International Association of Organizational Innovation

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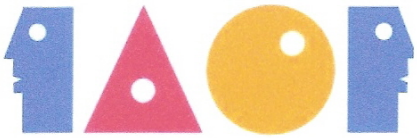

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# PREDICTION OF THE LONG TERM SEA LEVEL RISE OF PENGHU OFFSHORE ISLAND UNDER GLOBAL WARMING

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Abstract

Sea-level rise is one of the most significant effects of the global warming, two desert islands in Kiribati disappeared at sea level in 1999. Therefore, In the face of the threat of being submerged by the sea, the country will be engulfed by the sea if no positive action is taken. Taiwan's offshore Islands include Penghu, Kinmen, Lüdao, Orchid Island, Lauloi Wan, Matsu and the South China Sea islands and other islands. Taiwan's sea-level rise is the fastest in the world, especially in the Penghu offshore Island is more than twice as high as the world average. This paper is aim to develop the artificial neural network to evaluate the long term sea-level data and estimate the possible sea level in 2030 and 2050 based on the Penghu offshore Island at Taiwan. The results indicate that the artificial neural network can be efficiently forecasted sea level change. The average rate of sea level rising on the Penghu offshore island in 2030 and 2050 is about 4.36~6.29 cm.

Key Words: Prediction, global warming, offshore island, sea level change

## Introduction

In 2015 The UN Framework on Climate Change (UNFCCC) at the 21th of the annual Conference of Parties (COP21), also known as the 2015 Paris Climate Conference, for the first time in over 20 years of UN negotiations, aim to achieve a legally binding and universal agreement on climate, with the aim of keeping global warming below 2°C. The ability to keep temperatures below 2°C will avoid that extreme weather will induced the increase the vulnerability of disaster, such as sea levels rise.

As an island, Taiwan is especially sensitive to the impact of the global climate change. Taiwan's Offshore Islands include Penghu, Kinmen, Lüdao, Orchid Island, Lauloi Wan, Matsu and the South China Sea islands and other islands. Taiwan's sea-level rise is the fastest in the world, especially in the west. The Kaohsiung, Changhua,

Hsinchu and Penghu are more than twice as high as the world average. The world is growing at a rate of 0.3 cm per year, 1 cm per year in western Taiwan and 1.7 cm per year in Penghu. The threat of sea-level rise included to the coastal erosion, coastline retreat, land loss, flooding caused by sea water intrusion and rise of groundwater level. In addition, the sustainable development of the island, tourism industry and ecological balance also have a significant impact. In view of this, it is urgent to grasp the characteristics of the long-term sea level changes in the offshore areas of Taiwan Islands under global warming.

In the pass, the Fourier transform, the linear regress model, the moving average model, the ensemble empirical mode (EEM) and the ensemble empirical mode decomposition (EEMD) will often were to evaluate the sea level change. However, these two methods need to a lot of measured data. Add, they cannot predict the variable of sea level.

Recently, Artificial neural network (ANN) has been widely applied to a variety of areas especially applications in diagnosis and forecasting. For example, in water resources, ANNs were used to predict the rainfall intensity (French et al., 1992), for river flood forecasting (Campolo et al., 1997) and to forecast raw-water quality parameter for the North Sakatchewan River (Zhang and Stanley, 1997). Other successful examples of the application of neural network in earthquake induced scour depth around bridge piers in the literature (Lee et al., 2007).

In coastal engineering, the ANNs technique to assess the stability of the armor unit and the rubble-mound breakwater and estimate the wave forces acting on the structures has been proposed (Mase, 1995). Tsai and Lee (1999) used neural networks for tide forecasting by using the field data of diurnal and semi-diurnal tide. Lee and Jeng (2002) extended the diurnal and semi-diurnal tide to the mixed tides, which are more likely to occur in the field. Lee (2004) proposed the application of ANNs combined with the equation of harmonic analysis for the long-term prediction of the tidal level. ANNs have also been applied to calculate sea level and wave parameters (Makarynskyy et al., 2005). Lee (2009) used neural networks for storm surge prediction.

In this study, we will aim to develop the different innovative algorithms, such as the Fourier transform, the back-propagation neural network (BPN) and the ensemble empirical mode decomposition, to evaluate the long term sea level change on the Penghu offshore Island at Taiwan based on the observed tidal gauge data.

## Back-Propagation Network

An Artificial Neural Network is a mathematical system, which can model the ability of biological neural network by interconnecting many simple neurons. The neuron accepts inputs from a single or multiple sources and produces outputs by simple processing with a predetermined non-linear function.

A typical three-layered network with an input layer (I), a hidden layer (H) and an output layer (O) (see Fig. 1) is adopted in this study. Each layer consists of several neurons and the

layers are interconnected by sets of correlation weights. The neurons receive inputs from the initial inputs or the interconnections and produce outputs by transformation using an adequate nonlinear transfer function.

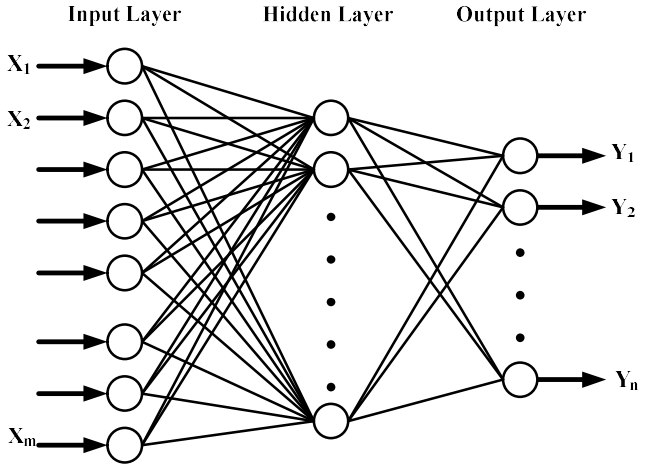


Figure 1. Structure of an Artificial Neural Network.

(Editor's Note: the following text is published in single column in order to facilitate the reading of the formulas.)

A common transfer function is the sigmoid function expressed by: $f(x)=(1+e^{-x})^{-1}$ which has characteristics of $df/dx = f(x)[1- f(x)]$. The training processing of a neural network is essentially executed through a series of patterns "input-target output". In the learning process, the interconnection weights are adjusted within input and output value. Therefore, the primary characteristics of ANN can be presented as following: (1) the ability of learning; (2) distributed memory; (3) the fault tolerance and (4) operation in parallel. With these characteristics, ANN has been widely applied to various areas. Since the principle of ANN has been well documented in the literature, only a brief description is given in this section.

The back-propagation neural network (BPN) is the most prevalent in supervised learning models of the ANN. The BPN uses the gradient decent backpropagation learning algorithm to update the weights and biases of artificial neural nets in the direction of the negative gradient of the performance function with a pre-set learning rate. This can cause a very slow training when the gradient has a small magnitude. The BPN are easily solved the interaction of processing element by adding the hidden layers. In the learning process of BPN, the interconnection weights are adjusted using an error convergence technique to obtain a desired output for a given input.

In general, the error at the output layer in the BPN model propagates backward to the input layer through the hidden layer in the network to obtain the final desired outputs. The gradient descent method is utilized to calculate the weight of the network

and adjust the weight of interconnections to minimize the output error. The error function at the output neuron is defined as

$$E = \frac{1}{2}\sum_{n}(T_j - A_j)^2 \qquad (1)$$

The gradient decent algorithm adapts the weights according to the gradient error which is given by

$$\Delta W_{ij} = -\eta \times \frac{\partial E}{\partial W_{ij}} \qquad (2)$$

in which $T_j$ and $A_j$ are separately the actual and predicated values of output neuron, respectively, and is the output neuron. Further details of the BPN algorithm can be found in Rumelhart et al. (1986).

where $\eta$ is the learning rate and the general form of the $\frac{\partial E}{\partial W_{ij}}$ term is expressed by the following form (Rumelhart et al. 1986):

$$\frac{\partial E}{\partial W_{ij}} = -\delta_j{}^n \cdot A_i{}^{n-1} \qquad (3)$$

Substituting (3) into (2), we have the gradient error as,

$$\Delta W_{ij} = \eta \cdot \delta_j{}^n \cdot A_i{}^{n-1} \qquad (4)$$

in which $A_i{}^{n-1}$ is the output value of sub-layer related to the connective weight ($W_{ij}$). $\delta_j{}^n$ is the error signal, which is computed based on whether or not neuron *j* is in the output layer. If neuron *j* is one of the output neurons, then:

$$\delta_j = (T_j - Y_j)\cdot Y_j \cdot (1 - Y_j) \qquad (5)$$

If neuron *j* is the neuron of the hidden layer

$$\delta_j = \left[\sum_j \delta_j \cdot (W\_hy)_{hj}\right] \cdot H_h \cdot (1 - H_h) \qquad (6)$$

where $H_h$ is the value of hidden layer.

Finally, the value of weight of inter-connective neuron can be expressed as:

$$W_{ij}^{\,m} = W_{ij}^{\,m-1} + \Delta W_{ij}^{\,m} = W_{ij}^{\,m-1} + \eta \cdot \delta_j^{\,n} \cdot A_i^{\,n-1} \quad (7)$$

To accelerate the convergence of the error in the learning procedure, Jacobs (1988) proposed the momentum term with the momentum gain, $\alpha$, into the equation (7).

$$W_{ij}^{\,m} = W_{ij}^{\,m-1} + \eta \cdot \delta_j^{\,n} \cdot A_i^{\,n-1} + \alpha \cdot \Delta W_{ij}^{\,m-1} \quad (8)$$

in which the value for $\alpha$ is within 0 and 1.

The root mean squared error (RMSE) and correlation coefficient (CC) were used to estimate accuracy of the methodology.

$$\text{RMSE} = \sqrt{\sum_{k=1}^{n} (y_k - \hat{y}_k)^2 / n} \quad (9)$$

$$CC = \frac{\sum_{k=1}^{n} (y_k - \bar{y}_k)(\hat{y}_k - \bar{\hat{y}}_k)}{\sqrt{\sum_{k=1}^{n} (y_k - \bar{y}_k)^2 \sum_{k=1}^{n} (\hat{y}_k - \bar{\hat{y}}_k)^2}} \quad (10)$$

in which $y_k$ and $\hat{y}_k$ are the network predictions and the value of observation. $\bar{y}_k$ is the mean of network predictions ( $\bar{y}_k = \frac{1}{n}\sum_{k=1}^{n} y_k$ ) and $\bar{\hat{y}}_k$ is the mean value of observation ( $\bar{\hat{y}}_k = \frac{1}{n}\sum_{k=1}^{n} \hat{y}_k$ ).

*Applications and Discussion of Results*

The monthly tidal level data was collected at Penghu at Taiwan from 1977 to 2014 were used to test the accuracy of the proposed neural methodology. The location of the Penghu offshore island is indicated in Figure 2.

First, we will discusses how the neural network structures effect the performance of the forecasting model, which includes the number of neurons hidden layers, the learning rate (η), the momentum factor(α) and the number of training iterations (Epochs).

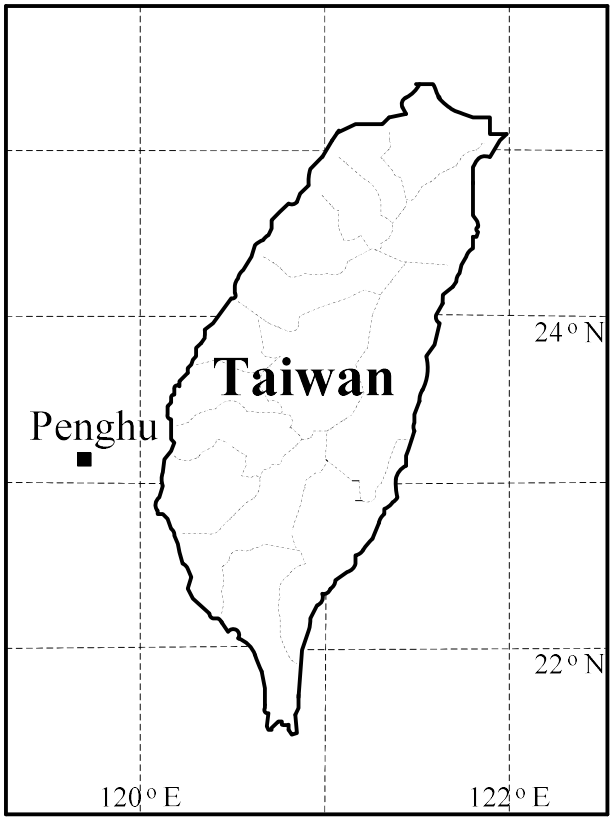


Figure 2. Location of Penghu offshore island in Taiwan.

Using 60 days data as a training set with one hidden layer, 3000 Epochs, η is set 0.01 and α is set 0.9 is presented in Table 1 for the optimized neural network structure at the Penghu offshore island.

Figure 3. presents that the comparing results of tidal measured data form 1954 to 2014 using the regression analysis and FFT method at Penghu offshore island. The comparing results of tidal measured data form 1954 to 2014 using the regression analysis and EEMD method at Penghu offshore island also shows in Figure 4. In these two figures, we can find sea levels had risen from 1954 to 2014.

Table 1. The optimized neural network structure for Penghu.

| | |
|---|---|
| η | 0.01 |
| α | 0.9 |
| Hidden Neural | 3 |
| Epoch | 3000 |
| RMSE | 0.2082 |
| CC | 0.9998 |

Figures 5 and 6 present that the long term tidal predictions for 2030 and 2050 years at Penghu offshore island with five years data were training.

In this figure, for blue solid line is the measured results, red solid circle is the training data, green solid line is the regression analysis results of BPN, red dashed line is EEMD, blue dashed line is FFT. It is shown that the forecasting result (green dashed line) has the sea level variation.

Table 2 shows the variation for the sea level forecasting in 2030. The result displays the average changes for the sea level is about 6.29 mm/year for BPN, 5.82 mm/year for FFT, 6.36 mm/year for EEMD.

Table 2. The rising quantity of sea level for 2030 at Penghu offshore island.

| BPN | FFT | EEMD |
|---|---|---|
| 6.29 mm/year | 5.82 mm/year | 6.36 mm/year |

Table 3 shows the variation for the sea level forecasting in 2050. The result displays the average changes for the sea level is about 4.36 mm/year for BPN, 4.15 mm/year for FFT, 4.7mm/year for EEMD.

Table 3. The rising quantity of sea level for 2050 at Penghu offshore island.

| BPN | FFT | EEMD |
|---|---|---|
| 4.36 mm/year | 4.15 mm/year | 4.7 mm/year |

## *Conclusion*

This paper is aimed to propose the application of the artificial neural network in forecasting the long term sea-level in the future. The original data of Penghu offshore Island at Taiwan is used for the verification and prediction the possible sea level in 2030 and 2050. The results indicate that the long term sea-level has risen in 2030 and 2050. The average rate of sea level rising on the Penghu offshore island in 2030 and 2050 is about 4.36~6.29 cm.

## *Acknowledgments*

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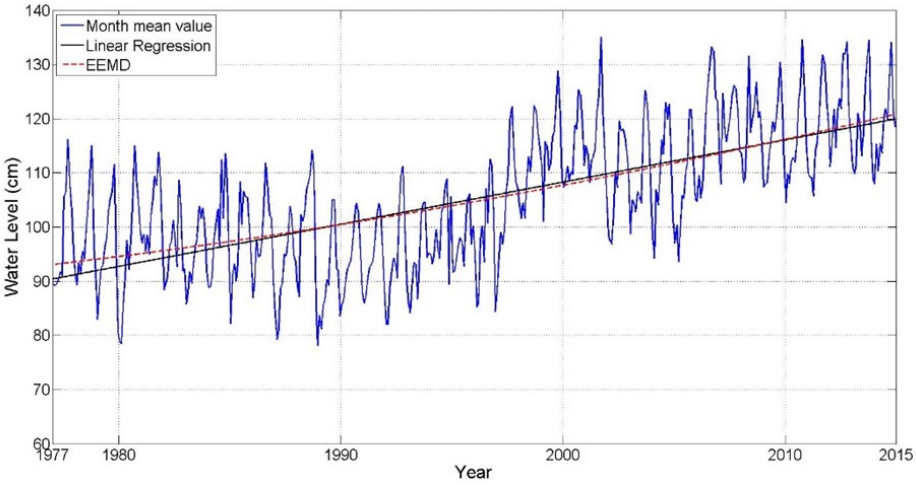


Figure 4. Comparison the results of tidal measured data by regression analysis and EEMD method with the observations.

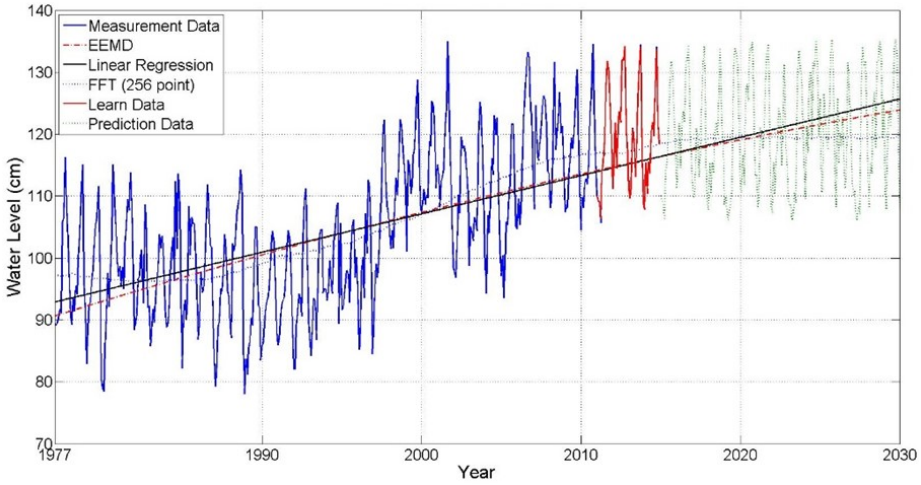


Figure 5. The long term tidal predictions for 2030 years at Penghu offshore island.

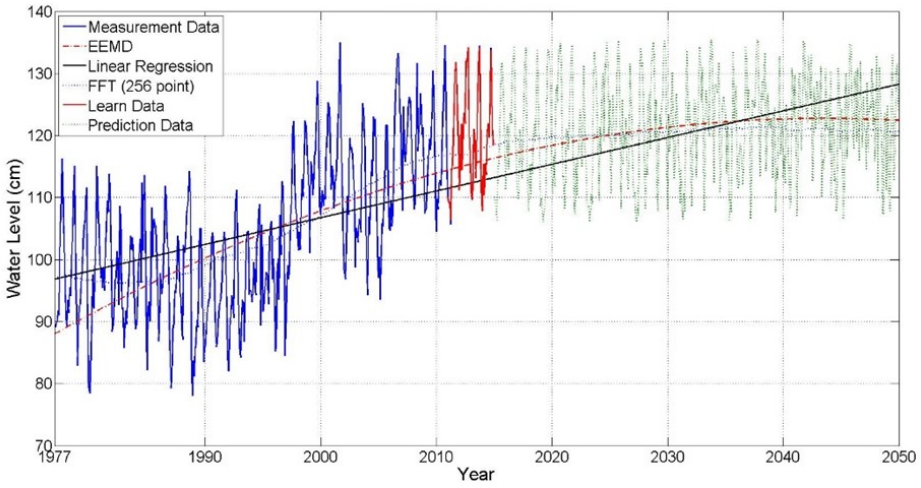


Figure 6. The long term tidal predictions for 2050 years at Penghu offshore island.

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# A STUDY OF THE IMPACT OF GLOBAL WARMING ON THE ENVIRONMENTAL PROTECTION CURRICULUM OF TAIWAN'S CIVIL ENGINEERING STUDENTS ON ENVIRONMENTAL VALUES AND ENVIRONMENTAL PROTECTION BEHAVIOR USING QUASI-EXPERIMENTAL METHODS

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Abstract

Global climate and environmental anomalies have brought serious disasters throughout the world and affected the entire human infrastructure and even life safety. In 2010 alone, more than 370 natural disasters had occurred around the world, killing about 300,000 people and injuring more than 200 million people. Taiwan is no exception; the 2009 Morakot Typhoon had caused major casualties of 681 deaths and 18 people missing in southern Taiwan. However, due to Taiwan's economic recession in recent years, the society has fallen into a contradictory emotion on economic development and environmental protection. Under such circumstance, this study intends to understand the tug-of-war of Taiwanese people's thought between environmental protection and humanism. In this regard, environmental protection videos, classroom dis-

cussions, environmental contests and other innovative teaching methods were used by this study to serve as the experimental process variables to compare the experimental group and control group, and find out the variances between environmental awareness and environmental protection behavior. The results showed that the experimental group students scored more significantly than the control group regardless in new environmental paradigm (NEP) scale or environmental protection behavior intention, and that environmental awareness did affect the students' environmental behavior. Even if the students reflected a positive view on NEP scale, but they still expressed an anthropocentrism thought in some questions. Not only does this indicate that environmental education needs to be done, but also has much room for improvement.

