The process of production has led to the climate change that causes the global warming. Even though the operation of several institutions including governmental sectors, private sectors, state enterprises and many departments in universities provided beneficial issues towards society, they also create drawbacks to society in terms of consumption of some natural resource and energy and releasing of sewage and pollution such as air pollution, noise pollution and water pollution. It can be asserted that the environment can be destroyed by these drawbacks that are mentioned above. Moreover, it also leads to an increase in the level of greenhouse gas in the atmosphere that causes the climate change and greenhouse effect [1].

The effect of burning fossil fuels in many manufacturers makes the climate change occur 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. These causes climate change, the change in rainfall, and sea level rise. Moreover, it also affects many living organism such as plants, animals and human.

The global warming or climate change is mainly caused by human activities that always lead to the production of CO<sub>2</sub> and greenhouse gas. If the level of CO<sub>2</sub> in the air is very high, it will make the temperature higher [2].

Recently, the overall quality and the environment of the water were changed as a result of climate change in the world. In the past, there was more water enough for everyone to consume. At present, the water is insufficient to satisfy peoples' needs since the number of population is gradually increasing as well as the demand for the water rises [3]. There are now several corporations that focus on how to manage the environment effectively. In the recent decades, there is a growing concern about Green Office as it is an environmental service for offices with the main goal of bringing an environment which is good for the health, for conservation of energy, diminishing emission

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of carbon dioxide in the atmosphere and the ecological footprint of the offices. The green office aims to mitigate the environmental problem and its effects such as climate change. It is a practical environmental management system for the offices, applicable to all kinds of organization, be it a small or large organization, private companies or the public sector, easy to implement in an urbanized environments and which help in reducing the office's emissions of greenhouse and ecological footprint [4]. With green office, offices' impact on the environment will be reduced, will be able to achieve savings economically and at the same time will lessen the burden on the environment, thereby retarding the effect of climate change in the environment. There are many ways for the consumption of energy. Among them, offices and its daily operations consume a lot of energy and therefore a sustainable solutions lies in the organization of office and its system. This led to the creation of a system or program called the green office, which aims to motivate staff in an office to work in an environmentally friendly way with regard to daily office activities. In addition, it aims to perform office tasks economically by means of environmental education to bring awareness and benefits of following the standard of green office. This will help to bring benefit to both the parties, that is, office and the environment [4]. On the whole, the following are the purposes of green office standard as:

- Reduction in the consumption of natural resources by making the office to be environmentally efficient.
- Promotion of the sustainable environmental practices in office by training and educating the employees so as to improve environmental awareness.
- Bringing awareness on the effect of climate change and counter measures steps necessary to mitigate it with activities or practices such as energy saving measures and use of renewable energy sources [5, 6]. Therefore, 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 objectives of this study were as follows:

- 1) To study the factors affecting the efficiency of standard application of Green Office;
- 2) To develop indicators for measuring water resources usage;
- 3) To be a guideline for other corporations which provide a strategy of how to reduce the use of greenhouse gases.

## 2. Materials and methods

### 2.1 Methods

The study uses descriptive research design, describing facts as it is based on survey data collected by the administration of both close and open ended questionnaire from the offices who were engaged in the project of green office. In addition, personal face to face interviews were also conducted to get more information from the subjects included in the study. Regarding the sampling method, this study applied the purposive sampling technique by selecting committees whose works were related to the Green Office project. All the samples were selected from the corporations or institutions that were registered as a member of the Green Office project, which belongs to the Ministry of Natural Resources and Environment cooperating with the Faculty of Environment and Resource Studies of Mahidol University. There were altogether 55 corporations in Thailand.

### 2.2 Materials

Regarding the tool used for data collection, it is divided into two parts.

First, this research used surveys in collecting all the data from the offices engaging in the project. For the questionnaire design, 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. This survey was separated into three parts.

*First* part was closed ended questions including biography of the applicants such as gender, age, position etc. *Second* part was questions including the general information of the firm such as firm's name, the number of employees in a firm etc. *Third* part was the questions that assisted in measuring the knowledge about the Green Office project, and the study of factors affecting the efficiency of standard application of Green Office. For this part, the questions were subdivided into two parts which were

• *First part* contained the overall knowledge about the Green Office project.

