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THE STUDY OF EMPLOYEE'S JOB STRESS, HAPPINESS AND JOB PERFORMANCE - TAIWAN CONSTRUCTION INDUSTRY COMPANY FOR EXAMPLE

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Abstract

In recent years, Taiwan industry have been experiencing the impact of slow economy due to poor economic performance, but the number of construction industry companies actually increased in the period and result in price war within the industry and more pressure for workers of the industry. We searched studies related to construction industry in Taiwan, and no study have discussed how to improve job performance through the reduction of job stress and finding ways to relieve job stress. Therefore, we try to regard happiness as a variable that can relieve job stress and improve job performance, and discuss if construction industry companies are able to enhance employee's performance by improving their happiness. Through the feedback of 252 respondents, we found that job stress can impact on the job performance of respondents if only the impact made by job stress is considered. If happiness is added as a variable, the negative impact of job stress on job performance will be reduced significantly. As a result, the strong relationship between happiness and the relief of job stress and the improvement of job performance is proven. The study also make recommendations based on the result.

Keywords: Construction Industry Company, Job Stress, Happiness, Job Performance

Introduction

In recent years, slow economic growth in Taiwan have resulted in the recession of domestic real estate market and the tightening of loans to the construction industry. But with the quantity of public and private construction projects keeps shrinking, the number of construction industry companies keep increasing against the trend, and the business crisis and competition pressure is therefore prevalent in the industry. The survey of Grade A, B, C Comprehensive Construction Enterprises, Specialized Construction Enterprises and Civil Engineering Contractors in Taiwan (2015, Construction and Planning Agency Ministry of the Interior) collected 2,456 samples and shows that as of the end of 2015, there are 14,935 Comprehensive Construction Enterprises, Specialized Construction Enterprises and Civil Engineering Contractors in Taiwan, increased 114 enterprises compared to the end of 2014. The price war within the industry made it hard to win the bid and affected the overall revenue of the industry. The survey of the Construction and Planning Agency shows that the annual revenue of the construction industry was 571.689 billion NTD in 2015, and decreased almost 16.2 billion NTD from 2014. The challenge of the industry is in accordance with the statistical results of the survey of the Construction and Planning Agency, construction business owner recognize two urgent challenges that need to be solved are industry competition and labor issues. As for the labor issues, the stereotypes of construction works are heavy, torturous and labor-intensive works, and the lack of domestic labors made it dependent on foreign labors. Even employees (technical specialist, supervisors and managers) are taking heavy job stress from overall economic downturn and price war.

Yerkes & Dodson (1980) argued that the relationship between stress and performance is inverted-U-shaped, that means job stress and job performance spontaneously while job stress under a contain boundary, but when job stress exceeds that boundary, job performance will decrease as job stress increases. It shows that moderate stress can help an individual keep vitality and productivity, but excessive stress will cause physical and mental fatigue and diseases. A Yeh & Yu (2009) study that focused on job stress and turnover rate showed that if job stress and loading exceeded the level that a new employee can afford, the new employee will feel very stressed and frustrated, and result in the motivation and action on leaving the job. Chang, Lin, Wang, Jao, Wu and Liang (2010) found out that if stress cannot be relieved promptly, it will result in physical and mental fatigue, more job dissatisfaction and more intention to leave the job. Because job performance is highly relevant with job stress, it is essential to think about how to relieve job stress of employees and improve the physical and mental condition of employees. Moreover, according to the definition of individual health (WHO, 1948): Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. Therefore, well-being is related to living environment, social stress and mental traits of an individual. Social scientists argue that the state of well-being come from the positive and subjective feelings of individuals and lacks of external and objective evaluation criteria, and external criteria cannot really reflect the well-being of people. In general, concepts related to well-being include happiness, subjective well-being, well-being, physical well-

being and life satisfaction (Lin, 2004). Among them, life satisfaction and psychological well-being are indeed helpful to reduce stress. Therefore, the enhancement of well-being of employees is likely to enhance job performance as well.

In this study, we do not discuss the impact of government policy and macroeconomics on construction industry, and focus on job performance of employees. We aim to enhance the job performance of construction industry employees through the understanding of the feeling of job stress of them, and put the variable "happiness" into our model to study if it is able to enhance their job performance.

Literature Review

Job Stress

Michie (2002) argued that stress result from the interaction between individual and organization environment. When an individual is under uncertain, uncontrollable, threatening or unknown environment, and the stress exceed the level that he/she can afford, negative physical and mental reactions may appear. And job stress is stress reactions resulted from work-related events.

The scope and object of stress related study are very extensive. Generally speaking, we can classify stress into job stress and non-job stress. Job stress (occupational stress) put the concept of stress more specifically in the working environment and workers, and focus on the discussion of job-related factors. Job stress of employees must be taken seriously in order to enhance business performance, protect individual health or ensure system safety, and various studies with regard to job stress of all levels of employees and stress management are published as a result.