Key words: Environmental protection, behavior, environmental paradigm, experiment, the Department of Civil Engineering, Global Warming

## Introduction

Based on greenhouse gas data published by the Intergovernmental Panel on Climate Change (IPCC) in 2007, the concentrations of major greenhouse gases, such as CO2, CH4 and N2O in the earth's atmosphere in 2006 were 35.4%, 154.7% and 18.2% higher than those before the era of industrialization, respectively. As the rapid increase in greenhouse gas concentrations would lead to abnormal global temperature rise, it would also result in global climate and environmental anomalies. However, the current global greenhouse gas concentration has already reached up to 430ppm (normal concentration should be below 400ppm). Even if the governments actively take measures to reduce greenhouse gases, there is still a high probability of the global temperature to rise 2~3°C (Stern, 1996). Following a temperature rise of 2°C, Stern points out that many areas of the world would experience sea level rise, more frequent storms and hurricanes, melting of glaciers and snow, and uneven rainfall that would lead to torrents and floods during the rainy season, drought in many parts of the world, and the dilemma of large tracts of rainforests to disappear. IPCC warns that by 2100, there is a 50% chance of global temperature to rise by 1~4°C, which would hasten the Green-land Ice Plate to melt faster and cause the sea level to rise by about seven meters (IPCC, 2007). Thus, global warming has brought serious natural disasters to affect the global human infrastructure and even life safety.

The environmental impact caused by global warming has created environmental refugees around the

world. For example, in August 2005, the residents of Tegua in the Pacific island countries were forced to move to inland highland from the coastal villagers because of rainstorms and monstrous waves caused by climate change. They have become the first batch of environmental victims to move due to global warming. India's Sunderbans Delta used to have 102 islands, but four islands had been permanently submerged by sea water in the past 25 years to affect the livelihood of thousands of residents. In 2005, the Atlantic hurricane season broke several records where Katrina hurricane had caused nearly a thousand deaths, and tens of thousands of people homeless. In June 2005, India was hit by heat waves with a soaring local temperature of up to 49°C and took more than 100 lives. In February 2009, the high temperature of 46.4°C at Melbourne in Australia broke the 150-year record, killing more than 20 people. In 2009, the Morakot Typhoon had caused major casualties of 681 deaths and 18 people missing in southern Taiwan. According to Oxfam Hong Kong statistics, in 2010 alone, more than 370 natural disasters had occurred around the world, killing about 300,000 people and injuring more than 200 million people. Among them, human casualties and property losses were particularly serious in the developing countries when struck by disasters due to lack of resources, infrastructure and information.

Casualties and damages caused by natural disasters have prompted people to actively take environmental protection actions mandatory. Stern and Gardner (1996) note that the value, attitude and behavioral concepts of people can be improved through environmental education. In this regard, this study hopes to use environmental education courses to enhance the environmental values of Taiwanese students in department of civil engineering, and further encourage them to take actions beneficial to environmental protection. The reason for this study to take civil engineering students as the experimental objects was inspired by the "Sustainable Buildings: Challenges and Policies" report (2003) issued by the Organization of Economic Co-opera- tion and Development (OECD) in that buildings around the world consume about 32% of the earth's resources, 12% of water and 40% of energy each year, thereby causing 40% of the landfill wastes (Chen & Chen, 2006). A survey conducted by the City of Portland Energy Office found that buildings consume about 1/4 of the world's logging of wood, and 2/5 of resources and energy. In the United States, buildings consume about 54% of energy and emit 35% of total carbon dioxide emissions. In Taiwan, data published by

the Architecture and Building Research Institute, Ministry of Interior showed that carbon dioxide emitted by the building industry account for 28.82% of the country's total emissions. As the majority of civil engineering students would serve in the construction or related industries after graduation, if these graduates possess environmental protection awareness and willing to integrate environmental awareness into building designs and building materials procurement, they would help to transform buildings into green architectures, and reduce carbon emission volume (Li, & Lin, 2003).

## Literature Review

### *New environmental paradigm (NEP)*

Created by Dunlap and Van-Liere (1978), the main reason for introducing NEP is that human beings have been acknowledged by the worsening of environmental problems and environmental pollution to force them to reconsider the relationship between man and environment. Dunlap and Van-Liere note that the prevailing social model is presented in an anti-ecology image, but the NEP scale is an attempt to declare the environmental attitude. However, the real positive attitude is much more complex than we have imagined. In this regard, Dunlap, Van-Liere, Merting and Jones amended the NEP scale in 2000 by increasing the originally 12 questions to 15.

In previous studies on NEP, Thapa (1999) used NEP scale to predict the relationship between college students' environmental attitude and environmental behavior. The results showed that all students supported NEP due to their sympathy towards the environment. But in addition to resource recovery behavior, few students participated in other environmental activities. While investigating Taiwanese people on environmental attitude, Hsiao (1986) and Hsiao & Tseng (1999) found that people are gradually supporting the connotation and value of NEP, but they are facing a kind of dilemma situation of economic growth and environmental protection in the aspect of deep-rooted relationship between environment and growth. Over the past 20 years, NEP has been widely used by Canada, Switzerland, Belgium, Japan, and even studied by university students in some colonial countries. The focus is almost agreed upon NEP theory (Dunlap, Van Liere, Merting & Jones, 2000). While using NEP scale to measure 412 Mexican citizens, Corral-Verdugo and Armendariz (2000) discovered that although they generally agreed with NEP, but still withheld some conservative concepts, such as although human beings are concerned

about nature but they have the right to control nature.

From the above research findings, we can see that human beings often hold a contradictory attitude on natural environment. On one hand they pursuit the balance of natural ecology, but on the hand they do not want to give up the rights of anthropocentrism. The values of NEP have been widely accepted by the public, but education plays an important role if we really want to plant these values deep into people's mind.

## Environmental behavior

Hungerford and Peyton (1980) propose the concept of responsible environmental behavior, defining it as "an act expressed by individuals or groups who want to address an environmental problem." A responsible environmental behavior refers to a path used by a person or group to prevent or solve the environmental problems or issues through the usual application of some strategies (Hungerford & Peyton, 1980). While evaluating the past studies related to environmental education, the environmental action model developed by Hungerford and Peyton is a theoretical framework most capable of establishing specific environmental behavior indicators, and its environmental behaviors are divided into five types: eco management, consumer/economic behavior, persuasion, political action and legal action.

The contents of which are described as follows:

1. Eco management: It refers to the actual action taken by an individual or group to maintain or promote the existing ecosystem. It is done through daily home life personally to directly achieve the goal of protecting the environment.
2. Consumer action: An economic support or resistance act taken by an individual or group to achieve the goal of protecting the environment.
3. Persuasion: The appeal adopted by an individual or group to influence others to support environmental protection, and of which is an interpersonal communication act to address the environmental issues.
4. Political action: To achieve certain environmental purposes through lobbying, voting, campaigning and other political actions. Such political action made by the government can generate a significant impact on environmental decisions.
5. Legal action: A legal action taken by an individual, group or organization to strengthen or amend the environmental laws, or prohibit certain acts to address the environmental problems.

## Research Methods

*Experimental process*

In this study, the junior students from the Department of Civil Engineering at a certain University of Science and Technology at southern Taiwan were selected as the test samples. The two classes in this grade were required to take an elective course of Introduction to Civil and Spatial Information for one hour per week. There were 60 people in the control group (male: 32; female: 28), taking the course outline in accordance with the existing planning; while the 61 people in the experimental group (male: 29; female: 32) attending classes through watching the environmental protection videos played by the teacher, and participating in classroom discussions and environmental action proposal contests. Both the experimental group and control group were asked to fill out the NEP scale at the beginning of the first lesson (October 3 and 5, 2016). Three months later, both groups were again asked to fill out the NEP scale and the environmental behavior scale to check if the environmental curriculum can really enhance the students' environmental awareness, followed by encouraging the students to take environmental protection actions.

In this study, the environmental curriculum of the experimental group included playing 30 minutes of videos, each of 30 minutes on such topics as: green building, green consumption, green action, green and clean energy, green industry, grain production, animal and plant issues, global environmental change and warming, etc. The students were then led to discuss the contents with the teacher and stipulated to submit an environmental protection action proposal at the end of the term. They were also need to share the proposal contents with the group members on how to encourage others to take environmental protection actions. Three sets of proposals were chosen from 10 as an encouragement, and the top three proposals were published on the bulletin board for students in the campus to browse.

Questionnaire

*NEP scale*

To understand the students' awareness on environmental issues, the NEP scale was cited by this study to investigate the students' environmental awareness after receiving the experimental manipulation. A total of 15 questions in the NEP scale were divided into five factors: limits to growth: questions A, F and K; anti-anthropocentrism: questions B, G and L; balance of nature: questions C, H and M; rejection of exemptionalism: questions D, I and N; and

possibility of an eco crisis: questions E, J and O.

The contents of NEP scale are listed as follows:
A. We are approaching the limit of the number of people the Earth can support. B. Humans have the right to modify the natural environment to suit their needs. C. When humans interfere with nature it often produces disastrous consequences. D. Human ingenuity will insure that we do not make the Earth unlivable. E. Humans are seriously abusing the environment. F. The Earth has plenty of natural resources if we just learn how to develop them. G. Plants and animals have as much right as humans to exist. H. The balance of nature is strong enough to cope with the impacts of modern industrial nations. I. Despite our special abilities, humans are still subject to the laws of nature. J. The so-called "ecological crisis" facing humankind has been greatly exaggerated. K. The Earth is like a spaceship with very limited room and resources. L. Humans were meant to rule over the rest of nature. M. The balance of nature is very delicate and easily upset. N. Humans will eventually learn enough about how nature works to be able to control it. O. If things continue on their present course, we will soon experience a major ecological catastrophe.

*Environmental behavior scale*

Five major types of Hungerford and Peyton's environmental actions were cited by this study to measure if the students accepting this experiment would generate the will to take environmental actions. As the respondents in this study were university students, different types of environmental behaviors were used by this study after taking the university students' abilities and the environmental behaviors they would more likely to implement into account. The environmental protection behaviors that the university students would implement in their life were then elaborated as follows with a total of 20 questions:
A. Eco management: (1) To respond to environmental protection, I will eat more fruits and vegetables and take less meat. (2) I will do resource recovery. (3) I will turn off unused electrical appliances. (4) During outing, I will prepare my own environmental friendly tableware and cup. (5) When shopping, I will bring my own shopping bag or re-use the plastic bag. (6) I will walk and ride a bicycle more to reduce the chance of riding a motorbike.
B. Consumer action: (1) When necessary, I will take first priority to purchase environmentally friendly electrical appliances. (2) I will take first priority to purchase practical and durable clothing. (3) I will purchase more local food in-

gredients to replace imported food. (4) I will select the most energy-saving environmentally friendly touring method. (5) I will avoid buying the bottled water.
C. Persuasive action: (1) I will spend time to share environmental protection information with my classmates or friends. (2) I will convince friends and relatives to take environmental protection actions together. (3) If I find someone spoiling the environment, I will attempt to persuade him/her tactfully.
D. Political action: (1) I will support candidates who possesses environmental protection policies. (2) I will participate in joint activities to support environmental policies or regulations. (3) I will urge elected representatives or government officials to support environmental protection policies.
E. Legal action: (1) I will participate in environmental protection-related assembly or march. (2) I will support environmental groups to report polluters. (3) If I find that the environment has been destroyed, I will report it to the relevant units.

## Research Findings

### *Differential tests among the respondent groups*

To understand the differences between the experimental group and the control group, an independent samples test was used by this study to analyze the significant differences between the two groups in NEP scale. The resultant t test was not significant. We can see that before the experiment, both the experimental group and control group did not have significant different views on NEP scale, thereby allowing the study to continue the follow-up experimental process.

Table 1. Summary table of differential tests between the experimental group and control group

| | **No. of people** | **Average value** | **t value** | **Significance** |
|---|---|---|---|---|
| Experimental group | 61 | 3.18 | -1.264 | .209 |
| Control group | 60 | 3.24 | | |

*Experimental effects testing*

1. Overall NEP pre- and pro-tests on the experimental group

The main focus of this experiment is to understand if the civil engineering students would be affected by environmental awareness and environmental protection behavior after taking three months of environmental protection courses. In this part, paired samples statistic t test was adopted by this study to analyze the differences of NEP pre- and post-tests on the experimental group students. The results showed that after three months of experimental manipulation, the experimental group students scored 3.28 points in NEP scale. It was higher as compared with 3.18 points before the experiment, indicating a significant t test result. This indicates a significant positive enhancement of environmental awareness viewpoints on experimental group students before and after the experiment (Table 2).

Table 2. Summary table of overall NEP pre- and post-tests on the experimental group

| | **No. of people** | **Average value** | **Correlation coefficient** | **Significance** |
|---|---|---|---|---|
| NEP pre-test | 61 | 3.18 | .320 | .012* |
| NEP post-test | 61 | 3.28 | | |

Note: In this study, as the reverse questions on NEP scale had been dealt with reverse scoring, so the higher the score, the higher is the recognition on NEP scale. * P <.05

2. Question-by-question NEP pre- and post-tests on the experimental group

Furthermore, the independent samples t test was used by this study to analyze the different views in NEP scale pre- and post-tests on the experimental group. The results showed significant differences in every question of NEP scale pre- and post-tests on the experimental group. This represents that the experimental manipulation has an impact on the experimental group students. It is worth mentioning that the study also found that even after three months of environmental courses, the experimental group students had a tendency to support anthropocentrism view in a number of questions. For example, the experimental group students still think that "humans have the right to modify the natural environment to suit their needs," "humans have a higher survival power over plants and animals," "humans have special abilities and less likely to be dominated by the laws of nature," "we have over exaggerated the ecological crisis," "the earth is not like a spacecraft with limited space and resources," and "hu-

mans have the right to control all things on earth." This part will be left for discussion by follow-up researchers (Table 3).

Table 3. Summary table of NEP pre- and post-tests on the experimental group

| NEP questions | Group | people | Mean | Correlation coefficient | Significance |
|---|---|---|---|---|---|
| A. We are approaching the limit of the number of people the Earth can support. | Pre-test | 61 | 3.57 | .290 | .024* |
| | Post-test | 61 | 4.07 | | |
| B. Humans have the right to modify the natural environment to suit their needs. | Pre-test | 61 | 3.46 | .614 | .000*** |
| | Post-test | 61 | 3.95 | | |
| C. When humans interfere with nature it often produces disastrous consequences. | Pre-test | 61 | 4.28 | .412 | .001** |
| | Post-test | 61 | 4.56 | | |
| D. Human ingenuity will insure that we do not make the Earth unlivable. | Pre-test | 61 | 1.62 | .722 | .000*** |
| | Post-test | 61 | 1.56 | | |
| E. Humans are seriously abusing the environment. | Pre-test | 61 | 4.26 | .330 | .009** |
| | Post-test | 61 | 4.44 | | |
| F. The Earth has plenty of natural resources if we just learn how to develop them. | Pre-test | 61 | 3.64 | .304 | .017* |
| | Post-test | 61 | 4.02 | | |
| G. Plants and animals have as much right as humans to exist. | Pre-test | 61 | 2.74 | .297 | .020* |
| | Post-test | 61 | 2.18 | | |
| H. The balance of nature is strong enough to cope with the impacts of modern industrial nations. | Pre-test | 61 | 2.79 | .690 | .000*** |
| | Post-test | 61 | 2.38 | | |
| I. Despite our special abilities, humans are still subject to the laws of nature. | Pre-test | 61 | 2.38 | .677 | .000*** |
| | Post- | 61 | 1.84 | | |

| NEP questions | Group | people | Mean | Correlation coefficient | Significance |
|---|---|---|---|---|---|
| | test | | | | |
| J. The so-called "ecological crisis" facing humankind has been greatly exaggerated. | Pre-test | 61 | 3.21 | .415 | .001** |
| | Post-test | 61 | 3.77 | | |
| K. The Earth is like a spaceship with very limited room and resources. | Pre-test | 61 | 2.10 | .437 | .000*** |
| | Post-test | 61 | 1.66 | | |
| L. Humans were meant to rule over the rest of nature. | Pre-test | 61 | 3.43 | .288 | .024* |
| | Post-test | 61 | 4.07 | | |
| M. The balance of nature is very delicate and easily upset. | Pre-test | 61 | 4.16 | .419 | .001** |
| | Post-test | 61 | 4.41 | | |
| N. Humans will eventually learn enough about how nature works to be able to control it. | Pre-test | 61 | 1.84 | .401 | .001** |
| | Post-test | 61 | 1.77 | | |
| O. If things continue on their present course, we will soon experience a major ecological catastrophe. | Pre-test | 61 | 4.30 | .320 | .012* |
| | Post-test | 61 | 4.48 | | |

*$p$ <.05, **$p$ <.01, ***$p$ <.001

3. NEP pre- and post-tests on the control group

The paired samples t test was used by this study to analyze and compare the views of NEP scale pre- and post-tests on control group students. The results showed no significant different views on NEP scale pre- and post-tests by control group students (Table 4).

4. NEP pre- post-tests analysis on the experimental group and control group

After the independent samples t test was used to analyze and compare the NEP scale pre- and post-tests on the experimental group and control group, the experimental group students had scored significantly high in NEP scale pre- and post-tests than the control group. This indicates that the

Table 4. Summary table of NEP pre- and post-tests on the control group

| | people | Mean | Correlation coefficient | Significance |
|---|---|---|---|---|
| NEP pre-test | 60 | 3.24 | .005 | .972 |
| NEP post-test | 60 | 3.00 | | |

Table 5. Analytical summary table of NEP pre- and post-tests on the experimental group and control group

| | people | Mean | t value | Significance |
|---|---|---|---|---|
| Experimental group | 61 | 3.28 | 7.185 | .000*** |
| Control group | 60 | 3.00 | | |

environmental curriculum design can indeed improve the environmental awareness on experimental group students (Table 5).

5. Analysis of environmental protection behavior on the experimental group and control group

One of the experimental priorities of this study is to understand if the implementation of environmental protection education courses would make significant differences on experimental group and control group students in environmental protection behavior. Through the independent samples t test analysis, it is found that the experimental group students scored significantly higher in five environmental protection behavior types and overall environmental behavior intention (average value of five environmental protection behavior types) than control group students. This represents that environmental protection courses can indeed enhance the students' will to take environmental protection actions (Table 6).

*Analysis on environmental awareness and environmental protection behavior*

To understand if environmental awareness will affect the environmental protection behavior of experimental group students, a regression analysis was adopted by this study to take NEP post-test as an independent-variable to predict the environmental protection intention (overall environmental protection behavior and five environmental protection types). The results showed that NEP will positively affect the overall environmental protection behavior of experimental group students ($\beta$=.341***). With regard to the five environmental protection behaviors, NEP will positively affect experimental group students in eco management ($\beta$=.396**), green

Table 6. Analytical summary table of environmental protection behavior on the experimental group and control group

| Environmental protection behavior | Group | people | Mean | t value | Significance |
|---|---|---|---|---|---|
| Eco management | EG | 61 | 4.15 | 2.666 | .009** |
| | CG | 60 | 3.85 | | |
| Consumer action | EG | 61 | 4.27 | 4.150 | .000*** |
| | CG | 60 | 3.80 | | |
| Persuasive action | EG | 61 | 4.38 | 5.064 | .000*** |
| | CG | 60 | 3.72 | | |
| Political action | EG | 61 | 4.37 | 4.906 | .000*** |
| | CG | 60 | 3.84 | | |
| Legal action | EG | 61 | 4.30 | 4.311 | .000*** |
| | CG | 60 | 3.81 | | |
| Overall environmental protection behavior | EG | 61 | 4.29 | 4.488 | .000*** |
| | CG | 60 | 3.82 | | |

EG: Experimental group, CG: Control Group; ***$p$ <.01

consumption ($\beta$=.690***) and legal action ($\beta$=.433) (see Table 7).