• *Second part* contained the study of factors affecting the efficiency of standard application of Green Office, and further suggestion on factors affecting the standard application. The questions in this part are closed ended questions. The parameters or variables included in the study includes the variables of personal factors, organizational factors, and environmental factors. Fifty-one (51) variables or factors were studied and analyzed in order to find the factors affecting the efficiency of standard application of Green Office. Of these 51 factors, only 12 variables

or factors can be used in factor analysis. The details of the variables or factors can be seen in Table 1. A *rating scale* of 5 levels was used in this part. The class interval was 0.80 and the reliability was 0.946.

Second, the data of this research was also collected by the administration of interview and questionnaire, which the respondents were questioned on water usage, which provide data for developing indicators of Green Office which is water usage in the office per person and per area.

### 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, the data was analyzed by using factor analysis, a technique of grouping of all the similar factors and variables.

## 3. Results and discussion

### 3.1 Results of analysis general information

According to the analysis of the survey, there were 474 respondents in total consisting of 232 male respondents which was 48.9 percent and 242 female respondents which was 51.1 percent. Most of the employees were at the age group of 30 - 39 years old and 40 - 49 years old which were 45.1 and 25.1 percent respectively. 47 percent of the respondents completed bachelor degree, and 43.5 percent of them completed higher than bachelor degree. Additionally, 44.9 percent of the respondents were from governmental organization, and 41.4 were from state enterprise. Apart from that 10.1 percent were from private organizations, and another 3.6 percent came from educational organizations.

### 3.2 Results of factor analysis

Fifty-one (51) variables or factors were studied and analyzed in order to find the factors affecting the efficiency of standard application of Green Office. Of these 51 factors, only 12 variables or factors can be used in factor analysis. The deviation of the information was 71.931 percent. The detail of all the 12 variables included for factor analysis were presented in Table 1.

From the study of factors affecting the performance of the standard office application of environmentally friendly (Green office), the discussion and results of the participating offices, is presented as follows:

There were 474 respondents in all. Most of the respondents were female; there were 242 female respondents. Most of the respondents were at the age

group between 30-39 years old. The majority of the respondents completed bachelor degree. This group has high level of factors affecting performance in education, period, communication, working position, participation, organization's structure and size and type of the organization, technology and equipment, environment in the office, and also very high level of factors affecting the performance in establishing policy and planning. Regarding the use of various resources in most levels, from the analysis of data through interviews with the respondents on the efficiency of standard office applications, the results found out that it was environmentally friendly. Additionally, the respondents were having awareness of green office application, understanding of the performance, and were having skills about the green office and skills and education of the manual operation which will subsequently create easy and efficient operations system of an office thereby leading efficiency to the organization in various fields. This is consistent with Yotsamun (2008) [7], who studied the relationship between personal factors of nurses to the performance. The results showed that the performance of individual resulted from environmental factor of the workplace and depended on the duties 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. It is consistent with the theory of PhoemPhon (1998) [8] who too, mentioned that the first thing that people needed in the operation of an organization was knowledge of operation in the organization. In addition, the person must have knowledge to meet the organization's requirements. According to this theory a person's knowledge need to be adapted, developed or capable enough to enter and work effectively. Second, when a person enters the job in an organization it was his duties to work for the interest of the organization and to develop personal efficiency and apply the ability to work productively for the organization. Therefore, development of their own personal efficiency is very important so as to develop performance in an organization which would lead to the effective organization's performance. Thus, gives the importance of the factor of cognitive performance aspects. The study of the offices characteristics or factors of the green, therefore, guide as a part of the efficient operation system of an organization and its efficiency.

**Table 1** Factors affecting the efficiency of standard application of green office

Factors	% of Variance	% of Cumulative
Support and cooperation in Green Office project by the executives, and their intention in operating the project	30.934	30.934
Communication and good relationship among the executives of the organization and colleagues	7.122	38.055
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
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
Skills and abilities in operating the project, and having specialists from outside assisting in developing innovation in the organization	3.941	51.984
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
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
Types and management within an organization	3.021	61.788
System of information technology within an organization	2.846	64.634
Recruitment of new employees who have potential to carry on the Green Office project	2.677	67.311
A period of time that each employee has been working with an organization	2.426	69.737
Changes of technology	2.193	71.931

The type of organization, the structure and size of the organization, policy and planning, including technology, literature review which is found from the works of Chamratsri (2009) [9], mentioned three factors related to this research. The three factors were as follows.