Although previous studies have various arguments of stress, relevant studies are essentially discussing the interaction between external stimuli, stress reaction and personal characteristics. In this study, we define job stress as "In a working place, an individual affected by the requirements, threats, restrictions and opportunities of the working environment, generate subjective perception with the influence of personal characteristics or mental process, and after comparing the subjective perception with personal ability (and expectation), inequality occurred (may be higher or lower) and the state of physical, mental and behavioral stableness of an individual is spoiled, resulted in instability".

Happiness

Among China philosophy, Confucianism emphasizes consider others in one's own place, and it illustrates that the realization of morality is highly consistent with individual happiness, and harmonious interpersonal relationship is equal to well-being. The collective social orientation of Chinese people is strong, that means the source of happiness may not only include satisfaction and pleasure in the self-level but also harmonious interpersonal relationship in the social level (Lu, 1998). Wu (2005) pointed out that the definitions of happiness from Confucianism, Buddhism and Taoism all include the same concept "harmony". Yen (1998) discovered that in Chinese philosophy, happiness from spiritual satisfaction is more valuable than those from material well-being.

As for happiness related theories in the West, Need Theory argues that happiness come from the satisfaction of in-

dividual demands, and the individual can only feel happy upon the satisfaction of his demand; on the contrary, if an individual feel unhappy, that means his/her demand fail to be satisfied for long. Related theories emphasized that happiness mainly come from the satisfaction of individual demand, such as Maslow's Hierarchy of Needs, seven hierarchy of needs are relevant to happiness indicators.

Trait theory argues that personalities is the most strong and consistent indicator to predict happiness, because different personalities will affect how individuals regard things and further trigger different corresponding actions, handle things differently and experience different levels of happiness. This is a top-down mode of thinking. The theory explain the origin of happiness from individual cognition and personal characteristics, and regard happiness as a stable trait. From the perspective of personal characteristics, happiness is dependent on how an individual regard to the external environment, and individuals with different personalities will react differently to the external environment. Therefore, some people are much happier than others. Study of DeNeve and Cooper (1998) and Lu (1998) found that extroversion personality is positively correlated with happiness, while neurotic personality is negatively correlated with happiness.

Job Performance

Job performance refers to "the behavior an individual acts as a member of the organization to fulfill the expectation, requirement or formalized role needs of the organization" (Campbell, 1990). Job performance also refers to the value, quality or quantity of the work contributed by an employee, i.e. the productivity of an employee. If employees' productivity is high, it means the overall business performance of the organization is high. In the study of organizational behavior, job performance is often regard as a dependent variable, the ultimate goal of leadership, organization design, process optimization and staff motivation is the pursuit of performance. In summary, job performance refers to the results or objectives employees achieved from their works in a certain period.

According to the framework of Campbell (1990), Borman & Motowidlo (1993) proposed the classification method of job performance and divided job performance into task performance and conditional performance. Task performance refers to the results of individual works, the results directly related to tasks assigned or expected by the organization. The judging criteria of task performance is the requirement of the official role of the individual. Conditional performance is a more comprehensive concept, and does not directly support the critical technique of the organization, but support more general organizational, social and metal environment, and the environment is the background of the operation of the critical technique.

Research Design

Research Framework and Assumptions

According the finding of Yeh & Yu (2009) and Chang, Lin, Wang, Jao, Wu and Liang (2010), job stress can negatively affect the mental feelings, output and performance of employees. In this study, we assume that job performance of construction industry works will be negatively affected by job stress. More-

over, researches including Lin (2004) found that happiness can reduce stress feeling of individuals and enhance job performance. Therefore, in this study, we analyze whether happiness is a variable that can reduce the negative impact of job stress on job performance (Figure 1).

Measures of Variable

(1) Job Stress

In this study, we refer to the job stress scales of Borg and Riding (1993), Chaplain (1995), Kelly and Bethels (1995), Alison and Berthelsen (1995), Pearson and Moomaw (2005), and design a scale to measure the job stress of construction industry workers based on the characteristics and working environments of the construction industry. In this study, we define the job stress of construction industry workers as the level of stress feeling from interpersonal relationships, work autonomy interfered by supervisors and colleagues, workload and working feedback. Through the four measuring aspects, the job stress of construction industry workers is higher as the index increases. As of the measuring method, we adopt Likert five-point scale to measure the job stress of workers (Strongly agree: 5 points, Agree: 4 points, Neither agree nor disagree: 3 points, Disagree: 2 points, Strongly disagree: 1 point).

The four aspects are: 1. Interpersonal relationship: the interaction between respondents and their colleagues, supervisors and customers. 2. Work Autonomy: the extent that works are under the respondents' control. 3. Workload: the work scope and responsibilities of the respondent, including daily works, assigned tasks from the supervisor and scheduling. 4. Work Feedback: salary, promotion and development of construction industry workers.

(2) Happiness

In this study, we refer to the "happiness scales" of Lai (2009), the scale includes four aspects "Life Satisfaction", "Interpersonal Relationships", "Self-Affirmation" and "Physical and Mental Health" and total 25 questions items in all. The scoring mechanism adopt Likert five-point scale, items include "Always", "Usually", "Neutral", "Sometimes" and "Never", and giving 5, 4, 3, 2, 1 point respectively. The happiness is higher as the score increases.