## Discussion

During the course of this experiment where only one hour of lesson was given per week, the attendance of university students was almost 90% despite no attendance was marked throughout the introduction of large numbers of lively videos, and discussions and contests. This has obviously proved that environmental protection courses can really attract university students to achieve such a high attendance. During the lessons, many students had even discussed and collected new ideas on Internet for the final environmental protection behavior proposals. All these are helpful to deepen the environmental protection awareness and environmental protection actions.

By the end of NEP scale measurement, the study found that the score of nine questions out of 15 in NEP scale from the experimental group were in line with environmental protection awareness, but six questions were still remained on anthropocentrism stage. This means that students have learned the seriousness of environmental problems on one hand, but as long as human issues are involved, they will return to think that human beings can lead and solve the environmental problems. This finding is similar to that of Hsiao, Hsiao (1986), Hsiao & Tseng (1999), Corral-Verdugo and Armendariz (2000). For such outcomes, this study is not dis-

couraged by the respondent students' environmental awareness at all as the score of nine questions out of 15 in NEP is regarded as a high environmental awareness and keen environmental protection behavior. It is clear that students were indeed affected by the environmental protection curriculum and would further improve their environmental protection intention. On the other hand, the study speculates that the reason for the tendency of a number of questions to support anthropocentrism is associated with Taiwan's economic development recession in recent years, and contradictions in the country's priorities for economic development or environmental protection. Most of all, the study was conducted in a city at southern Taiwan where it is full of heavy industries and petrochemical industries, and of which people are living in the city subjected to air pollution and heavy industry environmental risks all the year round. Residents feel helpless on one hand about the importance of heavy industries and employment rate for Kaohsiung's economy, but on the other hand, they hope that the current status can be changed through the power of the government and environmental-conscious citizens. In view of the poor economy and serious unemployment rate, many people are accustomed to live in a city with work opportunities despite being plagued by pollution. In their hearts, they look forward to more employment opportunities and improved economic measures, and choose to deal with the environmental issues later after the economy has been improved. In such circumstance, it is really rare indeed for the experimental group students to

Table 7. Summary table on environmental protection behavior and environmental awareness

| Dependent variable: environmental protection behavior, significant regression model.000*** | | | | | | |
|---|---|---|---|---|---|---|
| | UC | | SC | | | |
| | B | Std. Error | Beta | t value | Significance | $R^2$ |
| Constant | 1.459 | .659 | | 2.215 | .029 | .116 |
| NEP post-test | .829 | .209 | .341 | 3.961 | .000*** | |
| Dependent variable: Eco management, significant regression model.002** | | | | | | |
| | UC | | SC | | | |
| | B | Std. Error | Beta | t value | Significance | R2 |
| Constant | .883 | .990 | | .892 | .376 | .157 |
| NEP post-test | .998 | .302 | .396 | 3.311 | .002** | |
| Dependent variable: Green consumption, significant regression model.000** | | | | | | |
| | UC | | SC | | | |
| | B | Std. Error | Beta | t value | Significance | $R^2$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| Constant | .187 | .558 | | .334 | .739 | .477 |
| NEP post-test | 1.246 | .170 | .690 | 7.328 | .000*** | |
| Dependent variable: Persuasive action, significant regression model.106 | | | | | | |
| | UC | | SC | | | |
| | B | Std. Error | Beta | t value | Significance | $R^2$ |
| Constant | 2.980 | .855 | | 3.484 | .001 | .044 |
| NEP post-test | .428 | .261 | .209 | 1.643 | .106 | |
| Dependent variable: Political action, significant regression model.278 | | | | | | |
| | UC | | SC | | | |
| | B | Std. Error | Beta | t value | Significance | $R^2$ |
| Constant | 3.411 | .874 | | 3.902 | .000 | .020 |
| NEP post-test | .292 | .266 | .141 | 1.095 | .278 | |
| Dependent variable: Legal action, significant regression model.000*** | | | | | | |
| | UC | | SC | | | |
| | B | Std. Error | Beta | t value | Significance | $R^2$ |
| Constant | 1.481 | .764 | | 1.939 | .057 | .188 |
| NEP post-test | .859 | .233 | .433 | 3.691 | .000*** | |

UC: Unstandardized coefficient, SC: Standardized oefficient; **$p$ <.01, ***$p$ <.001

have such a good view on environmental awareness.

With regard to environmental behavior, all environmental protection behavior intentions of experimental group students were significantly higher than the control group, and the environmental intention (scores of NEP scale post-test) would affect green consumption, legal action, eco management and overall environmental behavior. All these are very inspiring discoveries indeed. This has verified the view of Stern and Gardner (1996) that education and advocacy are able to improve people behaviors. It has also allowed this study to understand that if the respondent students were enhanced with environmental awareness, they would change their consumer behavior viewpoint in priority, and then support the environmental groups with green act and further implement the environmental actions personally.

While comparing the five environmental behaviors, those that are most happy to be taken by experimental group students in order are: persuasive action, political action, legal action, consumer action and eco management. This order is different from guesses done by the study at the beginning as the author thought students would more likely to

implement simple environmental protection behaviors where the results can be seen immediately. Such differences in outcomes are due to the following discoveries after the respondent students were asked by the study. They answered that if people only take a simple personal environmental behavior in this current Taiwan's environment condition, it can hardly help to improve the environment at all. So it is better to take more effective and large-scale environmental behaviors, such as turning to legislators who support the environmental policies, or take to the street to express their demands directly as direct and civic action-style environmental behaviors are more helpful to suit the current environment. For the results of such survey, the author, on one hand, is pleased with the passion and enthusiasm of students on environmental protection, but on the other hand, feels pity that Taiwan is still lack of comprehensive environmental policies and practical actions, prompting students to take a more positive environmental citizenship behavior to save Taiwan's environment.

A glance through the domestic tertiary institutions would see that although environmental awareness has been incorporated into the school syllabus, but a careful examination of the timetable would reveal that only a small number of environmental-related departments would emphasize environmental protection issues, while most other departments have mostly reduced the environmental protection courses to one chapter in some curricula. This has long been an epitome of Taiwan to focus on economy development but ignore the environmental development. Secondly, the results of this study were only obtained from junior civil engineering students, whether or not the results can be inferred to the rest of college students is yet to be studied and discussed by follow-up research. Thirdly, the environmental protection behavior types investigated by this study were "willingness-based" by asking the students' intentions. It is not directly equivalent to the environmental protection results finally taken by the students. Although Ajzen (1991) thinks that the correlation between behavioral intention and behavior is extremely high, and can almost be regarded as behavior. However, this study still believes that follow-up studies should be emphasized on tracking the students' real environmental protection behaviors in order to confirm the impact of environmental protection intention on environmental protection behavior.

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# THE FACTORS INFLUENCING THE SELECTION OF GREEN-HOUSE FOR INNOVATIVE AGRICULTURE

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Abstract

In recent years, the government adopted subsidy policy to enhance the willingness of farmers to invest in the Protected Culture. The effective environmental control would improve the stability of agricultural products on its yield and quality. However, information search cost and product switch cost might affect farmers' decisions to invest Protected Culture. This study will explore decision criteria of investing Protected Culture and the attitudes of farmers toward Protected Culture.

Keywords: Innovative Products, Protected Culture, AHP

## Research Background and Purposes

The agriculture in Taiwan has attracted many attentions and showed trends of growth. The government has endeavored to allow farmers to produce in an enterprising, delicate, and effective manner. It has issued relevant plans to encourage farmers to invest in materials and equipment so as to enhance the stability of output and quality of agricultural products. This study explored if the introduction of new products was different from that of other industries, if the government's policies had a significant impact on the procurement of farmers who subse-

quently made different decisions, and if farmers attached more importance to the benefits of greenhouse. It studied how manufacturers won the trust of buyers under such commercial model and what aspects should manufacturers emphasize in their follow-up promotion.

The contributions of this study lied in three aspects. First, practical contribution. It probed into the introduction of new products to the existing market, learned the significance to develop new products, and explored different factors including the purchase of consumers via expert questionnaire. Second, academic contribution. There were few studies on the greenhouse of agriculture in Taiwan and even fewer studies on the factors influencing the introduction of new products to the market. Third, corporate contribution. It aimed to learn what kind of marketing tactics should be used by the sample company so as to enter the market based on government subsidies in the past. This study investigated both farmers and non-farmers (including manufacturers, suppliers, and policy makers) to promote academic development and expand to more relevant fields.

## Literature Review

### *Agricultural Greenhouse*

According to the statistics of the area of greenhouses in Taiwan in 2011 based on aerial photos, the area of greenhouses in Taiwan reached about 2,171 hectares. Environmental control greenhouses were mainly used for the production of butterfly orchid, while simple facilities and average greenhouses were adopted for the production of vegetables and fruits (Journal of Tainan Agriculture, 2013). Cultivation model had evolved from open-air cultivation in the past to quality agriculture and to facility-aided cultivation. More and more orchids, fruits, and vegetables were grown up in greenhouses, driving the demands of greenhouses. The advantages of facility-aided cultivation included: To improve quality, reduce pests and diseases, control production period, reduce manpower, increase profits, and so on. Facility-aided cultivation plus environmental control system enable the production of agricultural products which were substantial and quality, promoting the transfer of modern quality agriculture (such as vegetables and flowers) towards the era of facility-aided cultivation. However, as the investment costs of the facilities were high, they must be properly planned so as to optimize the overall efficiency and meet economic benefits.

### *Strategic Marketing 4C Theory*

The sample company in this study was a new comer to agriculture. While providing exchangeable costs to buyers, the company was exploring strategies to analyze the explicit benefits and explicit exchangeable costs concerned by buyers. Thus, Strategic Marketing 4C Theory was the most suitable for the development of the questionnaire in this study.

Explicit unit cost.

Explicit unit cost refers to the benefits buyers get from products excluding the influences of product brand and company, including "tangible

benefits" and "intangible benefits". The total cost to get a product refers to all the costs that a buyer must spend so as to "own" and "use" the product.
The information collection cost of buyers.

Chiu (2001) deemed that higher complexity of product information required buyers to pay higher costs to collect such information. Hence, the understanding of the degree of concern of buyers is a vital part of buyer behavior. The degree of involvement of buyers refers to the degree of concern of buyers about the evaluation, acquisition, and consumption of a product.

The moral crisis cost of buyers.

This is a risk cost and stands for the suspects of buyers if the product or service of a seller can realize the functions asserted before exchange.
Though both buyers and sellers have clear understanding of the product or service to be exchanged, there is still a crisis cost after the exchange that if the seller could fulfil the commitments on the function or service previously. This is the so-called moral crisis cost of buyers.

The exclusive involving cost of buyer.

This cost refers to the intangible or tangible assets of buyers investing in the relationship of exchange, which cannot be converted to other relationships, in order to retain the involving cost of exchange-specific assets invested. As long as the specific exchange relationship disappears, the value of the exclusive intangible or tangible assets disappears as well or becomes less valuable.

The 4C theoretical framework is closely integrated with many marketing concepts. While exploring the development and management of new products, it is helpful to clarify the relationships between different operating methods and profit sources by examining the development of agricultural greenhouse through this theoretical framework.

## Research Method

Based on 4C Strategic Marketing Theory, this study explored questions from four dimensions and confirmed items with experts, professors, and researchers in the field. It conducted pretest to confirm questions first, established expert questionnaire, and adopted Analytic Hierarchy Process (AHP) to set up the evaluation indicators for the purchase of new products of greenhouse.

### *AHP*

Consumers face decisions often in their lives. One or several alternatives will be selected out of other alternatives based on several criteria. As these decisions are easy to make, consumers tend to make rational decisions as depicted in classic theory. However, if the situation is complicated or fuzzy, the decisions made in light of past experiences and subjective judgments may not be rational. If such decisions have a long-term influence on an individual or an enterprise, the decision-maker would face great decision-making pressure. Lin (2004) used AHP to integrate the views of experts or decision-makers involved in the process and systematize a complex issue into a simple and clear hierarchical structure.

After pairwise comparison of two elements of each level and quantization, pairwise comparison matrix can be established so as to obtain eigenvalues and eigenvectors. After unanimous verification, eigenvalues and eigenvectors can serve as weight indicators for reference.

*Basic Hypothesis and Questionnaire Scale of AHP*

There are three stages to adopt AHP for decision-making:
Phase 1: To establish a hierarchical structure

The elements influencing the system will be broken down into several groups. The items in each group are divided into several corresponding sub-groups. Then, the entire hierarchical structure will be formed layer by layer.

Phase 2: To calculate the weights of elements of each level

First, pairwise comparison matrices shall be established. Eigenvalues and eigenvectors shall be calculated to test if the matrices are consistent. On the basis of the suggestions of Saaty, no matter the evaluation of decision-makers' judgment or the test of the hierarchical structure, consistency index shall be about 0.1 (generally C.I.< 0.1).

Phase 3: To calculate the overall hierarchical weight

After calculating the weights among the elements of each level, one shall calculate the overall hierarchical weight and test the consistency of the entire hierarchical structure. Lastly, based on the weight of each alternative, the optimal alternative is decided for the final solution.

AHP Hierarchical Analysis Process

This study used eight steps to analyze AHP:

1. Defining the problem:

The scope of problem should be as big as possible. The factors which may affect the problem shall be included. Definition of problem could be classified into problem clarification and decomposition.

2. Listing the elements related to the goals:

In accordance with the field and degree of complexity of the target problem, the experts or senior managers in the field were invited to offer their professional and practical experiences. All the relevant elements should be listed.

3. Establishing the hierarchical structure:

Satty (1980) suggested that each level should not be more than 7 elements ($n \leqq 7$). And the elements should be independent from each other so as to guarantee their consistency. The hierarchical structure was used to decompose the level target of the system. After problem formation, definition, element, and levels should be confirmed. The elements of each level should be identified. And the hierarchical relationships formed by ques-

tions and answers of these elements should be established.

4. Questionnaire design and survey:

The element of a level was considered as the evaluation benchmark of its following level. The relative degrees of importance of the elements were compared. Hence, the questionnaire should clearly show each pair of questions and offer detailed instructions.

5. Establishing pairwise comparison matrices and calculating eigenvalues and priority vectors:

Pairwise comparison matrices referred to the process in which the elements of the same level were compared pairwise in the consideration of specific items. The weight of each element would be obtained based on comparison and evaluation scale.

6. Testing consistency:

Saaty (1980) recommended that C.I.≦ 0.1 was an acceptable error value to ensure consistency. If the consistency of the overall hierarchical structure did not meet the requirement, it implied that there was something wrong with the correlation among the elements. Thus, the elements and their correlation must be analyzed again.

7. Integrating expert preferences:

In group decision-making, due to the different preferences of experts, the weights of the elements were different. Hence, their opinions should be integrated in two ways, that is, beforehand and afterwards integration. The former included geometric mean and the decision-making method of the majority, while the latter was generally arithmetic average.

8. Selecting the optimal solution:

Each level was aligned with the priority vectors of an upper level of different criteria so as to combine and form priority matrix. A comprehensive priority matrix was obtained by multiplying the priority matrix of each level, which referred to the final degree of importance or degree of advantage in the consideration of all the elements of the entire hierarchical structure.

*Questionnaire Planning and Design*

Part 1 Pre-test questionnaire.

This study distributed its pre-test questionnaire at the 3-day National Agricultural Machinery and Materials Exhibition from Oct. 31 to Nov. 2, 2015. Through Likert Five-Point Scale, the questionnaire was designated to learn the present significance of greenhouse. On the basis of Strategic Marketing 4C, the pre-test questionnaire contained 4 parts. The respondents were average farmers, manufacturers, suppliers, and policy-makers. 45 copies were collected. Excluding those invalid ones with incomplete answers, there were a total of 43 valid feedbacks.

SPSS was employed to analyze the pre-test questionnaire, which concluded the following sequence: High ventilation of greenhouse, solid material, cheap samples, improvement of post-disaster maintenance, trial use, recommendation by acquaintance,

short engineering time, and product with patents. We first selected the five items with average above 4.0 as reference, that is, high ventilation of greenhouse, solid material, cheap samples, improvement of post-disaster maintenance, and trial use and consulted the opinions of experts.

Part 2 Interview with experts.

Before the AHP expert questionnaire, in order to determine if the items were reasonable, we interviewed Mr. Chen of Promotion Section of the Douliou Farmers' Association and Ms. Huang of a manufacturer of greenhouse material in Taichung. With the status quo of agriculture provided by the experts, the relevant items of the questionnaire were confirmed again.

*AHP questionnaire dimensions*

In accordance with pre-test values and expert interviews, six elements were concluded, including "ventilation of greenhouse", "durability of greenhouse", "recommendation by word of mouth", "post-disaster maintenance", "price of greenhouse", and "engineering time". In light of the common value, this study classified them into two categories, namely, benefit dimension and cost dimension.

Benefit dimension.

Ventilation of greenhouse refers to the extent of stuffiness reduced inside the greenhouse so as to provide a comfortable working environment. Durability of greenhouse means if greenhouse can be more durable than other similar products under normal use, free from damage caused by natural disasters or other factors. As of recommendation by word of mouth, Li (2008) asserted that credence goods failed to directly, positively, and significantly influence behavior intention through perceived usefulness. Such influence was resulted indirectly from the attitude of others after using. Thus, with the recommendation of acquaintance, relatives, or friends, one could understand the product faster and increase is degree of trust in the effectiveness of the product.

Cost dimension.

Post-disaster maintenance refers to the advice, reinforcement, and maintenance provided by manufacturers after natural disaster for the damage to greenhouse. Price of greenhouse refers if it is cheaper than other similar products. Engineering time is also known as installation cost. It means the time, manpower, and resources invested to complete the installation of a greenhouse.

## Investigation and Analysis

This study employed AHP for quantitative analysis and research, hoped to explore the degree of importance of the factors influencing the purchase of buyers based on the analysis results, provided a more systematic decision-making model, and gave feedback on relevant decisions to the manufacture.

We first asked the intention of the experts who had participated in the decision-making of greenhouse to fill in our questionnaire and then distributed it those who showed such intention. After the questionnaire was collected,

"Choice Maker" and AHP expert decision making analysis software must be adopted to verify the consistency of the questionnaire. If the questionnaire was not consistent, we visited or called the experts to learn their opinions on weights or asked them to fill it in again. After repeated interviews and consulting, if it still failed to pass the verification, the sample data would then be removed. A total of 33 feedbacks had been collected. After the verification of consistency, 26 were valid.

Description of Sample Data

This study considered the experts in the field of agricultural greenhouse as its subjects. Appendix 4 shows the detailed questionnaire data. Experts were defined as those who had participated in the sale, re-sale, purchase, and decision-making of greenhouse. All the respondents had relevant work experiences for over 5 years, who were classified into manufacture, supplier, buyer, and policy-maker. A total of 33 feedbacks were collected, while 26 were valid after the verification of Consistence Index (C.I.).

This study used AHP to analyze data and Excel and Choice Maker to calculate the weights and sequence of importance of the factors influencing the success of greenhouse. The samples used in this study are described below.

Distribution of age of the expert group: Most of them were at 31 to 40 years old (63%) and above 51 (23%), accounting for 86% in total. The figures of age were distributed at two ends, while those at 31-40 were the majority. The reason was because that most of the experts were from National Agricultural Machinery and Materials Exhibition. We asked their willingness to accept interview and take questionnaire. It was during the time when the Exhibition provided the opportunity to farmers to apply for subsidy of greenhouse. Most of those who apply for the subsidy were young adults. Engagement in agriculture at hometown is a trend in recent years. Thus, most of the experts in this study aged between 31 and 40.

Distribution of education background of the expert group: Most of them graduated from vocational colleges (65%) and senior middle schools and vocational schools (19%), accounting for 84% in total. Due to their age distribution and the promotion of national education by the government, most of the respondents in this study graduated from vocational colleges, followed by senior middle schools and vocational schools. What was special was that 12% of the respondents worked at a research institute. And those whose education background was below junior middle schools (inclusive) were the fewest, accounting for 4%.

Distribution of years of working experience of the expert group: Those who had worked for 6-10 years accounted for 38%, while those for over 21 years, 27%, below 5 years, 23%, accounting for 88% in total. Most of the respondents had worked for 6-10 years, followed by over 21 years, and over 5 years. Most of them were young, thus they selected short years of working experience. Through interview, it finds that their years of working experience do not affect their understand-

ing of greenhouse. Though many experts had short years of working experience, they helped their family in farming since they were young and participated in the decision of greenhouse purchase, so they were highly familiar with greenhouse.