Factor 1: the organizational structure would be effective enough depending on how the appropriate structure was related to the release of important factors, including the policy covered, the factors determining the vision, to define the mission that was consistent with the vision.

Factor 2: the human factor was the most important factor. First of all, people were a group in the organization, and they had a role to perform tasks in

order to achieve the objective. The people comprised management personnel who were responsible for a job in the organization's structure, covering individuals, high levels of party, the middle and lower levels of the party. This would lead to the work effectiveness of the organization and it is dependent on the desired characteristics and properties which consisted of the number of personnel in each bundle, basic knowledge relating to job duties, skills, leadership and communication skills, skills in technology and management skills. The desired values were the ability to develop people and modify, which was in accordance with the policies and operations of the organization.

Factor 3: the technological factor influenced product design, design management, tool and advanced equipment in production process, control and quality inspection, preparation of system data link services for the distribution, and marketing. Moreover, Ashamas (2001) [10] discussed the factors that affected the efficiency of operations within the organization as the following.

1) Policy and planning of the organization: Policy was the first step of the plan because it was an important practice that senior management at the policy level leading the agencies responsible and concern compliance with specific time intervals.

2) Organization structure: Organization structure must fit the style, the size of the organization, and should be clearly defined. It should not be redundant and therefore it was treated as internal control which corresponded with the findings of Duangphatta (2001) [11]. They found that the organization structure was appropriate to the procedure which was one of the factors affecting performance in prosecuting drug.

3) Availability, service provision, and computer support: To perform efficient green office operations, the organization must plan and determine policy. In the campaign of energy saving and the use of resources, economic and technological changes, support and use of this technological equipments and the tools or methods of modern scientific methods used within the organization should be optimized. On the whole, modern technology may affect performance of an organization.

Monitoring was a key management control and required reporting, tracking and evaluation. Executives were responsible for clarification and explanation by indicating the difference between the estimated or actual plans, what the causes were, and who were responsible for that causes. These would facilitate in corrections and improvement which corresponded with the theory of Sakhakon *et al.* (2005) [12].

### 3.3 Results of indicators for measuring water resources usage for Green Office

The average water usage per person per area per month in 2015 was separated by the type of organization. The findings or result is based on the information of water usage. There were four main types of organization as: 1. private organization, 2. state enterprise 3. governmental and independent organization, and 4. educational organization. The information of water usage in 2015 separated by type of organization is shown in Figure 1 and Figure 2 respectively.

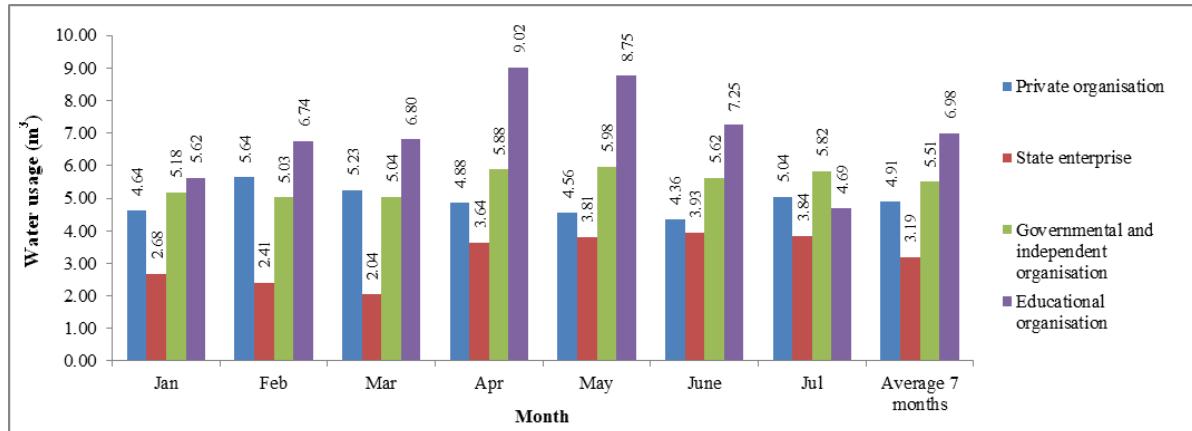
According to Figure 1, private organizations had an average water usage of 4.91 cubic meters during January to July. For state enterprise, governmental and independent organization, and educational organization they had an average of 3.19, 5.51, and 6.98 cubic meters, respectively. The result from analyzing the variance of information about water usage per head for each type of organization showed the difference of P-value < 0.0009. For each month, the average showed no difference of P-value = 0.300.