The four aspects are: 1. Life Satisfaction: the degree of consent to life needs, goals, meanings and safety. 2. Interpersonal Relationships: interaction and harmony with friends nearby. 3. Self-Affirmation: the degree of affirmation as of self-competency and personal image. 4. Physical and Mental Health: the evaluation of personal health condition.

(3) Job Performance

In this study we refer to Task Performance Questionnaire (TPQ) of Campbell (1987), Conditional Performance Questionnaire (CPQ) of Motowidlo & Van Scotter (1994) and Chinese job performance questionnaire revised and translated by Yu (1996) and Lin (2001), and design the job performance scale. The scale include two aspects: Task Performance and Conditional Performance, and scored by Likert five-point scale, include five items "Strongly agree", "Agree", "Neither agree nor disagree", "Disagree" and "Strongly disagree", and giving 5, 4, 3, 2, 1 point respectively. The job performance is higher as the score increases. The two aspects are: 1. Task Performance: the working per-

formance of an individual. 2. Conditional Performance: the working attitude, ethic and harmony an individual revealed to their supervisors and colleagues.

3. Respondent Survey Method

In this study, we use member list of Kaohsiung City Construction Industry Association and interview construction industry workers randomly by phone call to collect the views of construction industry workers about job stress, happiness and job performance. During the survey period from July 1st, 2017 to August 31st, 2017, 1,200 phone calls were made and successfully interviewed 252 respondents, with the success rate of 21%.

Results

Background of Respondents

The study successfully collected results from 252 respondents, most (162) of them are males, and 90 of them are females. As of the age statistics, respondents aged 31 to 40 accounted for the highest proportion (121 of them), and followed by aged 21 to 30 (65). As of the education, respondents with bachelor degree accounted for the highest proportion (127 of them), and followed by faculty degree (58) and master degree (42). As of the working tenure statistics, respondents with less than 10 years of working tenure accounted for the highest proportion (128 of them), and followed by 11 to 20 years (64). 101 respondents joined the construction industry in the first job after graduation, and 57 of them joined in the second job.

Factor Analysis

We adopted principal component analysis to conduct filter and internal validity test of job stress, happiness and job performance question items, rotate by Varimax and set the standard of factor selection as eigenvalue > 1 based on the standard proposed by Kaiser (1966) (quoted from Wu (2008)). Keiser argued that higher KMO value represents that there are more common factors between variables and more suitable for factor analysis. KMO > .9 represents marvelous, and KMO > .80 represents meritorious.

As of the factor analysis test of the three scales, the KMO value of the aspects of Job Stress Scale is .826, .814, .811 and .832, fit in “meritorious” definition of Kaiser. The KMO value of the aspects of Happiness Scale is .926, .872, .845 and .852, fit in “marvelous” and “meritorious” definition of Kaiser. The KMO value of the aspects of Job Performance Scale is .806 and .822, fit in “meritorious” definition of Kaiser. The Bartlett Spherical Test value of the three scales are all =.000. That means, the three scales of the study are very suitable for factor analysis. We found that the factor loadings of aspects are very concentrated and the reliability is high, that represents good internal validity (see Tables 4-1, 4-2, 4-3).

Item Analysis

After the previous step of factor loadings and filter of question items in the factor analysis, we further examine the relevancy and suitability of question items via item analysis.

According to Table 4-5, 4-6 and 4-7, the critical ratio (p <.000) and correlation coefficient (r>.700) of job stress, happiness and job performance revealed two meanings: 1. All question items are highly consistent and have high reliabil-

ity. 2. Question items of each aspect have high correlation coefficients, which means question items of each aspect are highly correlated.

Stepwise Regression Analysis

In this study, we use Stepwise Regression Analysis to discuss whether job stress will affect job performance or not, and whether happiness can reduce the negative impact of job stress on job performance. In Model 1, four aspects of job stress are independent variables, and Work Autonomy, Workload and Work Feedback have negative impact on job performance, apparently job stress indeed diminish the job performance of construction industry workers. In Model 2 of this study, we add four aspects of happiness to examine the effect of happiness to reduce the negative impact of job stress on job performance. The result shows that as four aspects of happiness are added, the negative impact of job stress to job performance is significantly reduced, among the four aspects of job stress, only Workload remains its negative impact on job performance, and the impact of all four aspects are diminished. Therefore, the four aspects of happiness can not only positively affect job performance, and can relieve the negative impact of job stress on job performance. As of the predictive power of the model, Model 1 only take job stress as independent variable, and the overall predictive power of the model is .221. As Model 2 take happiness as independent variable as well, the predictive power of the model increased to .559. The result of stepwise regression analysis shows that job stress indeed diminish the job performance of construction industry workers, but as happiness is included as an adjusting variable, it can efficiently relieve the job stress feeling of workers and improve job performance.