Roles of the experts in the field of greenhouse: Most of them were buyers (73%) and suppliers (12%), accounting for 85% in total. Most of the respondents in this study were buyers of greenhouse. As the researcher of this study is still a full-time student, it was difficult for me to reach the experts of manufacturers. Most of the experts were recommended by other experts so that I could have their contacts and asked their intention of interview and questionnaire.

Agricultural products planted by the expert group: They mainly planted vegetables with small leaves 35%, fruits 30%, and bonsai 22%, accounting for 87%. If the respondents were farmers, this study asked them to select the agricultural products they grew. They mainly planted vegetables with small leaves, followed by fruits and bonsai. But this result might be bias. This study finds that most the farmers grow vegetables, wherein, vegetable with small leaves are the easier for planting. The second most was fruit. Thus, the results are mainly vegetables and fruits. However, the governmental data showed that greenhouse was mostly used for planting orchid, followed by fruits, which was different from this study. Moreover, it might be related to the region of this study. This study focused on Yunlin which grew a large amount of fruits. Hence, this might be the reason why the findings of this study were different from those of the government.

*Overall Data Analysis*

1. Overall dimension analysis

With the 26 valid feedbacks qualified in consistency test, this study used Choice Maker AHP expert decision-making software to calculate the weight of each dimension and used Microsoft Excel to calculate the corresponding geometric mean of the weight of each dimension so as to understand the sequence of importance of both dimensions of benefit and cost influencing the purchase of greenhouse, as shown in Table 4-2-1.

(Editor's Note: Due to pagination and formatting issues, please see all Tables at the end of this article.)

Table 4-2-1 shows that among the main considerations when the respondents purchased greenhouse, they cared "benefit dimension" (72%) the most, followed by "cost dimension" (28%).

2. Analysis of the overall key factor

Each valid feedback of questionnaire was analyzed by Choice Maker AHP expert decision-making analysis software. It calculated the weight of each dimension and the weight of each factor with the dimension so as to obtain the weights of key factors. Then, Microsoft Excel was used to calculate the relative geometric mean of the weight of each key factor so as to learn the influence of weight of each key factor on dealers or selection of greenhouse by farmers and the sequence of importance of the factors. Table 4-2-2

shows the sequence of weight of the evaluation criteria.

This study finds that the top three are "benefit dimension". Because the calculation of weights has a great correlation with the previous level, it has a positive correlation with its factors' weight ranking. The factors of "cost dimension" like "price of greenhouse", "post-disaster maintenance", and "engineering time" are not ranked well. As of "cost dimension", the experts attached the greatest importance to "price of greenhouse". When the respondents purchased a greenhouse, as of cost dimension, they compared if the greenhouse was more advantageous than other similar products in cost. The result of multiplying the item with the main dimension, the proportion of the item against the overall weight is 12.3%. Most of practitioners in agriculture in Taiwan are individual farmers who seldom have fund support of enterprises. They attach great important to the cost of the initial price. Even the government subsidy could only cover 1/3 of the cost. In average, farmers have to pay several million of NTD by themselves. As the investment in planting with facilities is high, appropriate planning is a must so as to maximize the efficiency of the facilities and meet economic benefits. "Post-disaster maintenance" refers to the advice, reinforcement, and maintenance provided by manufacturers after natural disaster for the damage to greenhouse. The proportion of the item against the overall weight is only 10%. To provide such service, manufacturers shall consider a lot. Hence, mostly the experts do not influence the decision to purchase a greenhouse. Lastly, "engineering time", also known as installation cost, means the time, manpower, and resources invested to complete the installation of a greenhouse. The proportion of the item against the overall weight is only 6.1%.

*Analysis on the Data of Farmers*

Analysis of dimensions.

With the 19 valid feedbacks of farmers qualified in consistency test, this study used Choice Maker AHP expert decision-making software to calculate the weight of each dimension and used Microsoft Excel to calculate the corresponding geometric mean of the weight of each dimension so as to understand the sequence of importance of both dimensions of benefit and cost influencing the purchase of greenhouse by farmers, as shown in Table 4-3-1:This section analyzed the data of farmers. Benefit dimension accounts for 72.4%, while cost dimension, 27.6%. Compared with 71.6% of overall nonfuzzy value of benefit dimension and 28.4% of cost dimension, it shows that farmers pay more attention to the weight of benefit dimension.

Analysis of the key factors of farmers

Each valid feedback of questionnaire of farmers was analyzed by Choice Maker AHP expert decision-making analysis software. It calculated the weight of each dimension and the weight of each factor with the dimension so as to obtain the weights of key factors. Then, Microsoft Excel was used to calculate the relative geometric mean of the weight of each key factor so as to learn the influence of weight

of each key factor on dealers or selection of greenhouse by farmers and the sequence of importance of the factors, as shown in Table 4-3-2.

This study concluded the above data and sequence based on the survey with the farmers. With the comparison of the overall weight, it finds that the weight of "recommendation by word-of-mouth" has decreased from 15.1% to 7.2%, while its ranking dropped from the third to the fifth. However, the weight of "post-disaster maintenance" increased from the third to the fourth. From interview, it also finds that the farmers attach great importance to post-disaster maintenance. Since Taiwan has frequent natural disaster, greenhouses were all destroyed by typhoon. No manufacture provides a complete business model at present to shoulder the risk. Thus, farmers have to shoulder it themselves. Manufacturers only provided compensation and repair services after disaster. Most farmers rely on the subsidy on natural disaster from the government. Such phenomenon appears in circles.

*Analysis on the Data of Non-farmers*

The samples in this section were classified into manufacturers, suppliers, and policy makers. A total of 7 valid feedbacks were collected from the samples. This study used Choice Maker AHP expert decision-making software to calculate the weight of each dimension and used Microsoft Excel to calculate the corresponding geometric mean of the weight of each dimension so as to understand the sequence of importance of both dimensions of benefit and cost influencing the purchase of greenhouse by non-farmers, as shown in Tables 4-2-1 and 4-2-2.

Dimension analysis of non-farmers This section analyzed the data of non-farmers. Benefit dimension accounts for 69.3%, while cost dimension, 30.7%. Compared with 71.6% of overall non-fuzzy value of benefit dimension and 28.4% of cost dimension, it shows that non-farmers do not attach obvious importance to the overall weight of benefit dimension, while the overall weight of cost dimension is significant.

Analysis of The Key Factors Of Non-Farmers

Each valid feedback of questionnaire of non-farmers was analyzed by Choice Maker AHP expert decision-making analysis software. It calculated the weight of each dimension and the weight of each factor with the dimension so as to obtain the weights of key factors. Then, Microsoft Excel was used to calculate the relative geometric mean of the weight of each key factor so as to learn the influence of weight of each key factor on dealers or selection of greenhouse by non-farmers and the sequence of importance of the factors, as shown in Table 4-5-2.

With the non-farmer samples, this study found the above data and sequence. After the comparison of overall weight, "recommendation by word-of-mouth" was found to jump to the first place of the group, significantly larger than the second and third places. In this study, the manufacturers and the suppliers attached great importance to word-of-mouth recommendation, and even thought that its effects were better

than other functional items, so the "recommendation by word-of-mouth" accounted for the highest proportion. Another special feature was post-disaster maintenance. The weight of farmers was ranked the third. However, it was not valued according to data of manufacturers.

## Conclusion and Suggestions

The results show that the significance of benefit dimension (0.72) is greater than that of cost dimension (0.28). Most respondents believe that the cost of greenhouse is extremely high. If it does not have obvious benefits, crops cannot grow, while manpower cannot be taken full advantage of. No matter how advantageous cost dimension is, they still believe that benefit dimension is the most important. The sequence of importance of overall weight is: Ventilation of greenhouse (0.32), durability of greenhouse (0.244), recommendation by word-of-mouth (0.151), price of greenhouse (0.123), post-disaster maintenance (0.10), and engineering time (0.61). This study also finds that the top three are all benefit dimension factors. Because the calculation of weights has a great correlation with the previous level, the respondents think that importance of benefit dimension" has a positive correlation with its factors' weight ranking. By contrast, "price of greenhouse, post-disaster maintenance, and engineering time are not ranked well.

From the classification study, it is found that both farmers and non-farmers value "ventilation of greenhouse" and "durability of greenhouse" greatly, which are ranked the 2nd and the 3rd, and the 1st and 2nd, respectively. But recommendation by word-of-mouth is only ranked the 4th as of farmers and the 1st as of non-farmers. Manufacturers pay much more attention to this item than farmers, hoping that "recommendation by word-of-mouth" can attract more buyers. The weights of "post-disaster maintenance" are different, which is ranked the 3rd as of farmers, indicating great importance, and the last as of non-farmers. In fact, it reflects that, currently, no manufacturers in Taiwan can provide a perfect and beneficial business model to farmers but shift such risk to farmers and only provide compensation and repair services to farmers. Most farmers rely on the subsidy on natural disaster from the government. Such phenomenon appears in circles. In addition, it also finds that, due to the dependence on government subsidy in the past, "price of greenhouse" is not valued by by farmers. Neither did non-farmers. Overall, both farmers and non-farmers think that benefit dimension is much more important than cost dimension, which provides new opportunities to new comers.

This study used AHP to compare the degree of importance attached to greenhouse by farmers and non-farmers (manufacturers, suppliers, and policy makers), hoping that the results could contribute to existing manufacturers and further new comers to the field. This study puts out the following recommendations for the reference of future researchers:

1. This study only consulted the experts at National Agricultural Machinery and Materials Exhibition from and manufactures in the field for the confirmation of indicators

which were not perfect. It suggests that future researchers can consult professional farmers if they want to obtain materials related to agriculture and treat the field of planting different so as to make the initially set up structure more perfect and complete.

2. Due to the limited time, this study failed to conduct empirical investigation on the findings of "weight of selection of creative products of greenhouse" or conduct a test of the actual plan. It suggests that scholars can conduct empirical study in this aspect in the future.

3. As the researchers of this study were lack of industrial support and experts from manufacturers, suppliers, and policy makers, most of the samples of experts in this study were farmers. In the future, if researchers can investigate manufacturers, suppliers, and even policy makers at a broader region, their exploration will be more comprehensive and in-depth.

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Table 4-2-1. Non-fuzzy Value Sequence of Criteria—Overall Dimension

| Non-fuzzy Value | | Sequence |
|---|---|---|
| Benefit dimension | 0.716 | 1 |
| Cost dimension | 0.284 | 2 |

Source: Compiled by this study

Table 4-2-2. Sequence of Weight of the Evaluation Criteria—Overall Key Factor

| Weight of Evaluation Criteria | | Sequence |
|---|---|---|
| Ventilation of greenhouse | 0.320 | 1 |
| Durability of greenhouse | 0.244 | 2 |
| Recommendation by word of mouth | 0.151 | 3 |
| Post-disaster maintenance | 0.100 | 5 |
| Price of greenhouse | 0.123 | 4 |
| Engineering time | 0.061 | 6 |

Source: Compiled by this study

Table 4-3-1. Non-fuzzy Value Sequence of Criteria—Farmers

| Non-fuzzy Value of Farmers | | Sequence |
|---|---|---|
| Benefit dimension | 0.724 | 1 |
| Cost dimension | 0.276 | 2 |

Source: Compiled by this study

Table 4-3-2. Sequence of Weight of the Evaluation Criteria—Farmers

| Weight of Evaluation Criteria of Farmers | | Sequence |
|---|---|---|
| Ventilation of greenhouse | 0.386 | 1 |
| Durability of greenhouse | 0.266 | 2 |
| Recommendation by word of mouth | 0.072 | 5 |
| Post-disaster maintenance | 0.119 | 3 |
| Price of greenhouse | 0.108 | 4 |
| Engineering time | 0.049 | 6 |

Source: Compiled by this study

Table 4-5-1. Non-fuzzy value sequence of criteria—Non-farmers

| Non-fuzzy Value of Non-farmers | | Sequence |
|---|---|---|
| Benefit dimension | 0.693 | 1 |
| Cost dimension | 0.307 | 2 |

Source: Compiled by this study

Table 4-5-2. Sequence of Weight of the Evaluation Criteria—Non-Farmers

| Weight of Evaluation Criteria of Non-farmers | | Sequence |
|---|---|---|
| Ventilation of greenhouse | 0.143 | 3 |
| Durability of greenhouse | 0.184 | 2 |
| Recommendation by word of mouth | 0.366 | 1 |
| Post-disaster maintenance | 0.077 | 6 |
| Price of greenhouse | 0.135 | 4 |
| Engineering time | 0.095 | 5 |

Source: Compiled by this study

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# DEVELOPING GREEN, ENERGY-SAVING, LONG-ACTING AND WATER-WASHABLE FILTERS

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Abstract

This research focuses on the development of green, energy-saving, long-acting and water-washable filter and the non-woven fabric material of general filter to develop green products of long-acting and water-washable crude, primary and intermediate filter which can conform to the appeal of environmental protection and green energy; and then weaving technology, pleating technology and fiber fineness are used to improve product filtration efficiency, so that the product service life can last for 5 years and the long-acting and water-washable crude, primary and intermediate filter which can be washed by water for more than 60 times will be developed.

Keywords: Water-washable, Filter, Energy-saving, Developing Green Research

## Background and Purposes

This research takes water-washable, green and environmentally friendly filter as research subjects, in hope that the green products can break the original industrial rule via disruptive innovation and promote society to generate innovative service through such environmentally friendly product.

At present, filter material market is significantly potential due to the improvement of environmental protection and health concept; besides (L,C,L,W, 2012) ( L,W,C, L, 2013) , there are other 8 reasons for it: the global demand for indoor artificial heating and cooling is increased, the migration of Asian population is frequent, the demand for sea water desalination is increased, food

safety problem is increasing, the particulate matter in the air will become the preferentially controlled pollutant, the global fossil fuel is exhausted, ethyl alcohol will become the leading fuel in the future and the emission of greenhouse gases is reduced.

The polypropylene (PP) used in this research is provided by Taiwan Polypropylene(C, 2015) ( L,C,L,L , 2014) . The density of polypropylene fiber is 0.903g/cm3, and it is the lightest synthetic fiber among all the chemical fibers and also the only one which can float on the water. Due to almost non-hygroscopic feature, high strength of extension and good corrosion resistance, polypropylene fiber is almost not eroded by strong acid and strong alkali, but the maximum service temperature should not exceed 100℃ (L,L,L,L, 2015) . The filter made from this kind of fiber has a smooth surface and such fiber is also the material most commonly used in all the primary filter. In recent years, thanks to the improvement of environmental protection concept, the various countries all over the world gradually apply polypropylene (PP) fiber to filter, and its superior resistance to strong acid and strong alkali and temperature resistance also gradually improve so as to gradually replace other filters, see Table 1.

The disposable filter material may lead to waste of energy, and the pollutant of filter material thrown is also the common external cost of all the people. It is hoped to develop green and energy-saving products to improve these problems. Currently, the most primary problem is resource exhaustion, in hope of developing the green, environmentally friendly and water-washable filter material products which can be used repeatedly in the shortest possible time. In fact, filter material is used by everyone on a daily basis, and both the filter screen for cooling air and water filter must use filter materials. People become increasingly particular about green and environmental protection and health care, thus it is believed that to some extent its demand will also increase.

Air filtration accounts for about one third in the market of filtration and filter and it is portion with the fastest growth in the filtration field, which has been widely used in industrial field and families. (L,L,L,L, 2015) Generally speaking, air filtration is mainly to eliminate the suspended solid material in the air (aerosol), and the diameter of these particles ranges from 0.002 um to 100 um; the too small aerosol particle is like gas molecule, while too large particle is easy to be eliminated in the air due to its gravitational settling, (Robert Mcilvaine, Mcilvaine Company, Northfields, IL 60093 USA).

## Literature Review

This research conducts the experimental evaluation based on filtration efficiency:

1. Basis and method: Weight Arrestance of ASHRAE52.1-1992.
2. Experimental instrument: differential pressure gauge is Omega PX654-0.1D5V, particle counter is Las-x CRT type (flow velocity is 2.0cm/sec, air volume is 500CFM), feeder
3. Specimen preparation: standard dust (50g), standard dust filter screen, filter screen to be measured
4. Standard dust (50g): standard dust. The dust contents stipulated by ASHRAE 52: a. are applied in the course

of dust load test; the dust constituents of ASHRAE (weight: %): 72% (the dust on the road of Arizona) b. carbon black: 23% (particle size 0.08μm ) c. cotton velvet: 5% (15 mm*0.1mm).

5. Specimen specifications: the area for standard filter screen and filter screen to be measured is respectively 23.5 inches * 23.5 inches.
6. Test method: first of all, the filter screen to be measured is placed in the filtration modules to measure its initial loss of pressure, and then 50g standard dust is measured by the electronic scale; after the filtration modules are started, most dusts are captured by the filter screen to be measured and the rest are captured by standard filter screen; after the standard dust in the feeder is used up, it is weighed after the removal of standard filter screen to calculate the filtration efficiency of filter screen to be measured according to the following formula: the rate of dust collection of air filter collecting efficiency, weight method (above 1μm), and this method is also called as ATI weight method; in this method, the formula is obtained by testing specimen before and after the filter to weigh and compare them.

## Research Method

Dust collection capacity theory is used to show the defined standard of use, and the test for general air cleaning unit is conducted accordingly. Filtration performance is based on the initial performance of new cleaning mesh. When the performance changes due to dust accumulation in the device, it is also called load performance.

## Investigation and Analysis

The separation mechanism of mechanical filter is shown in Figure 1, which is divided into surface filtration (left figure) and deep filtration (right figure). In terms of surface filtration, the particles in the particle layer accumulated on the surface of filter interfere with each other, so that the separation effect can improve the particle layer sharply produced on the surface of filter to improve the rate of dust collection, meanwhile, the impedance is also increased. In terms of deep filtration, the particles in the spongy or rock-bottom filter are scattered and then separated. Due to the increase in load impedance, filtration efficiency will also decrease. This kind of structure is often used in filtration device and has the large filtration capacity. The filter used for air conditioner generally takes small concentration of air dust as subjects, and in addition to its easy cleaning, due to emphasis on air volume, the increase and decrease of impedance (large dust collection capacity) can make the inner filtration type become ideal. In the earlier period, it is planned to adopt single layer of honeycomb weave, and it is planned to adopt 7~16 layers of 3D fabric to increase the efficiency of deep filtration.

The research direction is the green, energy-saving, long-acting and water-washable filter product, and with the better foundation, it begins to develop towards the direction of other filter material industries (water, gas, etc.) based on the foundation.

During the exhibition, its effect of environmental protection and energy saving will be especially stressed to achieve the goal of green marketing.( P,

H, 2008) In terms of prices, the model of small profits but quick turnover is adopted, and the main purpose is to hope that everyone can put more emphasis on environmental protection, thus we can do our bit for the earth and environment through median price. In terms channel, the main promotion method is network marketing; in particular, group purchase and other activities are very popular in the networked society, it is also expected to achieve the effect of publicity through Yahoo Shopping, momo shopping, etc.; besides, the online shopping activities are also combined to achieve the promotional and spreading effect.

*Quantified Benefit:* See Table 2.

*Non-quantitative benefits:*

The physical conditions of fibers should be effectively used to produce environmentally friendly, non-polluting and green materials with higher value, higher strength and higher crystallinity to improve the problem; the safety in use may be the most important. As a professional, this is also our first step to produce the product, and the safe materials are used so that the load on the earth is not increased any more.

Although the research and development of green products may cause loss to manufacturers, its following effects may be more important to the society, and manufacturers can make use of the saved resources to improve their products and service, meanwhile they also do their bit for the earth and environmental protection, thus the next generation will have a cleaner and more comfortable place to live in. As a result, society may experience the great evolution, and then the cleaning industry will emerge to promote the generation of more small and micro enterprises, inspire the originality of society and equalize the wealth, and meanwhile the unemployment rate can be indirectly decreased.

*Effect on overall environment after the completion of this research*

1. Effect on company

The horizontal ties are carried out through plan and academic unit, and the cooperation of industry, official and university is expected to improve the kinetic energy of Taiwan's academic research and introduce new ideas to research fields; the filter products which combine the green and environmentally friendly concepts can achieve the effects of reducing the energy consumption, increase durability and reduce environmental pollution and damage, and the special and high-quality products can be developed continuously to increase market share.