According to the Figure 2, private organizations had an average water usage during January to July of 0.09 cubic meters. For state enterprise, governmental and independent organization, and educational organization had average of 0.09, 0.37, and 0.12 cubic meters respectively. The result from analyzing the variance of information of water usage per area for each type of organization showed the difference of P-value < 0.0009. For each month, the average showed no difference of P-value = 0.219.

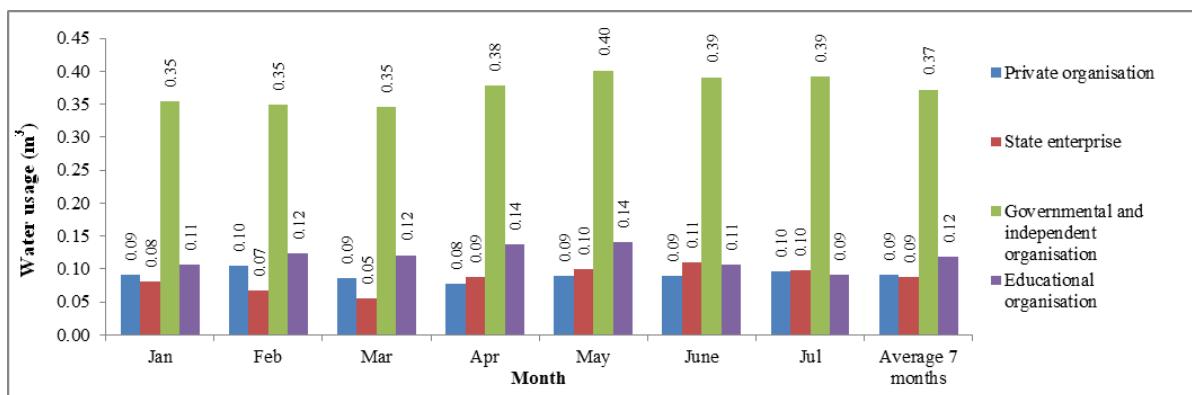
The development of performance indicators of water consumption per head should be used because it is the amount of space in each organization which is not equal when calculating per area and this causes high error. Therefore, indicators per head should be used and these are suitable than calculating per area. The Office of the Civil Service Commission (OCSC) (2009) [13] defined a theory to measure water which follows the guidelines of the SMART. The detail of this abbreviation is as: Objective S (Specific) = specific indicators. In other words, there 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 and to compare data from other indicators and statistical analysis. A (Attainable) / (Achievable) = accomplish. R (Realistic) = true, a more realistic indication of operating principles which are appropriate for the organization. Temple exorbitant T (Time Bound) = under reasonable timeframe which can measure performance within a given time.

### 4. Conclusions

In conclusion, the factors which affected the efficiency of standard application of Green Office consist of 12 factors. Water supply usage is an uncontrollable activity because external factors are involved such as the damage of instruments or of water usage in that time. However, if an organization



**Figure 1** Average of water usage per head per month in each type of organization in 2015



**Figure 2** Average of water usage per area per month in each type of organization in 2015

insists to operate the Green Office Project in accordance with the operation manual and applying all related factors into the operation system, the usage of water supply will be decreased and worthwhile to use. There are twelve factors for the successful operation of green office as follows:

- 1) Support and cooperation in Green Office project by the executives, and their intention in operating the project.
- 2) Communication and good relationship among the executives of the organization and colleagues.
- 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.
- 4) Examining, monitoring, and recording for writing a report on the operation of the environmental project and the participation of the executives.
- 5) Skills and abilities in operating the project, and having specialists from outside assisting in developing innovation in the organization.
- 6) Preparing manuals to support the Green Office project such as creating environment and atmosphere in workplaces in order to bring interest of the employees in developing the project.

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.

- 8) Types and management within an organization.
- 9) System of information technology within an organization.
- 10) Recruitment of new employees who have potential to carry on the Green Office Project.
- 11) A period of time that each employee has been working within an organization.
- 12) Changes of technology.

Lastly, the development of performance indicators of water usage should be per head.

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