Discussion and Recommendations

In this study, in order to build scales to evaluate the job stress, happiness and job performance of construction industry workers, we firstly conduct literature review and then proposed three scales based on long-term observation of the construction industry by the author. We use factor analysis and item analysis to test the reliability and validity of the three scales before conducting Stepwise regression analysis, and the results show that job stress, happiness and job performance scales proposed in the study have high reliability and validity, it means the scales can really reflect the feeling of respondents (construction industry workers). In addition to build scales for survey, we focus on discussing the impact of job stress on job performance and whether happiness can reduce the negative impact of job stress on job performance. The result shows that in Model 1, only the impact of job stress on job performance is considered, and Work Autonomy, Workload and Work Feedback indeed negatively affect job performance, and the result is consistent with the findings of Yeh & Yu (2009) and Chang et al. (2010) – job stress will reduce morale and capability of workers. In Model 2, we add four aspects of happiness as adjusting variables in the regression model, and the result shows that all four aspects of happiness can positively affect job performance, and among the three job stress factors with significant negative impact in Model 1, the impact of them all reduced, and only Workload remains its significance in Model 2 and the impact of other aspects become insignificant. That means happiness can indeed reduce the

negative impact of job stress on job performance.

With regard to the results in this study, we argue that in Model 1 that only consider the impact of job stress on job performance, respondents generally believe that their works are exceed the extent that they can control, feel very burdensome about tasks assigned by supervisors, working schedule and responsibilities, and are unsatisfied with salary and personal promotion/development program given by the company. These psychological feelings directly worsen the working attitude, ethic and harmony that respondents revealed to their supervisors and colleagues. However, as the variable happiness is added, the feeling of job stress of respondents reduced significantly and only Workload remains its negative impact. Thus, we can argue that the respondents are able to increase the satisfaction level on life and work target, have more harmonious interaction with friends and colleagues, get more affirmation of individual capability and focus more on personal physical and mental health, the impact of overall job stress can be efficiently reduced and job performance can keep improving as a result.

We propose the following recommendations for construction business owners to improve employee happiness to keep improving the competiveness of employees and the whole company.

(1) Build up team happiness: construction companies should conduct more brain storming activity with employees to find ways to enhance employee happiness, such as providing tickets of sports center, yoga center and fitness center to employees for them to relax and improve their fitness through sporting and yoga.

(2) Improve self-affirmation: construction companies should design and conduct more events that employees can participate with their family, such as family kitchen and rural tourism, or conduct social welfare events such as beach cleansing and community care to improve the social status and identification of construction workers, and help to improve the self-affirmation of employees.

(3) Enhance team fraternity and cooperation: We suggest that construction companies can divide sections or departments into units and there are one or more supervisors to actively take care or help employees of the unit. The care and help from supervisors can promptly respond employee problems or provide instant help, and can enhance team morale and identification with the company as well. As a result, the feeling of happiness is improved. Company executives or managers from other departments can also play the role as mentors to observe employee behavior and provide help.

(4) Regard communication as a necessary work of supervisors: to enhance the communication between the company and employees, supervisors should regard communication as a necessary daily work or an important job-to-do. Supervisors can arrange for the best time to talk with colleagues in accordance with the work situation. If possible, supervisors can regularly spend 15 minutes every day to talk to colleagues in the team on a rotating basis. In addition to understand the status of each employee, employees can be encouraged with promptly response and feedback. Furthermore, in order to enhance the effectiveness of communication, we recommend that supervisors to examine their strengths first and then choose appropriate communicating method to assure that

employees can receive the message correctly. For example, in certain situations, only face-to-face communication is suitable, such as supervisors want to solve conflicts in the organization or to declare official messages; some kinds of communication are more casual, such as team gathering from time to time, or gossiping with colleagues about daily life.

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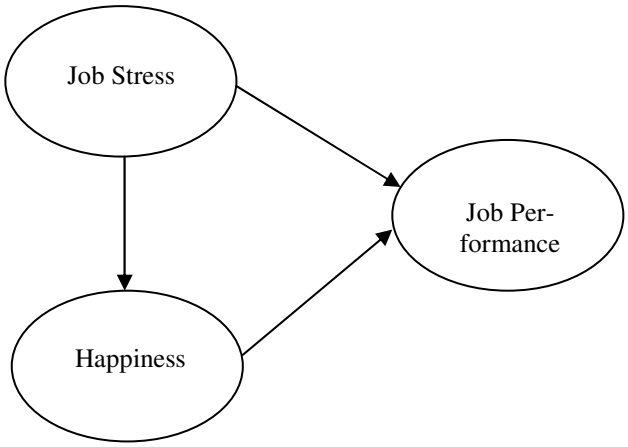