2. The benefits of creation, added value or circulation owned by industry and industrial technology

The company can develop forward-looking products through this plan to further bring positive competition for the improvement of industry and industrial technology. The saved resources can be invested into other products and service, and even the rested capitals can be invested into society to do their bit for the earth and country. The most special fact is that the cleaning industry will emerge at the right moment. Due to its lower technology threshold, more people can also be brought into workplace to reduce unemployment rate and change the redistribution of wealth.

Conclusion and Suggestions

The research results show that the horizontal ties are carried out through plan and academic unit, and the cooperation of industry, official and university is expected to improve the kinetic energy of Taiwan's academic research and introduce new ideas to research fields; the filter products which combine the green and environmentally friendly concepts can achieve the effects of reducing the energy consumption, increase durability and reduce environmental pollution and damage, and the special and high-quality products can be developed continuously to increase market share. In addition, the benefits of creation, added value or circulation owned by industrial technology can develop forward-looking products for the company through this plan to further bring positive competition for the improvement of industry and industrial technology. The saved resources can be invested into other products and service, and even the rested capitals can be invested into society to do their bit for the earth and country. The most special fact is that the cleaning industry will emerge at the right moment. Due to its lower technology threshold, more people can also be brought into workplace to reduce unemployment rate and change the redistribution of wealth.

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Table 1. Yarn Diameter: 0.25mm (400 denier) fabric specifications:

| Warp density (piece/inch) | Weft density (piece/inch) | Weaving width (inch) |
|---|---|---|
| 42 | 36 | ≧65 |

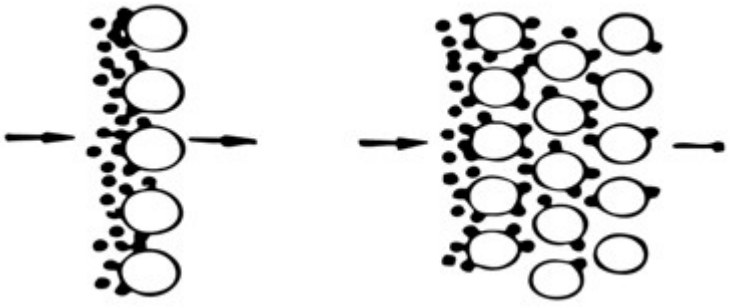

Figure 1. Instruction for filtration method: surface filtration (left figure) and deep filtration (right figure)

Table 2. Quantified benefits

| | | |
|---|---|---|
| Increased output value 10000 NTD | New product or service produced 5 items in total | Derived commodity or service 5 items in total |
| Invested research expenditure 2000 NTD | Promoted investment amount 10000 NTD | Decreased cost 2000 NTD |
| Increased the number of employed people 100 persons | Establish 1 new company | Invent 1 piece of patent |
| A total of 2 pieces of new or new type of patents | A total of 2 journal papers | A total of 1 conference paper |

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# APPLICATION OF ORGANIZATIONAL THEORIES TO A COMMUNITY MEDIA ORGANIZATION: AN EMPIRICAL STUDY OF A BUSINESS ORGANIZATION

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Abstract

This paper addresses how the traditional organizational structure affects the development, or lack of thereof, in a nonprofit broadcast media environment. The main idea is to explain how management methodologies decrease new approaches to participatory media, which are essential for survival in a technologically evolving and interactive multimedia-dependent world. A study of a small community media center in a major media market was conducted to ascertain the employees' understanding of their roles, authority, accountability, and effectiveness of the current organizational structure and departmental workflow. The authors conclude that Jaques' *requisite* organization approach could improve functional relationships, leadership, communications, and also increase innovation and trust.

Key Words: hierarchy, hierarchical organizations, organization structure, community media, requisite organization, Elliott Jaques, organizational roles, organizational strata

## Introduction

### *Community Media Background*

Telecommunications law in the United States is primarily defined by two major legislative efforts: The Communications Act of 1934, which regulated communications by radio and wire; and the Telecommunications Act of 1996, which opened communication markets and included telephone services, cable programming, video and broadcast services. In addition to national legislation, statewide and local lobbying efforts led to the creation and legal protection of community media stations granted to municipalities, through franchise agreements that bargain the community's rights of way for locally stewarded airwaves.

### *Organization's Background*

The organization was founded in 1988, after two decades of public access television stations surfacing all over the United States. Community media is broadly defined as any form of media created and controlled by a geographic community or interest group, which is separate from commercial media.

The organization provides training in various media production areas, giving the community an opportunity to create content that is a reflection of their own values, support freedom of speech, and other tenets outlined in the First Amendment to the Constitution of the United States. It is the only television station devoted entirely to local programming created by and for the community. Their mission is to empower people to exercise their freedom of speech by providing opportunities to learn, create and share media through training courses, access to state-of-the-art media facilities and distribution. Members, staff and produces are not beholden to advertisers or ratings. The organization can air whatever it wants, whenever it wants. There is no competition, creating an ultimate market niche.

## Organizational Structure

This company is a small non-profit broadcast television station in one of the world's top five media markets, with a $2.3 million USD annual operating budget. The organization provides training in various media production areas, giving the community an opportunity to create content that is a reflection of their own values. They manage and operate two in-house studios, high-definition video cameras and edit suites, with a broadcast capability of seven channels across three cable networks. It is a membership-based organization, where community residents pay a minimal fee to have access to broadcast-quality production equipment and discounted training classes.

Organization oversight is maintained by its Board of Directors, which has been chaired by a well-respected journalist and public figure for 20 years.

Senior Management is a team of three, which consists of Chief Execute Officer/President, Chief Financial Officer/Vice President of Administration, and an Executive Vice President. There are five Department Managers (Administration, Training and Produc-

tion, Creative Services, Membership and Outreach and Programming), six staff members, and roughly 3-10 contractors at any given time, based on projects. While the team is relatively small, there are many pseudo-management levels and obstacles in regards to communications, transparency, accountability, and innovation.

The CEO/ has been employed by the company since its inception in 1988, and has been in the highest staff position (previously Executive Director, and currently CEO/President) for over twenty years. It is unclear if there is proper oversight or documented assessment of the role.

*Example of a Business Process: Performance Appraisal*

Employees are evaluated once a year, by their direct supervisor with input from senior management. The company's evaluation form is a nineteen-page long document, not including additional written comments.

Once a supervisor completes the evaluation with feedback and future goals, the document can become over thirty pages in length. Goals are determined by supervisors and approved by senior management, and the evaluations occur annually based on the employee's start date. Staff is rated on how well they know, understand, and implement company policies and procedures. The evaluation document and evaluation process is lengthy, and void of role accountability and development, as related to the overall mission.

The steps in the process are as follows:

1. Staff completes evaluation independently;
2. Manager completes evaluation independently;
3. Manager meets with the CEO/President and department head; provides evaluations for review, discussion, feedback and recommendation changes;
4. Manager updates evaluation (if necessary) based on input from CEO/President, recommendations and feedback from discussions;
5. Manager and staff meet to discuss "grades" and any differences in ratings; and discuss outlined goals with a timeline for upcoming year;
6. Manager and staff sign and submit evaluation to CEO/President for approval/signature;
7. Manager forwards endorsed original to Vice President of Administration to file in employee's personnel record;
8. Manager provides endorsed copy to staff and maintains copy for the manager's file.

This evaluation process is an example of a traditional management approach at managing people, rather than the system.

## Organizational Study and Methods

The basis for this organizational study are the organizational theories developed by management theorists, Drs. Elliott Jaques and W. Edwards Deming (Jaques, 1964, 1996, 2002), (Deming, 1992, 1993). These methods have been validated by multiple scholars across time, such as Clement (2013, 2015), Lee (2007), Kraines (2001), and others. Additionally, one of the authors has confirmed and refined these meth-

ods to apply to this study (Ivanov, 2006, 2011, 2012, 2013, 2014, 2015).

Community media centers all around the country are in danger of closing their doors due to technological advances, lack of diverse funding, and a shift in people's relationship to media, from uninvolved audiences to active participants. Many of these centers rely on the "if we build it, they will come" approach. Knowing this, why haven't these stations restructured their hierarchies to address changing technology? What adjustments need to be made to modernize the current structure to ensure sustainability? How can community media centers adjust staff roles to better support the organization's mission? How can the organization's leadership address issues of fear, company waste, lack of focus and constantly changing priorities?

The goal of this organization study is to understand and analyze the current structure, in order to evaluate the following:

- Employee roles within the enterprise;
- Authority and accountability;
- Effectiveness of current hierarchal structure; and
- Department and project workflow.

Using a systemic approach, one of the authors surveyed 9 out of 15 employees over a two-week period.

Questions were organized in three sections:

1. Organization purpose, and how individual roles support that purpose;
2. Employees perspectives on resources available to support their roles; and
3. Timespan analysis, including supervisory leadership and task oversight.

The size and nature of the organization afforded access to employees at all levels: staff, management, and executive leadership. I decided not to interview the three staff that report directly to me, as I thought there could potentially be present unnecessary fear, which would make staff uncomfortable and result in unusable data – if they were too nervous to answer questions truthfully.

I conducted the in-person interviews in a relaxed, comfortable office environment, where there would be minimum distractions. I conducted my interview with the CEO/President in her office, to accommodate her. I allotted 15-20 minutes for employees to answer the ten-question survey. All of the meetings were completed around the allotted fifteen minutes, however the CEO/President's lasted for over 40 minutes. In order to ensure integrity of the data, upon completion of the surveys, I read all of the answers out loud to employees so they could make any corrections or additions to the answers I collected. Overall, employees seemed relaxed and comfortable with the process.

## Survey Findings

According to the questionnaire, the majority of the employees inter-

viewed share the same sentiments in all three of the survey areas. When asked about challenges within their roles, employees mentioned the company's cumbersome internal documents, processes, and internal issues: long evaluation form that does not accurately assess contributions or accountability, communication issues regarding company policy updates and initiatives, mistrust and lack of transparency from CEO/President and Board of Directors, and the need for additional human resources.

Interviewing the CEO/President was a challenge because questions were not answered appropriately. I was provided information that she wanted me to know, talking points and highlights. Unfortunately, the majority of it was not pertinent to the goals of the study. I found myself reframing the questions in an attempt to steer her in the direction of providing actual real-world information instead of her idealistic answers.

This made it difficult to analyze the aggregated data because once I arranged all of the information, her answers looked so different than all of the others. Here are some of the key findings from the survey that influenced my forthcoming recommendations:

- 100% understand and can clearly and simply state the organization's purpose.
- 100% understanding their role in achieving that purpose.
- 45% do not know or understand how role is managed.
- 45% believe role is managed by supervisor setting goals.
- 100% reported no required check-in points (unless they create them).
- 100% have not received training /instructions on how to complete tasks.
- 100% are satisfied with available technology and software resources.

Time Span Results:

- CEO/President role's longest task is 10 years.
- Executive Vice President's role's longest task is 3-5 years.
- All managers and supporting roles' longest tasks were less than 3 months.

*Theoretical and Philosophical Analysis and Discussion*

Harvey's writings in *The Abilene Paradox*, and *Eichmann in the Organization*, both explain the ease by which organizations like this media center can be led to its own destruction (1988).

Workers, or members of a close group (staff) under an authoritative figure (manager), can be seduced into behavior that is immoral, unprincipled and uncompassionate. Team members clearly understand the company mission and policies, but when management actions and directives are contradictory to the mission, what exactly can a staff person do? Usually nothing. According to Harvey, this type of collusion destroys the delicate thread of human fabric that is needed to make organizations function effectively and allow it to survive.

In his experiment researching the effects of authority on obedience in a hierarchal environment, social psychologist, Milgram, examined people's response to confronting authority in uncomfortable situations (1974). Top-level managers act out their roles in unconscious obedience to the wishes of the majority or authority of the other members of the organizations that they are leading. In this organization, that is the role of the Board of Directors. They are convenient scapegoats, whose insensitivity protects their constituents (managers) from the fury of those who are the victims (staff). And having a villain to blame makes it easier for the rest of us to escape the reality of our complicity in sanctioning a specific behavior.

According to Milgram, obedience is the psychological mechanism that links individual action to political purpose (1974). The organization is threatened by the very notion of disobedience, which may be necessary to salvage and trust and transparency. With the essence of obedience, a person views himself as an instrument for carrying out another person's wishes, and is no longer responsible for those actions, hence the hierarchal organizational structure. Senior managers in organizations hire workers who they believe will act out their visions unquestioned or without being challenged. Milgram's experiment serves to test when and how people would defy authority in the face of a clear moral imperative (1974).

## Structural Organizational Issues

### *Executive Management*

Leadership within the organization is a contentious topic. Throughout the organization's 26-year existence, they have had the same president and board chair for 25 of those years. Many members and staff have questioned how the organization can be innovative and relevant with stagnant leadership.

During the survey with the CEO/President, I asked specifically how the Board of Directors manages the CEO/President role. The response was that they provide guidance and oversight, but it was unclear if the CEO/President is regularly evaluated or given goals or benchmarks to meet.

Neither members nor staff understands the type of board (governing, policy, fund-raising, advisory, etc.) the organization has, nor is it known what the qualifications are to be considered for board seat. The CFO/VP of Administration is a major role, but the person in that position is only part-time.

By title, the executive team should be operating at Level V and VI roles, with long-term projects, but in actuality they are more like Level IV. This is where it becomes evident that the company has an *extant* organizational structure because innovation, new programs and creative approaches do not flow from the top down, like the structure would suggest. Senior management is not engaged in long-term projects or even developing a viable strategic plan with the Board of Directors.

The long-term ideas and push for modernizing systems comes from

managers, which makes approval and implementation a major challenge. The current structure also does not speak to how problems are solved, defines accountability for tasks, or how the organization operates in reality.

*Middle Management Level*

All managers are placed in Level I and II roles. While there are employees in these roles with the capacity to complete more complex tasks, their time is spent on short-term projects, responding to day-to-day needs of the organization and members, or problem solving. There are no systems in place for project selection or criteria to determine whether or not a project is accepted. This is problematic because with a small team, even small projects can weigh heavily on company resources, and major projects are the responsibility of employees in lower management roles.

*Organizational Issues*

The organization has been in existence for 26 years and there seems to be no plan for the next quarter century. Staff and management are basically self-directed, creating their own tasks and benchmarks. Individual goals are not connected to larger organization goals. Based on the surveys, no staff has received training or instructions on how to do their jobs successfully. As a multimedia organization, it is imperative that the entire team stays relevant with new technologies, including senior management.

Additionally, there is a lack of transparency between the various management levels. As a nonprofit public organization, board meetings are open to the public. However, the board meetings are not publicized. The information is buried on the website and staff, members and other stakeholders are kept in the dark. The president and CFO are the only people present at board meetings, and there seems to be a veil of secrecy separating the staff, members and managers from the board.

Conclusion

The organization suffers from minimally two of W. Edwards Deming's deadly diseases: *lack of constancy of purpose* and *emphasis on short-term profits* (1992, 1993). It is common for the organization to shift goals with no plan how to achieve them. Thus, when the next exciting project comes along, priorities change.

The organization also puts too much emphasis on short-term profits. Many of the projects cause internal confusion and strife because there is no respect for the research and planning process of project management. What is clear is that when the team does not understand the motivation behind the hard work, long hours and stress, they feel disconnected and disenfranchised.

The organization is not making necessary adjustments with changes in technology and society, and that includes changes in leadership. As a result, the strategic direction of the organization is compromised and the company lacks cohesion.

But all hope it not lost! With a highly functional facility that allows people to create media, it is a hub for innovative thinkers, artists and activists.

Its diverse membership includes people from all over the city that represent different cultures, experiences, belief systems, perspectives, and ideas. The center gives voice to the voiceless. It allows regular people to speak to an audience. In essence, it validates the notion that everyone's voice matters, not just those who can afford to create million dollar commercials and pay for channel time.

Because of the organization's secure funding and connection to the community, the organization can still salvage their vision and future. The organization can address the leadership issues, and empower people to exercise their freedom of speech. This is not just the often-recited company line, but a motto that is consistently displayed.

Entrepreneur and businessman, J. Willard Marriot, founder of Marriot hotels and other enterprises, is credited to have said, "If you take care of your people, your people will take care of your customers and your business will take care of itself."

Under the new leadership, this is could be the foundation of how this company could retain its spot as a valued community resource for media engagement in the next 25 years. The current Board Chair and CEO could assist in the development of a new strategic plan, providing institutional insight that may guide a new leader's vision.

Let go of old traditions and ways of thinking. Be bold and think outside of the box. Explore lateral, partnership-style collaborations instead of a competitive spirit. Why is it important to have an 8-hour workday? Focus on tasks and completing projects, not hours spent in the office. What is the goal of employee evaluation tools? What kinds of incentives can you develop for staff?

Create a vibrant company culture by abolishing the business/professional dress code and encourage genuine diversity and expression. Allow employees to express themselves creatively in offices and workspaces.

Family photos, decorations and other personal items in the work environment would make the office more relaxed and friendly. Invest resources into the human capital of organization.

Provide professional training and development, company retreats, acknowledgement of birthdays and work anniversaries. Treat each person as an individual, not an expendable commodity. Be human. This is what the study found out conversing with the employees of this organization.

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# TQM-BASED ORGANIZATION DEVELOPMENT MODEL (AN EMPIRICAL STUDY IN MILITARY ACADEMY)

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Abstract

Goal-oriented and sustainable organization arrangement and development have been the strengths of military academy in producing professional army's (TNI AD) junior officers with modern and strategic mindset in facing the threats of this global era full of uncertainties. This research aims at analyzing organization development through TQM in military academy (hereinafter Akmil). The population of research were all members of Akmil organization and in reference to the use of LISREL the research is conducted to the valid data of 188 members of Akmil organization. The data are collected through questionnaire, and the model confirmatory analysis uses a program software of AMOS version 22.0. The research results indicate that the fit correlation model between service quality, organizational culture, and educational leadership, through TQM on the organization development in Akmil are proven and accepted. It is suggested that the leaders of Akmil could determine the strategy they would use to develop their organization to optimally face the current, knowledge and technology development. Continuous improvement needs to be done, considering that TQM plays an important role in improving Akmil's quality and public accountability.

Keywords: Service Quality, Organizational Culture, Leadership, TQM, Organization Development

## Introduction

The successful sustainable development lies in superior human resources (HR) quality. Human development can be said as the cutting edge of sustainable development strategy. Since the key to human development is education, it is necessary for us to be aware that education is a long-term investment in the effort of building human resources. To fulfill such necessity, there is a need to seriously arrange and manage educational institutions for the youth in Indonesia to have highly competitive HR quality at both local, regional and global levels. In reality, when it comes to our ability as a nation, it seems educational institutions in Indonesia have not been capable of producing HRs thoroughly ready in the face of global competition. It can be seen from the huge number of uneducated workforce. This is counterproductive given that the demand of occupational world in global era requires educated workforce, (Suyanto dan Hisyam, 2000:3).

Military academy as one of educational institutions plays an important and strategic role in continuous updates and it has always been grown and developed systematically by policy makers. To make its organization to be a place where education is administered optimally which will then enable them to adapt to the current globalization, in the face of its increasingly fiercer demand, organization development is needed. These objectives of Military Academy are in line with Samuel Finer's opinion in Fattah (2005:256) which reads: "What makes military different from other institutions is that it is not just an autocratic institution demanding complete loyalty and commitment, rather it is also an organization designed to be a robust power working as efficiently as possible whenever the state needs them."

Under the Decision Letter of Minister of National Education of the Republic of Indonesia Number 245/D/O /2010 dated December 29, 2010 concerning Permit to Administer a Study Program in Military Academy, the Military Academy (hereinafter Akmil) should adjust its educational system to the provisions applicable to universities, including those related to organization issue which is expected to be compliant with the National Standards of Higher Education, such as the existence of Internal Quality Assurance Agency, Research and Community Service Agency and Study Program. The organizational culture formed within Akmil influences the organization change and development towards betterment from the previous organizational pattern that enables this change and development, allowing the organi-

zation to survive in following the education standardization demand determined by both BAN-PT and Kemenristekdikti.

These organization change and development cannot be separated from those factors which support such organization development to occur, such as service quality, organizational culture, educational leadership, and Total Quality Management (TQM). TQM has some effect on organization development and, on the other hand, TQM is influenced by organizational culture. The result shows that there is a statistically significant influence of organizational culture, including meaningful values, supports and promotion of values, discipline values and freestyle values on TQM (Al-Bourini, Ghaith and Azzam, 2013).

The organization development of Military Academy cannot be separated from the factors existing within the organization to stay committed despite any change in the effort of continuous improvement. Furthermore, Sallis (2012) suggests TQM is not a set of slogans, but a deliberate and systematic approach to achieving appropriate levels of quality in a consistent fashion that meet or exceed the needs and wants of customers. It can be thought of as a philosophy of continual improvement only achievable by and through people. As an approach, TQM represents a permanent shift in an institution's focus away from short-term expediency to the long-term quality improvement.

With such organization change and development along with the demand from Kemenristekdikti which requires Akmil to follow the standards of BAN-PT in administering their education. This study aims at reviewing and analyzing TQM-based in Military Academy.

## Research Methods

The design of this research is a qualitative one through a model approach of Second Order Confirmatory Factor Analysis, i.e. the model is predetermined based on theories. This Second Order CFA model is characterized by a latent factor which has several indicators and these indicators are immeasurable directly and require other indicators in their measurement. This is different from First Order Confirmatory Factor Analysis model, where one latent factor has several indicators and these indicators could be measured directly (Ghozali, 2013: 143). The measurement of this research model is designed using Confirmatory Factor Analysis approach through AMOS (Analysis of Moment Structures) (Ferdinand, 2002:6; Ghozali, 2013:25; Hair et.a1, 2010:587). Such approach is used because the model is formed first.

### *Population and Sample*

The population of this research are all academicians of Akmil who support the operation in its education administration. The sample size consists of 200 respondents of Akmil academicians and as many as 188 respondents are valid for analysis.

*Exogenous Latent Variable*

There are four exogenous latent variables, namely service quality (ξ1), educational leadership (ξ2), organizational culture (ξ3), and Total Quality Management (ξ4).

First, Service quality is the service provided by the Military Academy to its students. Service quality (ξ1) is measured through observation variables, namely tangible (X11), reliability (X12), responsiveness (X13), assurance (X14), and empathy (X15).

Second, Organizational culture could be measured through indicators of organizational culture (ξ2) which consist of such observation variables as organization loyalty (X21), code of conduct (X22), values (X23), ritual/tradition (X24), and cultural network (X25).

Third, Educational leadership (ξ3) is measured through the observation variables such as integrated quality vision (X31), commitment (X32), quality message (X33), leading innovation (X34), and team building (X35).

Fourth, The TQM variable (ξ4) is measured through the observation variables such as thorough quality (X41), customer satisfaction (X42), and continuous improvement (X43).

*Endogenous Latent Variables*

This organization development (η1) is measured through its measurement variables, namely competition (Y1), social tendency (Y2), organizational effectiveness (Y3), and employee welfare (Y4).

*Validity and Reliability Testing*

The result of variance extracted testing of exogenous construct indicates that the variance extracted scores of exogenous construct for all exogenous variables are high, i.e. above the cut-off value 0.50. The result of variance extracted calculation of endogenous construct of TQM is 0.601 and organization development is 0.591.

The results of construct reliability testing of exogenous variables are service quality 0.773, organizational culture 0.747 and educational leadership 0.725. Have high score, i.e. above the cut-off value 0.70. The endogenous construct of TQM is 0.852 and organization development is 0.832. Based on these results of construct reliability calculation it can be concluded that the indicators of exogenous construct used in this research are reliable.

*Stages in Structural Equation Modeling (SEM)*

According to Hair et.al. (2010:602), Augusty Ferdinand (2002:33), and Iman Ghozali (2013:8), there are seven stages performed in structural equation modeling, namely; 1) theory-based model development, 2) path diagram development, 3) measurement model specification, 4) model identification, 5) parameter estimation, 6) fit model evaluation, and 7) model interpretation and modification.

*Data Analysis Technique*

The data in this study take the form of numbers gathered using questionnaire the validity and reliability of which are tested according to the requirements of SEM usage. The data are analyzed using Amos program version 22.0. Furthermore, the research variables which have been arranged in a structural relationship is tested for its validity using the data (fit model).

Results

The causality relationship model developed in this research tests 7 hypotheses. Afterwards, the structural full model which has passed the confirmatory analysis is processed using Amos version 22.0. The results of testing of hypotheses 1 through 7 are presented in Figure 1 below.

Figure 1. presents the result of analysis using Amos version 22.0. This structural full model has Chi-Squared ($\chi 2$) at 228.194; with its probability significance of 0.078; CMIN/DF 1,147; GFI 0.905; AGFI 0.879; TLI 0.982; CFI 0.984 and RMSEA 0.028. The model has a sound goodness of fit indices. The Chi-Squared ($\chi 2$) is relatively smaller (228.194) compared to $\chi 2$ cut-off value (232.91) in (0.05; 199). The significance probability value is greater (0.076), than cut-off value ($\alpha$ = 0.05). The significance probability which is more than 0.05 has caused the Hypothesis nil (Ho) to be confirmed. Hence, it could be concluded that the sample variant and covariant matrix is the same as the population variant and covariant matrix.

In addition to fulfilling the cut-off value $\chi 2$ and significance probability, the structural full model has also satisfied the other goodness of fit indices, such as; GFI (0.905), AGFI (0.879) close to the fit model requirement (cut-off value GFI and AGFI $\geq$ 0.90). The TLI and CFI indices could be achieved as per the acceptable cut-off value. Both TLI and CFI indices produced by the full model have values of 0.982 and 0.984 respectively. The full model

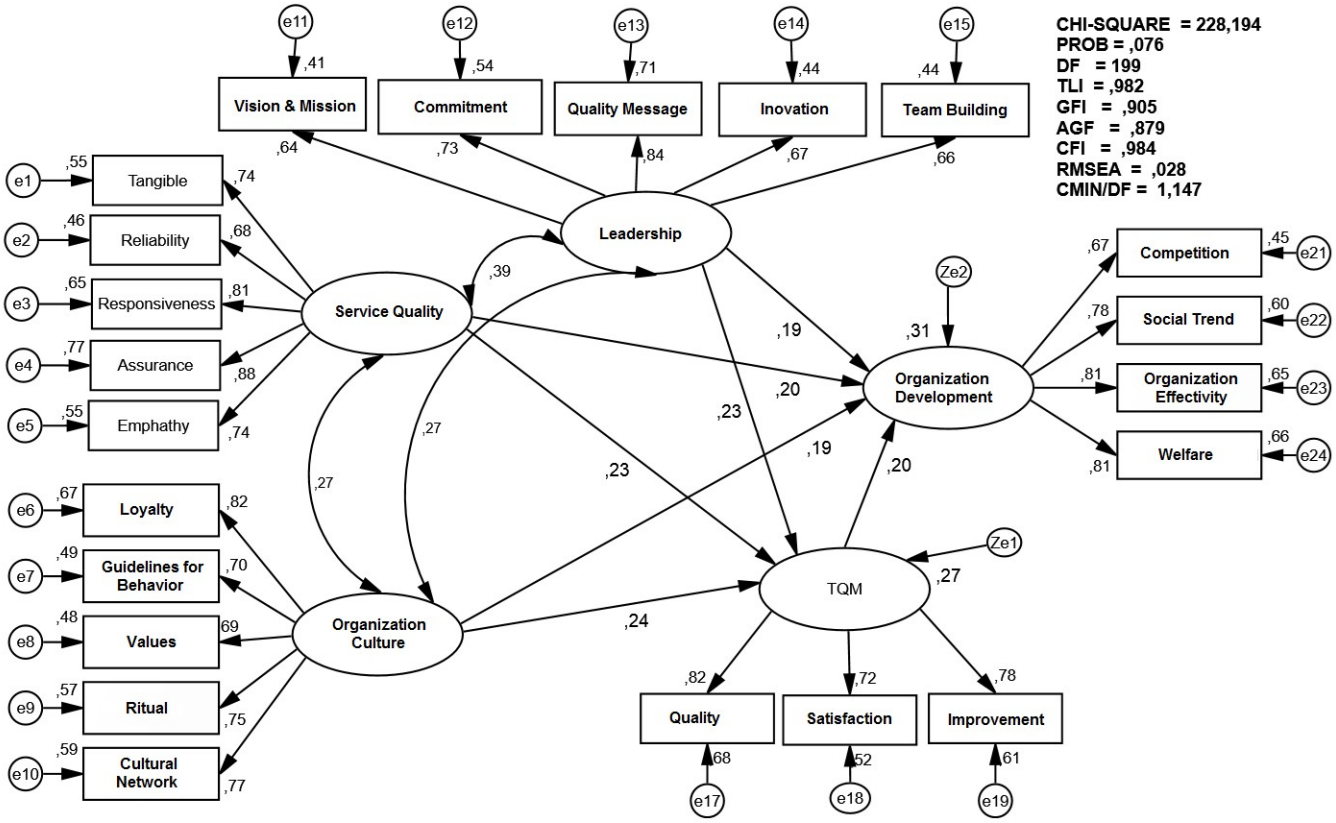


Figure 1. Structural Full Model

CMIN/DF index is 1.147 compliant with the cut-off value ≤ 2,00 requirement and the full model RMSEA is 0.028, also meeting the cut-off value ≤ 0.08 requirement. Therefore, it could be concluded that the structural full model is declared fit.

Thus, the model can be said to be fully fit. Meanwhile, the results of SEM full model regression weight are presented in Table 1. as follows.

Table 1. SEM Full Model Regression Weight

| Regression Weight | Unstd Estimate | Std Estimate | S.E. | C.R. | P |
|---|---|---|---|---|---|
| X14 ←- Service_Quality | 1.251 | .877 | .106 | 11.849 | *** |
| X12 ←- Service_Quality | .850 | .678 | .094 | 9.017 | *** |
| X11 ←- Service_Quality | 1.020 | .742 | .102 | 9.999 | *** |

| Regression Weight | Unstd Estimate | Std Estimate | S.E. | C.R. | P |
|---|---|---|---|---|---|
| Y1 ←- Organization_Development | 1.000 | .669 | | | |
| Y2 ←- Organization_Development | 1.301 | .778 | .148 | 8.795 | *** |
| Y3 ←- Organization_Development | 1.343 | .808 | .149 | 9.036 | *** |
| Y4 ←- Organization_Development | 1.278 | .811 | .135 | 9.462 | *** |
| X25 ←- Organizational_Culture | 1.000 | .766 | | | |
| X24 ←- Organizational_Culture | 1.200 | .753 | .118 | 10.162 | *** |
| X23 ←- Organizational_Culture | 1.049 | .695 | .112 | 9.340 | *** |
| X22 ←- Organizational_Culture | 1.028 | .700 | .110 | 9.364 | *** |
| X21 ←- Organizational_Culture | 1.155 | .821 | .106 | 10.941 | *** |
| X41 ←- TQM | 1.000 | .824 | | | |
| X42S ←- TQM | .243 | .718 | .026 | 9.404 | *** |
| X43 ←- TQM | 1.118 | .780 | .114 | 9.772 | *** |
| X13 ←- Service_Quality | 1.097 | .809 | .101 | 10.830 | *** |
| X15 ←- Service_Quality | 1.000 | .743 | | | |
| X31 ←- Leadership | 1.000 | .643 | | | |
| X33S ←- Leadership | .409 | .843 | .046 | 8.861 | *** |
| X32 ←- Leadership | 1.287 | .732 | .157 | 8.206 | *** |
| X34 ←- Leadership | 1.243 | .667 | .163 | 7.619 | *** |
| X35 ←- Leadership | 1.185 | .660 | .160 | 7.422 | *** |

Source: Processed Data, 2016

Based on the analysis results in Table 1. above, the data are described to form every construct. The biggest construct former of service quality at 0.877 is in the indicator of assurance. This means that the ability to provide timely service guarantee for students, the ability to give guarantee to be free from any cost during their education and the ability to provide education and the ability to provide dormitory guarantee are good and satisfy customers' expectation.

In the organizational culture, the biggest construct former is in the organization loyalty indicator. This means that all members in Akmil in terms of performing their jobs responsibly and loyally, they do so in a decisive, clear and disciplined manner which form their loyalty to the organization. When there is a violation, it should be accounted for in accordance with the applicable rules in Akmil and implemented well. The loyalty in performing the culture in Akmil has been something compulsory in the organization in Akmil.

For educational leadership, the biggest construct former is in the indicator of quality message with a loading factor at 0.840. This means the quality message has been something important in the educational leadership in Akmil in implementing the vision the want to build.

The highest construct former of TQM latent variable is thorough quality at a loading factor value of 0.824. This means that the quality in the curriculum has been standardized through some improvement by following well the development, standardized procedures.

In the organization development latent variable, the biggest construct former at 0.811 is in the indicator of welfare of all employees working in Akmil. This means that the ability to give additional welfare could be experienced by all members of Akmil. This welfare includes those facilities and leaves the employees, such as lecturers and educational staff, could obtain in Akmil.

The summary of indices on which the assessment of fit model and the results of structural full model (SEM) test are based on is presented in detail in Table 2. below.

## Discussion

The empirical model in this study consists of 7 hypotheses; each Hypothesis is referred to from various theoretical and empirical reviews. The results of data processing have tested these 7 hypotheses using Amos version 22.00 as can be seen in Table 3. below.

Table 2. Summary of Structural Model Suitability Index

| Model Suitability Index | Output Amos.22 | Cut-Off Value | Description |
|---|---|---|---|
| Chi-Squared ($\chi^2$) | 228.194 | < 248.33 | Good |
| Signifikansi Probability | 0.076 | > 0.05 | Good |
| CMIN/DF | 1.147 | ≤ 2.0 | Good |
| GFI | 0.905 | >0.90 | Good |
| AGFI | 0.879 | >0.90 | Good |
| TLI | 0.982 | >0.95 | Good |
| CFI | 0.994 | >0.95 | Good |
| RMSEA | 0.028 | ≤0.08 | Good |
| HOELTRE c-N 0.01 | 204 | >200 | Good |

Source: Processed Primary Data, 2016

Table 3. Revised Structural Full Model Regression Weight

| Regression Weight | | | Unstd Estimate | Std Estimate | S.E. | C.R. | P |
|---|---|---|---|---|---|---|---|
| TQM | <--- | Leadership | .279 | .231 | .111 | 2.515 | .012 |
| TQM | <--- | Service_Quality | .154 | .228 | .060 | 2.584 | .010 |
| TQM | <--- | Organizational_Culture | .273 | .244 | .095 | 2.878 | .004 |
| Organization_Development | <--- | Leadership | .201 | .186 | .098 | 2.047 | .041 |
| Organization_Development | <--- | Organizational_Culture | .191 | .190 | .086 | 2.218 | .027 |
| Organization_Development | <--- | Service_Quality | .120 | .198 | .053 | 2.253 | .024 |
| Organization_Development | <--- | TQM | .181 | .202 | .084 | 2.145 | .032 |

Source: Results of Data Analysis, 2016

*Influence of Service Quality on TQM*

The results of statistical testing on Hypothesis 1 indicate that the estimation parameter value of service quality on TQM is 0.228 at an error standard of parameter estimation of 0.060 and critical ratio value of 2.584 with p-value of 0.010. These values have fulfilled the Hypothesis confirmation requirement, i.e. CR > 1,96 at a significance level of 0.05. It could then be concluded that the influence of service quality on TQM is proven and significant.

The results of statistical testing on this Hypothesis indicate that the better the service quality given in the Military Academy, the better the total qual-

ity management (TQM) in the Military Academy would be. The statistical results of index calculation as have been presented in the descriptive analysis indicate that those activities which are the parameters of service quality in the Military Academy has been compliant with the SEM requirements and proven to have been good.

This research result confirms the study conducted by Munawaroh (2002:6) which indicate that service quality which include the changes towards quality in terms of: reliability, responsiveness, empathy, dan tangible, gives significant contribution to the improvement of quality and customer satisfaction. In addition, this research result confirms Stamatis's (1996:112) opinion that total quality service serves as an integrated and strategic system by involving individuals at managerial levels and using both qualitative and quantitative methods for continuous improvement which is driven for customer satisfaction, and moving towards future organization improvement and change. Additionally, this research result also supports the theory on customer satisfaction because the service the customers receive is just as they expect. The customers here are the customers of Military Academy, Magelang, i.e. all of the stakeholders Military Academy.

*Influence of Organizational Culture on TQM*

The results of statistical testing on Hypothesis 2 indicate that the estimation parameter value of organizational culture on TQM is 0.244 at an error standard of parameter estimation of 0.095 and critical ratio value of 2.878 with p-value at 0.004. Those values have met the Hypothesis confirmation requirement, i.e. CR > 1.96 at a significance level of 0.05. It could then be concluded that the influence of organizational culture on TQM is proven and significant.

The results of statistical testing on Hypothesis 2 indicate that the better the organizational culture provided in the Military Academy, Magelang, the better the TQM in the Military Academy would be. The statistical results of index calculation as have been presented in descriptive analysis indicate that those activities which are the parameters of organizational culture in Akmil have been compliant with SEM requirements and proven to have been good.

This research result confirms the research conducted by Cornesky (2003). The purpose of this book is to guide faculty in applying TQM processes and tools to instruction. Cornesky demonstrates how to implement TQM and continuously improve classroom effectiveness. The book is organized like a class syllabus, discussing the basic requirements of change, providing historical background, and using case studies to demonstrate the use

of specific quality tools. Judging from the fact that the organizational culture is implemented consistently, TQM can thus be said to have run well.

The empirical findings indicate that organizational culture is implemented consistently by members of Akmil, hence, in general, customer satisfaction could be created and as expected by Akmil's customers. In an education arena in Akmil they could unite to move forwards with a culture which has been sound, something we fundamentally need in responding to the diversity in our culture and society.

*Influence of Educational Leadership on TQM*

The results of statistical testing on Hypothesis 3 indicate that the estimation parameter value of educational leadership on TQM is 0.231 at an error standard of parameter estimation of 0.111 and critical ratio value of 2.515 with p-value at 0.012. Those values have met the Hypothesis confirmation requirement, i.e. CR > 1.96 at a significance level of 0.05. It could then be concluded that the influence educational leadership on TQM is proven and significant.

The results of statistical testing on this Hypothesis indicate that the better the educational leadership on the leaders' side of Akmil the better the TQM in the Akmil. The statistical results of index calculation in the descriptive analysis indicate that those activities which constitute the parameters of educational leadership in Akmil have been good.

*Influence Service quality on Organization Development*

The results of statistical testing on Hypothesis 4 indicate estimation parameter value service quality terhadap organization development sebesar 0,198 at an error standard of parameter estimation of 0,053 and critical ratio value of 2,253 with p-value at 0,024. Those values have met Hypothesis confirmation requirement yaitu CR > 1,96 at a significance level of 0,05 it could then be concluded that influence service quality terhadap organization development Military academy is proven and significant.

The results of statistical testing on this Hypothesis indicate that the better the service quality they give the better the organization development in Akmil. The statistical results of index calculation descriptive analysis indicate that those activities which constitute the parameters of service quality in Akmil has been compliant with SEM requirements and proven to have been good.

This research result confirms the research conducted by Sikora and Boczkowska (2012) entitled analyzing educational service and organization development. The variables used are

education service and organization development. The research finds that education service equips students with expertise qualification needed by companies. Furthermore, it is stated that service quality has causality relationship with organization development. The better the service given the better the organization development would be.

Empirically, it is found that service quality gives positive contribution to organization development. The organization development in Akmil has been a commitment along with the changes they should make in organizing military education in accordance with the national education standards. Service quality reflects the members involved in the organization who are committed to move towards organization change in line with the Akmil's objectives which are continuously developing as required by the era and globalization. The better the service given as per the standards and customer's expectation the better the organization development would be. Organization development becomes good and in line with the organization's objectives, in this case it is determined by the quality of service given and experienced by the Akmil stakeholders. Hence, the organization's objectives could be achieved according to the development expected by all members of organization.

*Influence of Organizational Culture on Organization Development*

The results of statistical testing on Hypothesis 5 indicate that the estimation parameter value of organizational culture on organization development is 0.190 at an error standard of parameter estimation of 0.086 and critical ratio value of 2.218 with p-value at 0.027. Those values have met the Hypothesis confirmation requirement, i.e. CR > 1.96 at a significance level of 0.05. It could then be concluded that the influence of organizational culture on organization development is proven and significant.