Figure 1 Framework of the Study

Table 4-1 Summary of Job Stress Factor Analysis

Aspects	Items	Factor Loadings	Vari-ance	Reliability
Interpersonal Relationships	1. I have difficulty in communicating with customers, and it makes me feel troublesome	.795	51.21	.822
	2. Competition with colleagues resulted in stress	.796		
	3. I have disagreement with colleagues, cannot get along with them and resulted in stress	.801		
	4. I cannot build good relationship with customers, and it makes me feel troublesome	.819		
	5. I have difficulty in communicating with supervisors, and it makes me feel troublesome	.732		
	6. I feel my supervisors and colleagues shirking their responsibilities to me, and it makes me feel troublesome	.747		
	7. Lack of communication with colleagues and cannot finding help make me feel troublesome	.710		
	8. Working atmosphere is bad in the company, and it affected my morale	.661		
Work Autonomy	9. The company or supervisors interfere with my working plan and make me feel stressed	.728	49.32	.807
	10. Colleagues interfere with my work and make me feel stressed	.801		
	11. The company interferes with my response to customer issues and makes me feel stressed	.773		
	12. The park interferes with my project execution and affects my professional autonomy	.692		
	13. I cannot make decision on the topic and content of my work and it makes me stressed	.673		
	14. Hard to acquire work-related resources from the company through application, and it	.804		

Aspects	Items	Factor Loadings	Vari-ance	Reliability
	makes me stressed			
Workload	15. Meetings in the company make me feel stressed	.814	53.23	.830
	16. Administrative or clerical works affect working schedule and make me stressed	.799		
	17. There are many assessments and inspections in the company and make me stressed	.802		
	18. Works cannot be finished in working hours and make me stressed	.732		
	19. Activities or plans assigned by supervisors make me overload	.772		
	20. Some planning activities are hard to design and make me stressed	.800		
Work Feedback	21. I feel lack of recognition from customers with regard to my work, and it makes me feel frustrated	.732	43.93	.792
	22. I feel that I have little progress with my work, and it makes me feel frustrated	.627		
	23. I think lack of training opportunities makes me feel troublesome	.693		
	24. I think the social status of construction industry workers is low	.702		

Table 4-2 Summary of Happiness Factor Analysis

Aspects	Items	Factor Loadings	Vari-ance	Reliability
Life Satisfac-tion	1. There are no shortage of my daily needs	.819	47.21	.831
	2. I think my daily life interesting	.802		
	3. I think the world is wonderful	.782		
	4.My life is purposeful and meaningful	.677		
	5. I love my life	.752		
	6. I am optimistic about my future	.693		
	7. I feel my life is secured and in safety	.742		
Interpersonal Relationships	8. I have good friends	.772	51.22	.801
	9. My friends care about me	.692		
	10. I think friends are essential for my daily life	.742		
	11. I am willing to make efforts and help oth-ers	.681		
	12. I feel happy accompanying with my friends	.774		
	13. My family and friends would help me when I have difficulty	.663		
Self-Affirmation	14. I can arrange my own life	.693	43.21	.770
	15. My engagement will result in better out-come	.742		
	16. I can solve problems in my life	.751		
	17. I like myself	.642		
	18. I think I am attractive in the group	.592		
	19. I am willing to express my thoughts	.661		
Physical and Mental Health	20. I am healthy	.699	41.18	.720
	21. I have good eating habits	.701		
	22. I think I am happy	.664		
	23. I do sports regularly	.732		
	24. I sleep enough	.711		
	25. I feel energetic every day	.689		

Table 4-3 Summary of Job Performance Factor Analysis

Aspects	Items	Factor Loadings	Variance	Reliability
Task Performance	1. I often follow standard operating procedures to complete my work	.773	51.12	.828
	2. I am familiar with standard operating procedures related to my work	.693		
	3. I often plan and arrange working progress of my responsible works	.745		
	4. I pay attention to safety and sanitation issues during work	.729		
	5. I often keep the cleanliness and sanitation of the working place	.734		
	6. I often put tools and documents nearby in order, and take them back to the original	.662		
	7. In general, my working efficiency is high	.756		
	8. In general, I am able to complete tasks assigned by the company	.732		
Conditional Performance	9. I often cooperate with other colleagues in the team	.821	47.22	.745
	10. I often show modest and humble attitude during work	.837		
	11. I often voluntarily take extra work	.793		
	12. I often follow operating procedures during work to avoid acting beyond my authority	.813		
	13. I will pay more attention on important tasks to avoid mistake	.809		
	14. I often support the decision of supervisors	.756		
	15. I will take care of work ethic during work	.767		
	16. I support and encourage colleagues when they have problems	.743		
	17. I actively seek for help and solution when I have problems with my work	.632.		
	18. I am self-restraint and disciplined in the working place	.805		
	19. I will be eager to execute on a difficult job assignment	.775		
	20. I often take extra work to help others or strive for team performance	.645		
	21.In general, I put myself in the company's position and voluntarily help colleagues	799		