The results of statistical testing on this fifth Hypothesis indicate that the better the organizational culture the better the organization development in Akmil would be. The statistical results of index calculation as have been presented in descriptive analysis indicate that the shared norm of values which give meanings to members and making the beliefs and values a rule to behave in Akmil has been compliant with SEM requirements and proven to have been good. This research result supports and confirms the research conducted by Castiglia (2005) who finds that cultural change influences the organization commitment in universities yet it does not have any effect on job satisfaction. Furthermore, this research also confirms the study performed by Csaszar (2009) who analyzes the influence of organizational structure on

organization performance. Organization development is also related to a planned change, i.e. to mobilize individual, team, group and organization in order for them to be better.

Culture is a pattern of basic assumptions used by groups in this case Akmil. They achieve this agreement when a study group solves a problem in their effort of adapting to the environment. The organizational culture in Akmil has been adherent to the culture which is formed since long ago with its military nature at high level of discipline and ritual values upheld to be the organizational culture performed consistently by all members involved in Akmil.

In terms of organization change and development phenomenon, the members involved in an organization should understand the main objective of such organization development. It is something all members of that organization, its leaders in particular, must do. Therefore, there is a need for intensive dissemination of organization objective to all organization members be it via printed or electronic media as well as website as what Akmil has done. This is to facilitate all members, especially the leaders, in understanding the main objective of such organization development in accordance with their vision and missions. Organizational culture is all beliefs, values, life practice as a habit, norms, rites, arts and objects owned, believed, practiced and inherited from generation to generation which signify specifically a community of society and make it different from any other communities. Just like the case in Akmil where the culture existing there is based on military which causes all organization members to give contribution in the formation of organizational culture and in turn the organizational culture which have been formed gives some influence on each and every organization member in their attitude and behavior.

Such empirical findings are as stated by Robbins (2001:510) who suggests that organizational culture is "... a system of shared meaning held by members that distinguishes the organization from other organizations. This system of shared meaning is, on closer examination, a set of key characteristics that the organization values." The organizational culture in Akmil forms specific characteristics with its military nature adherent to the discipline values, causing an effect on the development and change of organization which is performed consistently.

*Influence of Educational Leadership on Organization Development*

The results of statistical testing on Hypothesis 6 indicate that the estimation parameter value of educational leadership on organization development is 0.186 at an error standard of parameter estimation of 0.098 and critical ratio value of 2.047 with p-value at

0.041. Those values have met the Hypothesis confirmation requirement, i.e. CR > 1.96 at a significance level of 0.05. It could then be concluded that the influence of educational leadership on organization development is proven and significant.

The results of statistical testing on this sixth Hypothesis indicate that the better the educational leadership the better the organization development in Akmil would be. Educational leadership is the relationship existing inside an individual or a leader in influencing others to consciously work together in a form of duty relationship to achieve the goal desired by the leader.

The statistical results of index calculation of descriptive analysis indicate that educational leadership in the effort of achieving the vision and missions constitutes something unique and fundamental which distinguishes an organization from any other organizations and identifies a scope of operation of the organization target. Educational leadership is an ability to influence and mobilize others to be willing, able and committed to follow the management desire in order to achieve the goals previously set effectively and efficiently in Akmil has been compliant with SEM requirements and proven to have been good. This finding also confirms the research by Utsman (2010) which tests the influence of organizational culture, educational leadership, government policy, innovation adoption, and service quality on organization change and development. The variables used are organizational culture, educational leadership, government regulation, innovation adoption, service quality and organization change and development. The method of research used to test the variables is Structural Equation Model (SEM) using AMOS software, the result of which suggests that five exogenous variables namely organizational culture, educational leadership, government regulation, innovation adoption, and service quality have significant influence on organization change and development. Additionally, it also confirms the research conducted by Warrick (2011) who analyzes the integration of transformational leadership with organization development.

Educational leadership is a central figure in an organization development. As a decision maker, he/she is an agent of change. It also depends on the leader's capability to be more duty-oriented if the circumstance requires so, and change it with relational orientation to deal with the resistance to change which is more personal in nature. Thus, educational leadership which has commitment to make a change and innovation will directly influence organization development continuously according to the quality message.

*Influence of TQM on Organization Development*

The results of statistical testing on Hypothesis 7 indicate that the estimation parameter value of TQM on organization development is 0.202 at an error standard of parameter estimation of 0.084 and critical ratio value of 2.145 with p-value at 0.032. Those values have met the Hypothesis confirmation requirement, i.e. CR > 1.96 at a significance level of 0.05. It could then be concluded that the influence of TQM on the organization development is proven and significant.

The results of statistical testing on this seventh Hypothesis indicate that the better the TQM the better organization development in the Military Academy would be. Assuring the quality of education will have an implication on the organization change and development and this has been compliant with SEM requirements and proven to have been good.

An organization always tries to continually improve their quality in order for the organization to be able to give high-quality service. This high-quality service will influence customer satisfaction. Customer satisfaction influences their loyalty which, in turn, will develop the organization. The TQM indicator with the biggest loading factor is thorough quality at 0.82. It means that quality has been a necessity in TQM. TQM influences organization development positively and significantly, meaning that if a change occurs to TQM, a change will also happen in the organization development to the same direction in the Military Academy.

This empirical finding confirms the research conducted by Al-Dhaafri, Hassan Saleh, Rushami Zien Bin Yusoff (2012) who analyze the special leadership competence necessary to apply TQM, check the influence of competence leadership to apply individual TQM principles and study the relationship between TQM implementation principles and TQM outputs among Thailand manufacturers at various level of leadership competence. In addition, it also confirms the results of research conducted by Alnaweigah (2013) who analyzes the role of Total Quality Management in organization change and development. The variables used are Total Quality Management and organization change and development. The research results indicate that the role that TQM plays in the change and development of organization of Taif University is highly important because there is a positive correlation between TQM and organization change and development and it significantly influence the increase in organization performance.

Furthermore, Sallis (2012) suggests TQM is a practical but strategic approach to running an organization that focuses on the needs of its customers and clients. It rejects any outcome other than excellence. TQM is not a set of slogans, but a deliberate

and systematic approach to achieving appropriate levels of quality in a consistent fashion that meet or exceed the needs and wants of customers. It can be thought of as a philosophy of continual improvement only achievable by and through people. As an approach, TQM represents a permanent shift in an institution's focus away from short-term expediency to the long-term quality improvement. Constant innovation, improvement and change are stressed, and those institutions that practice it lock into a cycle of continuous improvement.

Based on the result of SEM analysis of the empirical model, all hypotheses proposed related to organization development in Akmil are acceptable at a confidence level of 95%. The fact that the seven hypotheses are accepted confirms that organization development in Akmil is something new and should be performed by all organization members through the sound implementation of TQM.

*Conclusions*

The TQM-based organization development model built is a fit model. Service quality influences TQM, and its influence is positive and significant. It means that the better the service quality the better the TQM implementation would be. Organizational culture influences TQM. The influence of organizational culture on TQM is the most dominant influence of an exogenous variable. As to its influence, it is positive and significant. It means the better the organizational culture the better the TQM implementation would be. Educational leadership influences TQM. its influence is positive and significant. It means the better the educational leadership the better the TQM implementation would be.

The influence of service quality on organization development is 24.4%. Its influence is positive dan significant. It means the better the service quality the better the organization development would be. The good influence of service quality on organization development is contributed by the sound implementation of TQM. TQM has some contribution to organization development. If a change occurs to service quality, another change would also occur to the organization development in Akmil in the same direction. Meanwhile, the highest construct former in the organization development variable is in the welfare indicator at an estimation value of 0.82 and the smallest construct former is in competition in the organization members at 0.67.

The influence of organizational culture on organization development is 24.0%. Its influence is positive and significant. The good influence of organizational culture on organization development is contributed by the sound implementation TQM. Organization development in Akmil has been

a commitment of all organization members towards a change.

The influence of educational leadership on organization development is 22.8%. Its influence is positive dan significant. The influence of educational leadership on organization development is contributed by the sound implementation of TQM. TQM has some contribution to organization development. For educational leadership, the loyalty dimension has been the biggest construct former. It means that a leader's loyalty is important in the organization development in Akmil towards a change.

The biggest construct former in TQM is in the quality dimension at an estimation value of 0.841 and the smallest construct former is continuous improvement at 0.67. The influence of TQM variables on organization development is 20.2%. Their influence is positive and significant. It means the better the TQM implementation the better the organization development would be.

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# EVALUATION OF A BOUTIQUE CONSULTING FIRM: *DEADLY DISEASES* REPORTING TO MANAGEMENT

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Abstract

This paper delves into an analysis of a US-based boutique consulting firm through the scope of W. Edwards Deming's "*Seven Deadly Diseases*." The paper discusses five specific diseases, focusing on how they affect the firm from a business and organizational perspective. The study then attempts to provide recommendations to the underlying business and organizational issues to firm's executive leaders.

Key Words: Organizational Study, W. Edwards Deming, Leadership, Deadly Diseases

## Introduction and Firm Overview

This paper serves as an examination of "Profit Inc.," a US-based boutique consulting firm. Profit Inc. is a small boutique-sized firm, with offices in three locations across the United States. The overall employee base rests slightly above ninety people. Major lines of business for the firm are in marketing strategy, planning, and services, and marketing and sales analytic measurement.

There are four distinct teams within the company. The first two are the delivery teams (i.e. the teams that create the "product" for the client). The third team is the company's internal sales and marketing team. The fourth is the operations team – information technology, human capital assessment, firm wide operations, finance etc.

While the company attempts to portray an image of a prestigious consulting firm, engagements are sparse, and of generally low value (relative to more established and prominent consulting firms).

## Structural Issues

The absence of a coherent structure within the sales and marketing department is a primary reason for the company's lackluster client acquisition. Another notable point is the lack of cohesion and cooperation between each of the four branches. Due to little transparency, there tends to be widespread miscommunication between employees and managers, leading to petty rivalries and a weak firm structural integrity. These factors combine to give definitive proof of poor organizational performance.

## Deming's *Deadly Diseases*

Deming's *deadly diseases* apply well to the case study of Profit Inc. (1992, 1993). The first five diseases, specifically, have Profit Inc. symptoms weaved within each one. This paper explores these management diseases, Profit Inc. place within them, and potential solutions to smoothen the transition into a more functional firm in today's society.

### *Constancy of Purpose*

The first disease is lack of *constancy of purpose*. This disease is characterized by a lack of a long-term vision, with management only thinking about the next quarter's results. Deming further states that it is not enough to simply "announce intentions to improve quality" (1992, 1993). Rather, there should be a strong focus on a company vision to enhance quality in the long run.

Profit Inc. is notorious for having a strong focus on short-term projects that serve as stop gaps to help fill a revenue quota for financial meetings. Company vision changes frequently, with upper executives often holding impromptu gatherings to let everyone know of a new tag-line, go-to-market strategy, or revenue initiative.

Ultimately, however, there is no semblance of continuity as far as long-range plans. "Flavors of the week" are often used to give the appearance that the firm's leadership is thinking ahead.

Most employees, however, see through this false façade of success. This has caused internal disputes, and ultimately, higher churn among the staff. The frequency of new buzzwords and pseudo-strategies do not fool many, and this disease persists in the fabric of Profit Inc. day-to-day.

*Emphasis on Short-Term Profits*

Deming's second deadly disease is the company's focus on a short term profits (1992, 1993). Several organizations today are controlled by internal corporate financiers who change and massage figures, but do little in the way of making real changes in the production or quality. In Deming's words, the "relentless drive for paper profits has diverted attention and resources away from the job of transforming the productive base" (1992).

Profit Inc. fits this description to a tee. Despite claiming to be a leading partner with Fortune 100 organizations, the "partnerships" tend to be short, one-off engagements. This often results in a company using Profit Inc. for brief, two month stints, and not returning for more services.

The short duration of several contracts leads to a boost in profit in the very short term. The intense focus on these short term contracts also has the indirect consequence of mass layoffs.

Because the company is only able to keep its financial statements afloat based on temporary contracting, employees are scaled back depending on the number of new contracts acquired.

When Profit Inc. is unable to sign on a quota of new short-term deals, it lays off several employees to adjust overall short-term profits. Although this strategy does technically work (short term profits do appear to be higher when there are fewer employees to pay), it is by no means an effective method to stay profitable in the long run. Finally, the focus on short-term profit leads to disillusionment with the firm's future, pushing existing employees to leave the company.

*Management by Fear*

Frequent performance evaluations, or management by fear, as Deming calls it, is the third ingrained disease in Profit Inc. organization (1992, 1993). Ivanov (2011, 2012, 2013, 2014, 2015) describes and calls such paradigm *feararchy*.

There are several reasons why this disease is detrimental to a business.

Perhaps the primary effect is that it encourages short-term employee performance over longer term planning and strategy.

As stated earlier, this is a major issue with Profit Inc. focus. As several existing and former Profit Inc. employees can attest, the company is notorious for frequent performance evaluations.

This policy is in place to ensure employees are living up to the high standard and workload given on a day to day basis. Despite engagements being short and low value, work intensity is still remarkably high. This is primarily a means of Profit Inc. to market

their services. By promising a comprehensive service bundle in a short period of time and at a competitive price, certain firms choose to sign the contract. Unfortunately, this results in overworked employees and deliverables lacking in value.

Given the firm's relative understaffing because of layoffs and employees' quitting, and large scoped projects, expectations for employees are high to meet high demands. There is a monthly performance review that rates employees on a scale of 1-5 across several objectives.

These merit ratings clearly benefit some – given the few number of promotion slots available, certain employees thrive in this competitive atmosphere. A much larger contingent of employees, however, does not benefit from this practice.

These employees become disgruntled, feel inadequate, and begin to engage in work practices that do not ultimately benefit the organization.

When employees receive negative feedback in their review cycle, several begin to try emulating and copying work practices of the more "successful" employees – i.e. employees who received positive reviews. This leads to incongruence in their personality and work practice, leading to more inefficiency in their work practices. This ultimately has a net negative effect and downward spiral in their performance. More employees are then laid off as a result, and Profit Inc. hits further stagnation and understaffing.

*Management Mobility*

The core of a company's long term strategy is effective management who stays with the firm for an extended period of time. Had Steve Jobs planned to leave Apple in two or three months, the iPod, iMac, or iPhone would have never been fully realized.

Managers need to stay in the company to institute proper long term change that has a coherent and sustainable vision. Profit Inc. unofficial motto among employees is "get in, earn a little, and get out."

This mentality also extends to upper echelons of management. This wasn't necessarily because managers came in with this mentality. Rather, the polarizing culture (young and inexperienced employees, fairly cliquey, independently competitive, etc.), lack of firm unity, and subpar compensation eventually convince most managers to look for work elsewhere.

Furthermore, the vast majority of leadership is hired externally, often from other industries (although within the consulting/professional services capacity). The values and vision between them and existing leadership is often in conflict with one another, leading to flimsy long-term planning and vision. It is evident that many core illnesses need to be fixed, including upper management mobility.

*Running Company on Figures Alone*

The final applicable disease that Deming discusses is running a company purely on visible figures (1992, 1993).

Profit Inc. has a biweekly meeting within each department, and a firm-wide meeting every month to discuss overall sales revenue and projects in the pipeline. Everything is discussed purely from a client revenue point, and how the firm's numbers are.

The firm bases its entire reality and existence around how much cash flow is coming in, and where the leaks are. Profit Inc. pays little attention to conducting discussions on measuring employee satisfaction, client satisfaction, and employee and client retention.

If these aspects of the firm are improved upon, client revenue would begin to generate. The executives of the firm have a vision too narrow to fully realize this. This clearly leaves strong distaste among many at the firm, leading to more disillusionment among employees.

## Conclusion and Recommendations

There are steps that Profit Inc. can implement to improve their current position. It is vital that the current leaders take a hard look at the direction the firm is going, and come up with a structured, applicable, and attainable firm vision and strategy.

It is even more imperative that the firm sticks with the vision, even when the client revenue begins to dry up. If messages keep switching, the marketplace sees the firm as being unsure of their position. Employees too, begin to see the chinks in the firm's armor and what its future holds. An emphasis should be placed on long term goals versus trying to hit monthly financial figures.

Having a focus on short term profits distracts from the longer term vision, and is often incongruent with a longer term strategy. Performance evaluations need to be far less cut-throat, and employees should all be made feel they belong.

Discussions should be conducted to see what the most effective work method is for each employee, and they should be able to thrive on that (instead of fearing being let go, or having to compete with other employees).

Additionally, the firm should have a more rigorous application process, especially for upper management. It is necessary to have executives who are willing to work well with others to achieve a proper long term growth strategy. If managers aren't included (or if they come in with the mentality that they would leave soon), no vision-focused productivity would ensue.

Finally, it is important for the firm to measure its success on more than sales revenue. By understanding sources of client and employee satisfaction, engagements would be renewed, and good employees would stay.

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# CITTASLOW: A NEW PATTERN OF SUSTAINABLE TOURISM DEVELOPMENT IN TAIWAN

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Abstract

As of Oct. 2016, 30 countries and 222 cities around the world have become Cittaslow countries and cities, respectively. By contrast, Taiwan has only four Cittaslow townships. This shows that compared to other countries, Taiwan's Cittaslow development remains to be improved. Cittaslow is a new method for Taiwan to develop sustainable tourism. This study investigated the connection between the Cittaslow philosophy and sustainable tourism development as well as explored Taiwan's current Cittaslow situations. The goals of the Cittaslow movement are to encourage cities and towns to achieve sustainable tourism development by using their history, natural resources, so-

cial and cultural values, and tourism characteristics and to assist renowned quiet towns in sustainable development. The objective of this study was to provide information on how to systematically and rapidly implement sustainable tourism development in towns that wish to become Cittaslow towns, investigate factors that hindered them from obtaining Cittaslow certification, and evaluate the suitability of selected Taiwanese townships as Cittaslow candidates. This study chose Taiwanese townships with a population of 50, 000 or less and proposed new candidate townships (i. e. Pingxi, Baihe, and Taimali) to ensure a balanced regional development. The goal was to facilitate a harmonious coexistence between humans and nature by promoting Cittaslow development.

*Keywords*: Cittaslow, sustainable development, sustainable tourism, development (STD)

## Introduction

This study investigated Taiwan's current conditions in sustainable tourism development (STD) as well as its STD prospects by using Cittaslow's concept of sustainable development. According to Our Common Future, a report released by the World Commission on Environment and Development in 1987, sustainable development is defined as "… meeting the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987). Similarly, the book Caring for the Earth defined sustainable development as "improving the quality of human life while living within the carrying capacity of supporting eco-systems" (Gland, Switzerland, 1991). Currently, there are organizations such as Cittaslow that work to ensure and maintain the sustainable existence of historic buildings, natural resources, social and cultural values. Although Cittaslow's concept of sustainable development was not derived from that advocated by the tourism industry, the two are closely related. Accordingly, this study proposed the following objectives: (a) build assessment indicators for selecting Taiwanese cities with STD potential; (b) assign weights to the assessment indicators described in (a); and (c) systematically and rapidly increase the number of Cittaslow towns around the world to achieve the goal of sustainable environmental development.

*Sustainable Development and The Tourism Sector*

The goals of STD are to prevent frictions and confrontations arising from complex interactions between tourists, environments, and dining activities when tourists engage in group travel (Bramwell, & Lane, 1993). Tourism resources are divided into natural and man-made tourism resources; when developing man-made tourism resources, developers should consider the sustainable coexistence between humans and animals (Ayas, 2007). In 1995, the World Conference on Sustainable Tourism put forward the Charter for Sustainable Tourism, which emphasized the following: propose effective tourism management strategies, train local talents to develop the tourism industry, improve the financial situation of residents, promote sustainable environmental development and ecological conservation, and establish effective private–public cooperation mechanisms (The Global Development Research Center, 1995). At the United Nations (UN) Conference on Sustainable Development, global leaders reached a consensus that a well-designed and well-managed tourism industry has the advantages of promoting sustainable development, creating job opportunities, and facilitating trade. Therefore, in 2016, the UN General Assembly approved a new sustainable development agenda for 2030, set new sustainable development goals (SDGs), and declared 2017 as the International Year of Sustainable Tourism for Development, in which the tourism industry was categorized as one of the three sustainable development goals (UNWTO, 2015).