Table 4-4 Summary of Job Stress Item Analysis

Aspects	Items	Critical Ratio	Correlation Coefficient
Interpersonal Relationships	1. I have difficulty in communicating with customers, and it makes me feel troublesome	10.594***	.792***
	2. Competition with colleagues results in stress	10.532***	.833***
	3. I have disagreement with colleagues, cannot get along with them and results in stress	10.235***	.799***
	4. I cannot build good relationship with customers, and it makes me feel troublesome	10.383***	.813***
	5. I have difficulty in communicating with supervisors, and it makes me feel troublesome	10.932***	.833***
	6. I feel my supervisors and colleagues shirking their responsibilities to me, and it makes me feel troublesome	11.203***	.845***
	7. Lack of communication with colleagues and cannot finding help make me feel troublesome	11.405***	.853***
	8. Working atmosphere is bad in the company, and it affected my morale	8.232***	.864***
Work Autonomy	9. The company or supervisors interfere with my working plan and make me feel stressed	9.234***	.827***
	10. Colleagues interfere with my work and make me feel stressed	11.203***	.843***
	11. The company interferes with my response to customer issues and makes me feel stressed	10.239***	.745***
	12. The park interferes with my project execution and affects my professional autonomy	12.333***	.892***
	13. I cannot make decision on the topic and content of my work, and it makes me stressed	10.331***	.912***
	14. Hard to acquire work-related resources from the company through application, and it makes me stressed	11.680***	.901***
Workload	15. Meetings in the company make me feel stressed	12.295***	.892***
	16. Administrative or clerical works affect working schedule, and it makes me stressed	11.541***	.892***
	17. There are many assessments and inspections in the company, and it makes me stressed	12.543***	.912***
	18. Works cannot be finished in working hours, and it makes me stressed	10.197***	.931***
	19. Activities or plans assigned by supervisors make me overload	10.282***	.839***
	20. Some planning activities are hard to design, and it makes me stressed	11.383***	.856***
Work Feedback	21. I feel lack of recognition from customers with regard to my work, and it makes me feel frustrated	10.486***	.883***
	22. I feel that I have little progress with my work, and it makes me feel frustrated	9.696***	.834***
	23. I think lack of training opportunities makes me feel troublesome	8.596***	.811***
	24. I think the social status of construction industry workers is low	11.405***	.895***

Table 4-5 Summary of Happiness Item Analysis

Aspects	Items	Critical Ratio	Correlation Coefficient
Life Satisfaction	1.There are no shortage of my daily needs	11.555***	.867***
	2. I think my daily life interesting	10.823***	.881***
	3. I think the world is wonderful	11.377***	.769***
	4. My life is purposeful and meaningful	13.143***	.861***
	5. I love my life	13.295***	.892***
	6. I am optimistic about my future	10.541***	.892***
	7.I feel my life is secured and in safety	11.543***	.812***
Interpersonal Relationships	8. I have good friends	11.197***	.931***
	9. My friends care about me	10.133***	.892***
	10. I think friends are essential for my daily life	11.031***	.912***
	11.I am willing to make efforts and help others	10.130***	.863***
	12. I feel happy accompanying with my friends	11.694***	.792***
	13. My family and friends would help me when I have difficulty	12.532***	.833***
Self-Affirmation	14. I can arrange my own life	10.845***	.811***
	15. My engagement will result in better outcome	9.235***	.799***
	16. I can solve problems in my life	10.383***	.913***
	17. I like myself	11.932***	.873***
	18. I think I am attractive in the group	9.203***	.845***
	19. I am willing to express my thoughts	11.201***	.772***
Physical and Mental Health	20. I am healthy	9.493***	.803***
	21. I have good eating habits	10.583***	.799***
	22. I think I am happy	11.394***	.840***
	23. I do sports regularly	9.583***	.794***
	24. I sleep enough	8.495***	.884***
	25. I feel energetic every day	9.203***	.839***

Table 4-6 Summary of Job Performance Item Analysis

Aspects	Items	Critical Ratio	Correlation Coefficient
Task Performance	1. I often follow standard operating procedures to complete my work	8.839***	.803***
	2. I am familiar with standard operating procedures related to my work	10.392***	.893***
	3. I often plan and arrange working progress of my responsible works	9.394***	.837***
	4. I pay attention to safety and sanitation issues during work	8.203***	.821***
	5. I often keep the cleanliness and sanitation of the working place	11.203***	.848***
	6. I often put tools and documents nearby in order, and take them back to the original space	13.205***	.859***
	7. In general, my working efficiency is high	12.956***	.839***
	8. In general, I am able to complete tasks assigned by the company	11.694***	.862***
Conditional Performance	9. I often cooperate with other colleagues in the team	10.694***	.857***
	10. I often show modest and humble attitude during work	9.394***	.843***
	11. I often voluntarily take extra work	10.293***	.863***
	12. I often follow operating procedures during work to avoid acting beyond my authority	9.384***	.812***
	13. I will pay more attention on important tasks to avoid mistake	11.394***	.886***
	14. I often support the decision of supervisors	10.495***	.869***
	15. I will take care of work ethic during work	9.396***	.819***
	16. I support and encourage colleagues when they have problems	11.304***	.874***
	17. I actively seek for help and solution when I have problems with my work	10.405***	.863***
	18. I am self-restraint and disciplined in the working place	9.405***	.793***
	19. I will be eager to execute on a difficult job assignment	8.405***	.791***
	20. I often take extra work to help others or strive for team performance	11.405***	.843***
	21. In general, I put myself in the company's position and voluntarily help colleagues	10.203***	.882***