*Forms of Slowness and the Cittaslow Philosophy*

"Slowness" is the core concept of slow food, Cittaslow, and slow travel. Heitmann, Robinson, and Povey (2011) indicated that these three concepts are related to the sustainable development of the tourism industry. They explained that the Cittaslow movement is based on the concept of slow food, and that this concept is developed further by extending to cities and the field of tourism. In recent years, slow travel and slow food movement have become related concepts (Petrini, 2001; Ritzer, 1996; Dickinson, Lumsdon, &Robbins, 2011). The slow food movement was started by Italian writer Carlo Petrini in 1989 to boycott fast food restaurant chain McDonald's. Nilsson, Svärd, Widarsson, and Wirell (2007) believed that this movement attained its objectives through the Cittaslow philosophy

(Dickinson et al. , 2011). One of the major objectives of Cittaslow is to promote the notion of slow food to local communities and government departments to realize the goal of ecogastronomy in people's daily lives. Heitmann et al. (2011) asserted that the principle of slow food and the Cittaslow movement are ways to encourage people to change their status quos and reevaluate the changes that have occurred in the modern society. Peters (2006) noted that people should pay attention to the applicability of various factors to slow travel. For example, people should do things at the right speed; in addition, they should change their attitude concerning the use of time, that is, they should pursue quality over quantity (Dickinson et al., 2011).

Lumsdon and McGrath (2011) defined "slow travel" as a slow, short-distance travel where the goal is to enrich the journey experience by enjoying the journey and the destination themselves. Honoré (2004) commented that tourists should follow the following slow travel principles during their trip: enjoy the trip as a part of the holiday, learn about the local culture of the travel destination, relax, and minimize the negative impact created on local residents and the environment (Lumsdon, & McGrath, 2011). Nilsson et al. (2007) pointed out that slow food and the Cittaslow movement is not related to tourism or destination sales because they do not directly target the tourism industry (Heitmann et al. 2011). However, they influence local tourism in two ways: first, they influence the development of the travel destinations; and second, the brand "slow" builds favorable quality and reputation. Heitmann et al. (2011) remarked that the slow travel industry and Cittaslow can use the unique characteristics of "slow" to draw tourists and induce high-quality tourism development.

## Material and Method

### *General Research Framework*

In Table 1, all major structures used the 26 requirements directly related to STD, verifying the direct effect of the Cittaslow concept on sustainable development. When considering the six major standards, Heitmannet al. (2011) considered all planning-related key dimensions including environment, economy, and community, and asserted that by combining the entire requirement sunder a common principle; one can help realize the vision of sustainable tourism. On the basis of the requirements recommended by Cittaslow (Table 1), this study selected

candidate townships by considering their history, natural resources, social and cultural characteristics, and fundamental tourism dimensions. However, because the present study did not completely follow the classification standards used in Cittaslow certification, the standards used in this study can be viewed as a simplified version of Cittaslow certification.

*Evaluation Models and Weights Used*

This study adopted a semi- structured interview method; onsite interviews, questionnaire surveys, and telephone interviews were performed, in which local government agency representatives were asked to answer 26 questions categorized under six major dimensions (Table 1). Next, the results were generated using linear scale transformation. Linear scale transformation was defined as dividing the result obtained under a confirmed criterion by the maximum value.

The criterion for benefit j is as follows:

$$r_{ij} = \frac{X_{ij}}{X_j^*}, \qquad X_j^* = \max_i X_{ij},$$

Clearly, the result of $r_{ij}$ approaching 1 is desired for optimal results. Regarding normalization, it has the advantage of enabling all of the results to be converted to a linear scale so that they can be ranked by their importance.

Anderson (1981) and Shanteau (1970) maintained that when making decisions by using uncertain information, the weights of the parameters can be used to identify the reliability and likelihood of the information. However, other factors that influence the weights also exist. Anderson (1981) stated that weights can be used to determine the importance of attributes in a hypothetical range. Kahneman and Tversky (1979) mentioned that the weight of a decision indicates the possibility of choice, that is, the subjective probability of a preference. The weight of a decision shows not only the perceived possibility of an event, but also the measurement of the effect of possibility on an event. Therefore, this study used the weights of decisions to examine the study scope shown in Table 1. In addition, the present study adopted the perspective of urban tourism managers to assess townships' current STD conditions to determine their Cittaslow potential. The results are shown in Table 2.

Table 1. Primary requirements for Cittaslow membership in terms of STD.

| Major subject | Requirement |
|---|---|
| I- Environmental policies | 1. Verification of the quality of air, water, and soil under the parameters established by law<br>2. Existing purification facilities for urban or collective sewage<br>3. Preparation of projects that stimulate the collection of urban and private wastes by decomposing them<br>4. Encouraging the recycling/safe disposal of industrial waste and the composting of household waste<br>5. Preparation of a municipal plan for saving energy,with particular reference to the use of alternative hydrogen, mini-hydroelectric power plant),sources of energy (renewable resources, green hydrogen, mini-hydroelectric power plant)<br>6. Banning the use of Genetically Modified Organisms (GMO) in agriculture<br>7. Establishing systems for controlling and reducing electromagnetic, noise, and light pollution<br>8. Adoption of environmental management systems (EMAS and ECOLABEL or ISO 9001; ISO 14000, A 8000 etc.) |
| II- Safeguarding autochthonous production | 1. Promoting organic and/or locally planted products<br>2. Determining local products and supporting them for their commercial value e.g. alloting them spaces in the bazaars<br>3. Preserving and encouraging cultural traditions<br>4. Preparing relevant planning and certification programmes for saving tradesmen, craftsmen, and working methods/products which are in danger of dying out |
| III- Infrastructural | 1. Preparation of plans for developing and improving historic centres and/or works of cultural and historic value<br>2. Making plans for safe transportation and traffic<br>3. Promotion of programmes to facilitate family life and local activities<br>4. Applying programmes for redevelopment and improvement of urban life<br>5. Preparation of plans for the distribution of merchandise and the construction of commercial centres for natural |
| IV- Technologies and facilities for urban quality | 1. Providing wastebins consistent with environmental requirements and removal of rubbish in accordance with an announced timetable<br>2. Arranging programmes and promotional activities for planting environmentally suitable plants,preferably local ones<br>3. Making plans to brighten up the urban landscape e.g. flowers in house, window boxes, and gardens;hanging baskets and green spaces in public places;and clean, fresh paintwork on buildings |
| V- Hospitality | 1. Carrying out training courses on the provision of tourist information and quality hospitality<br>2. Using international signs on signboards at historic places<br>3. Arranging the 'slow' routes of the city |
| VI- Awareness | 1. Informing people about the aims and procedures of Cittaslow and how to become such a city<br>2. Preparation of programmes to attract social interest in acquiring the 'slow' philosophy, and the application of Cittaslow projects such as educational gardens,parks, and libraries<br>3. Preparation of training programmes in schools on taste and nutrition in collaboration with the Slow Food Initiative |

Sources: Heitmann et al. (2011); Köstem (2013).

Table 2. Scores for Current, Potential Candidate, and Unsuitable Candidate Cittaslows in Taiwan in terms of Cittaslow Requirements Jan 2016.

| Group | City | Equal weights |
|---|---|---|
| A | Nanzhuang | 0.66 |
| | Sanyi | 0.67 |
| | Dalin | 0.93 |
| | Fenglin | 0.72 |
| B | Pingxi | 0.64 |
| | Tianwei | 0.62 |
| | Baihe | 0.62 |
| | Taimali | 0.64 |
| C | Nangan | 0.61 |
| | Jiji | 0.58 |
| | Sandimen | 0.51 |
| | Shoufeng | 0.52 |

## Results and Discussion

This study selected Taiwanese townships with a population of 50, 000 or less which also feature historic buildings, natural resources, social and cultural values, and tourism potential. The townships were divided into Categories A, B, and C, signifying townships that had already been certified by the International Cittaslow Association (ICA), townships with the potential of passing the association's certification, and townships that may not pass the association's certification, respectively.

To ensure a balanced regional development, Taiwan was divided into eastern, western, southern, and northern Taiwan. Descriptive statistics were subsequently performed by using SPSS 22. 0 to divide the selected townships into the three categories. The results are as follows: Category A: Nanzhuang, Sanyi, Dalin, and Fenglin; Category B: Pingxi, Tianwei, Baihe, and Taimali; and Category C: Nangan, Jiji, Sandimen, and Shoufeng (Figure 1).

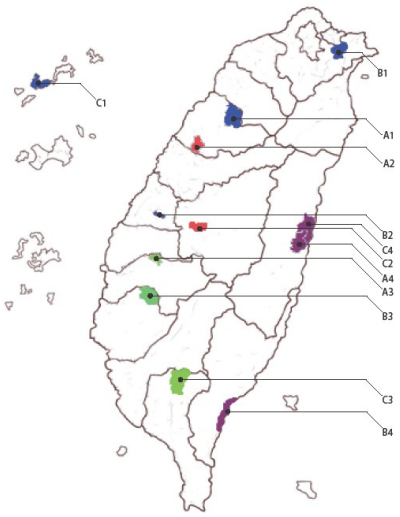


Figure 1. Taiwan Cittaslow: A, B, C city distribution map.

This study calculated the indices by considering the descriptive analysis scores, the questions, and the index results generated by the subclass weights shown in Table 2. The robustness analysis showed that question ranking did not change when the subclass combinations or post questions were manipulated and weighted. In addition, this study used radar graphs to show the relationships between the subclass combinations or post questions. Therefore, the weights of the subclasses shown in Table 2 could be traced back in Figures 2–4.

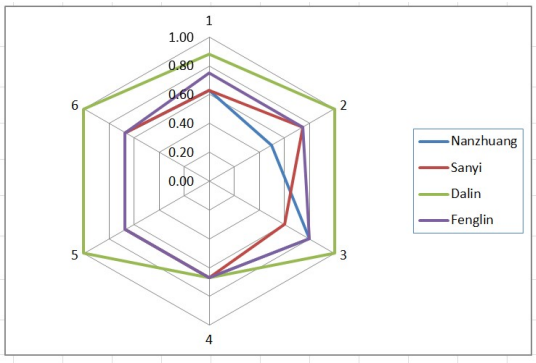


Figure 2. Radar graph of indices for current Cittaslows in Taiwan (Group A).

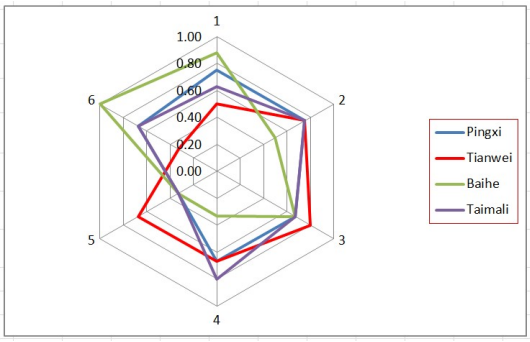


Figure 3. Radar graph of indices for potential Cittaslow candidates in Taiwan (Group B).

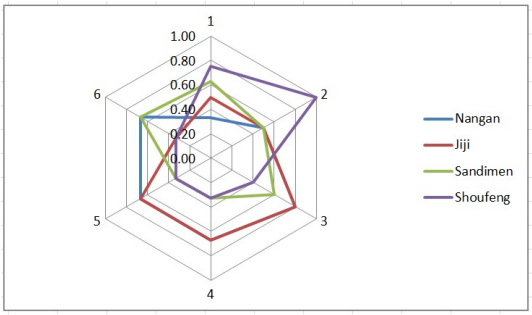


Figure 4. Radar graph of indices for cities unsuited to be Cittaslow candidates in Taiwan (Group C).

Townships from Categories A, B, and C were analyzed using descriptive statistics, and the results are as follows:

(1) Townships in Category A: All townships in this category had been certified by the ICA. Fenglin and Dalin outscored Nanzhuang and Sanyi in all six indices, a result that matched those obtained from the Cittaslow certifications. Historically speaking, Fenglin is the first township in Taiwan to receive the Cittaslow certification. Because of the collaborations between Fenglin's local residents and government, the township had received the Local Economy Award from the ICA. This showed that the township is markedly familiar with the Cittaslow concept and Cittaslow's method of operations. Dalin received the highest certification score (i. e. , 79. 71) because it has many local volunteers who manage the communities, possess academic resources such as National Chung Cheng University and Nanhua University, and has health care resources such as the Dalin Tzu Chi Hospital. These advan-

tages facilitated Dalin's diverse community developments. With respect to Sanyi, it considered "maintaining local production" its most satisfactory dimension and "formulation of environmental policies" and "infrastructure policies" two of its poorer dimensions. By contrast, Nanzhuang considered "infrastructure policies" its most satisfactory policy and "maintaining local production" one of its poorer dimensions.

(2) Townships in Category B: Townships in this category failed to meet some of the criteria required to become Cittaslow townships. However, they possess natural resources, social and cultural characteristics, and tourism capacity that make them potential Cittaslow township candidates. Of all the townships in this category, Taimali scored the highest, followed by Pingxi, Tianwei, and Baihe. Taimali considered "resident hospitality" its most satisfactory dimension and "building of technological and high-quality urban facilities" one of its poorer dimensions. Taimali has natural hot spring resources, several indigenous people reserves that remain undisturbed, and rich natural landscapes retaining their original features, making it a hot spring area with great development potential.

(3) Townships in Category C: Data analysis showed that to transform into Cittaslow townships, the townships in this category will have to spend a considerable human, material, and financial resources. Compared with townships in Categories A and B, the local governments in Category C must achieve stronger consensus with the local residents, properly plan the township environments, and search for more infrastructural resources. This result matched actual local development situations.

Table 3 shows additional data obtained from further investigations; such data included length of bicycle lanes, traffic and poverty conditions, local software and hardware facilities, and residents' living environment quality and welfare level. In addition, potential obstacles preventing the townships from becoming Cittaslow townships were identified and the suitability of selected townships as Cittaslow candidates was assessed.

a. Includes government-certified and noncertified B&Bs
b. Includes star/non-star and boutique hotels etc.
c. Includes permanent and/or temporary markets.

Table 3: Additional information on current, potential candidate, and unsuitable candidate Cittaslows in Taiwan July 2016.

| Subject | A | | | | B | | | | C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nanzhuang | Sanyi | Dalin | Fenglin | Pingxi | Tianwei | Baihe | Taimali | Nangan | Jiji | Sandimen | Shoufeng |
| **1.General information** | | | | | | | | | | | | |
| Length of roads(km) | 51.17 | 30.82 | 16.16 | 110.92 | 82.24 | 43.72 | 37.1 | 178 | 11 | 11.74 | 68.88 | 110.92 |
| Length of bicycle lanes(km) | 5.4 | 5.8 | 8 | 12.5 | 21 | 9 | 10.5 | 6.7 | 0.8 | 4.5 | 13 | 26 |
| BL/R ratio (%) | 10.6 | 18.8 | 49.5 | 11.3 | 25.5 | 20.6 | 28.3 | 3.8 | 7.3 | 38.3 | 18.9 | 23.4 |
| Trafficconditions | Congested during weekends and holidays | Congested during weekends and holidays | NO | NO | Congested during weekends and holidays | Congested during weekends and holidays | NO | NO | NO | Congested during weekends and holidays | NO | NO |
| **2.Accommodatio facilities** | | | | | | | | | | | | |
| Number of B&Bs (a) | 60 | 34 | 1 | 22 | 4 | 5 | 26 | 4 | 8 | 19 | 2 | 91 |
| Number of hotels certified by the city and county governments (b) | 0 | 2 | 5 | 2 | 1 | 0 | 22 | 12 | 1 | 6 | 3 | 5 |
| Total number of hotels | 60 | 36 | 6 | 24 | 5 | 5 | 48 | 16 | 9 | 25 | 5 | 96 |
| **3.Poverty situation** | | | | | | | | | | | | |
| Number of low- and middle-income residents | 127 | 80 | 503 | 136 | 62 | 1065 | 566 | 328 | 77 | 375 | 318 | 166 |
| Total number of residents | 10577 | 17020 | 31697 | 11115 | 4874 | 27567 | 29271 | 11374 | 7409 | 11229 | 7701 | 18195 |
| LMIR/TR ratio(%) | 1.2 | 0.47 | 1.58 | 1.22 | 1.27 | 3.86 | 1.93 | 2.88 | 1.03 | 3.33 | 4.12 | 0.91 |
| **4.Market structure** | | | | | | | | | | | | |
| Are there specialty stores that sell local products(yes/no)(c) | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Number of specialty stores that sell local products | 73 | 16 | 8 | 5 | 2 | 44 | 4 | 10 | 7 | 10 | 3 | 2 |
| **5.Protection and promotion of local cultural activities and values** | | | | | | | | | | | | |
| How is the traditional local culture protected? | The Saisiyat people's Pas-ta' ai Ritual | The Sanyi Wood Sculpture Art Festival | The Cultural and Creative Industry Development Project for A Rice and Orchid Town | The Hakka Cultural Festival | The Pingxi Lantern Festival | The Tianwei Handicraft Cultural and Creative Market | The Baihe Lotus Flower Festival | The Bunun people's Malahodaigia n Ritual | The Mazu's Ascension to Heaven Festival | The Jiji Farmers' Market | The cultural life experience camp for Indigenous youth hunters and the Sandimen Indigenous Museum | Cultural events such as the Amis people's Mirecuk and the Harvest Festival, and the Sho-fong Indigenous Museum |

Residents' quality of life and welfare can be best represented by the length of bicycle lanes to length of roads ratio (hereafter referred to as "BL/R ratio") because such a ratio indicates the distance that people can move leisurely in a township. Of all the townships examined in this study, Dalin had the highest BL/R ratio, validating its position as the number one Cittaslow town in Taiwan. By contrast, Taimali had the lowest BL/R ratio, which was likely caused by the greater attention that Taiwan paid to developing its western regions than its eastern regions. However, Shoufeng, which is located in eastern Taiwan, has seen developments by large corporate tourism groups; thus, its BL/R ratio was 23.4, relatively higher than that of Taimali . This shows that the degree of local development has an undeniable effect on a region's tourism environment and its local residents' quality of life. With respect to traffic conditions, Nanzhuang and Sanyiof Category A, Pingxi and Tianweiof Category B, and Jiji of Category C all showed traffic congestions during weekends and holidays; however, the traffic is determined by the number of tourists that came during peak seasons.

Nanzhuang offered the most accommodations, whereas Pingxi, Tianwei, and Sandimen provided the least accommodations; a township's accommodation capacity is directly proportional to its population size and tourism capacity. Among all the candidate townships, Baihe has the second most number of B&Bs. This is because its administrative regions contain hot spring scenic areas, which showed the paramount importance that natural resources are to tourism development.

A region's current economic development can be best represented by ratio of number of low- and middle-income residents to the total number of residents(hereafter referred to as "LMIR/TR ratio"). Cittaslow's sustainable development concept posits that when a region is unable to support its local residents' economic development and maintain their quality of life, population migration and population aging will inevitably occur. The present study showed that townships in Category A (i.e., Cittaslow townships) have an LMIR/TR ratio lower than those of townships in Categories B and C. This showed that Cittaslow accreditation has a positive effect on the local economy of townships and their residents' quality of life.

A comparison between the market structures of the three township categories showed that on average, townships in Category A have more specialty stores that feature local products than those in Categories B and C do. However, townships in Categories B and C have invented their own specialty cuisines according to local agricultural products available. This indicated that both potential and unsuitable Cittaslow candidates in Taiwan were aware of the importance of protecting the sustainability of local products and culture, coinciding with the Cittaslow philosophy.

## Conclusion and suggestions

Sustainable tourism means the integration of the tourism industry with sustainable development, which is applicable to all regions that wish to adopt long-term tourism development methods that ensure harmonious coexistence between humans, natural resources, and social and cultural environments. The UNdeclared 2017 as the International Year of Sustainable Tourism for Development. Cittaslowhas been believed to be able to prevent or delay the negative effects of modernization on society. The Cittaslow concept is directly related to the sustainable development of a local environ-

ment because it focuses on preserving the local residents' history, natural environment, social and cultural values, and economic development. Thus, townships that wish to adopt and implement such a philosophy can facilitate STD.

One of the objectives of this study was to balance regional development by examining various regions and recommending appropriate Cittaslow dimensions. On the basis of such recommendations, sustainable tourism and environmental developments can be realized. This study identified a number of Cittaslow candidates including Pingxi (northern Taiwan), Baihe (southern Taiwan), and Taimali(eastern Taiwan). With appropriate assistance, these townships would be able to realize the Cittaslow concept and facilitate sustainable tourism and environmental developments.

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