Table 4-7 Summary Table of Stepwise Regression Analysis

Model	variable	Unstandardized Coefficients		Standardized Coefficients	
		B	Std. Error	Beta	Significance
Model 1	Constant	4.078	.133		.000
	Interpersonal Relationship	-.117	.059	-.112	.051
	Work Autonomy	-.225	.064	-.220	.000***
	Workload	-.302	.051	-.322	.000***
	Work Feedback	-.279	.050	-.298	.000***
	R square	.221			
	Sum of Squares	57.322			
	Degree of Freedom	4			
	F Value	.976			
	Significance	.000***			
Model 2	Constant	3.466	.361		.000
	Interpersonal Relationship	-.092	.047	-.084	.112
	Work Autonomy	-.098	.031	-.090	.103
	Workload	-.102	.047	-.100	.000***
	Work Feedback	-.131	.043	-.128	.210
	Life Satisfaction	.198	.079	.172	.005**
	Interpersonal Relationship	.295	.059	.277	.013*
	Self-Affirmation	.173	.021	.162	.010*
	Physical and Mental Health	.312	.074	.300	.001**
	R square	.559			
	Sum of Squares	57.322			
	Degree of Freedom	8			
	F Value	1.642			
	Significance	.000***			

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THE KEY FACTORS PROMOTING THE USE OF GREEN BUILDING MATERIALS FOR THE INTERIOR DESIGN AND DECORATION

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Abstract

In recent years, the government actively promotes the environmental sustainability as well as the carbon reduction related policies. The use of the green building materials is an important means to promote green infrastructures. This development prompts the construction industry to grow its attention for green building materials. In this paper, the application of the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) for evaluating the key factors to the improvement and application of green building materials in the interior design and decoration are presented. The Fuzzy AHP was conducted to rank the importance and identify the key factors of green building materials in the interior design and decoration successfully. The results indicate that the four key factors are "reduction of environmental pollution", "re-improvement of interior decoration materials", "industrial upgrading to maintain competitiveness" and "type and quantity of green building materials" respectively.

Key Words: Green building materials, Fuzzy Analytic Hierarchy Process (Fuzzy AHP), the interior design and decoration

Introduction

The concept of green building integrates a variety of strategies during the design, construction and operation of building projects. The use of green building materials represents one very crucial strategy during the design and construction of a building. In particular, green building materials are composed of renewable, rather than nonrenewable resources. Also, green materials are environmentally responsible because impacts are considered over the life of the product (Ross Spiegel and Meadows, 1999)

Chiang (2005) indicated that recycling green building material products should completely conform to the

three principles of Reuse, Recycle, and Reduce.

Green building materials are derived from recycled or renewable sources. The building industry and homeowners are utilizing more green-building materials, which should make the built environment more sustainable (Steinemann et al., 2017).

In recent years, the government actively promotes the environmental sustainability as well as the carbon reduction related policies. The use of the green building materials is an important means to promote green infrastructures. This development prompts the construction industry to grow its attention for green building materials. Since the starting of Green Building Material Labels in 2004 in Taiwan, the number of manufactures applying for and obtaining the labels has increased year by year. So far, the green label materials include more than 7,531 product items. It can be seen that getting the Green Building Material Labels has become the new trend of the industry. Its market potential should not be overlooked.

In this study, the application of the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) for evaluating the key factors to the improvement and application of green building materials in the interior design and decoration is presented. The Fuzzy AHP was conducted to rank the importance and identify the key factors of green building materials in the interior design and decoration.

Fuzzy analytic hierarchy process

The Analytic Hierarchy Process (AHP) developed by Saaty (1980) has been widely used for multi-criteria decision-making and practical decision-making problems. In spite of its popularity, this method has been criticized for its inability to adequately handle the inherent uncertainty and imprecision associated with the mapping of the decision-maker's perception to exact numbers (Deng, 1999).

In the conventional formulation of the AHP, human's judgments are represented as exact numbers (or crisp, according to the fuzzy logic terminology). However, in many practical cases the human preference model is uncertain. Thus, decision-makers might be reluctant or unable to assign exact numerical values to the comparison judgments. Therefore, a Fuzzy Analytic Hierarchy Process (Fuzzy AHP) is used on each factor to determine the weight of fuzziness of its attributes. Herein, we apply the Fuzzy AHP to find the importance sequence and identify the key success factors for the selection of appropriate OWES sites in Taiwan.

In the problem of decision making, the following main steps are taken for the AHP:

1. Problem hierarchically structuring: The AHP decision problem is structured hierarchically at different levels. Each level consists of a finite number of decision elements. The top level of the hierarchy represents the overall goal, while the lowest level is composed of all possible alternatives. One or more intermediate levels embody the decision criteria and sub-criteria.

2. Development of judgment matrices by pair-wise comparisons: The

judgment matrices of criteria or alternatives can be defined from the reciprocal comparisons of criteria at the same level or all possible alternatives. Pair-wise comparisons are based on a standardized evaluation schemes from 1 to 9.

3. Assessment of global priorities: Several methods for deriving local priorities (i.e. the local weights of criteria and the local scores of alternatives) from judgment matrices have been developed, such as the eigenvector method (EVM), the logarithmic least squares method (LLSM), the weighted least squares method (WLSM), the goal programming method (GPM) and the fuzzy programming method (FPM), as summarized by Mikhailov (2000). Consistency check should be implemented for each judgment matrix.

4. Calculation of global priorities: The last step of the AHP aggregates all local priorities from the decision table by a simple weighted sum. The global priorities thus obtained are used for final ranking of the alternatives and selection of the best one.

In this study, the triangular fuzzy numbers will be adopted. A triangular fuzzy number $\tilde{N}$ is defined by three real numbers ($\ell \le m \le u$), and characterised by a linear piecewise continuous membership function $\mu_{\tilde{N}}(x)$ of the type.

$$\mu_{\tilde{N}}(x) = \begin{cases} (x-\ell)/(m-\ell) & , \ell \le x \le m \\ (u-x)/(u-m) & , m \le x \le u \\ 0 & , \text{otherwise} \end{cases} \quad (1)$$

Where *l*, *m* and *u* are also considered as the lower bound, the mean bound, and the upper bound, respectively. The fuzzy number $\tilde{N}$ is often expressed as a triplet (*l*, *m*, *u*).

After pair-wise comparisons are finished at a level, a fuzzy reciprocal judgment matrix $\tilde{A}$ can be established as.

$$\tilde{A} = \begin{bmatrix} 1 & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ \tilde{a}_{12} & 1 & \dots & \tilde{a}_{2n} \\ : & : & . & : \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \dots & 1 \end{bmatrix} \quad (2)$$

in which *n* is the number of the related elements at this level and $\tilde{a}_{ji} = 1/\tilde{a}_{ij}$.

After constructing $\tilde{A}$, we use the fuzzy geometric means to derive fuzzy priorities $\tilde{w}_i$, $i = 1,2,...,n$, in this paper. Finally, the global priorities expressed as fuzzy numbers can be determined by aggregating fuzzy local priorities in the following:

$$\overline{W} = \prod_{i=1}^{n} \overline{W_i} \quad (3)$$

where *n* is the number of level and $\prod_{i=1}^{n} \overline{W_i}$ is the product of weights for all levels.

Conceptual model for Promoting the use of green building materials

A conceptual model of promoting the use of green building materials is established on the basis of the Delphi method and the Fuzzy AHP method. Four main criteria have been chosen for Government politics, Green building materials industry, Decoration design industry and Consumer, and each

main criterion is additionally divided into four sub-criteria, namely International standards, Green building materials use regulations, Green Building Material Labels relief, Green Building Material Labels application procedures, With the government policy to promote, Reduce environmental pollution, Industrial upgrading to maintain competitiveness, Interior decoration materials upgrading, Upstream industry promotion, Consumer requirements, Industry cognition, Customer rights and interests, Improve the quality of living, Low health of human health, Green building materials product type and quantity and Price considerations. The goal here is to select the key factors of promoting the use of green building materials, satisfying all criteria in the best way.

The solution process is based on the proposed fuzzy modification of the AHP method. The first step in applying the fuzzy AHP is to construct a (four level) hierarchy of promoting the use of green building materials and criteria for choice, as shown on Figure 1.

An important consideration in terms of the quality of the ultimate decision relates to the consistency of judgments that the decision maker demonstrated during the series of pair-wise comparisons. The consistency ratio (*C.R.*) is a measure of the consistency of pair-wise comparison judgments, which measure the degree of consistency among the pair-wise judgments provided by the decision maker. If the degree of consistency is acceptable, the decision process can be continued. On the other hand, if the degree of consistency is unacceptable, the decision maker should reconsider and possibly revise the pair-wise comparison judgments before processing the analysis. In general, the ratio is designed in such a way that values of the ratio exceeding 0.10 are indicative of inconsistent judgments. The *C.R.* is estimated as the following:

Step 1: Multiply each value in the first column of the pair-wise comparison matrix by the relative priority of the first item considered. Same procedures will be applied to other items. Sum the values across the rows to obtain a vector of values labeled “weighted sum”.

Step 2: Divide the elements of the vector of weighted sums obtained in Step 1 by the corresponding priority value.

Step 3: Compute the average of the values computed in Step 2. The λ_{max} is maximum Eigen value of the comparison matrix.

Step 4: Compute the consistency index (*C.I.*):

$$C.I. = \frac{\lambda_{\max} - n}{n-1} \qquad (4)$$

where *n* is the number of items.

Step 5: Compute the consistency ratio (*C.R.*):

$$C.R. = \frac{C.I.}{R.I.} \qquad (5)$$

where *R.I.* is the random index, which is the consistency index of a randomly generated pair-wise comparison matrix.

Results and Discussion

The fuzzy comparison judgments of the four main criteria with respect to the overall goal are shown in Table 1.

Green building materials industry is regarded as the most important criterion. Utilizing the fuzzy prioritization method, the exact weights value of main criteria is obtained as shown in Table 2. As shown in Table 2, the value of the consistency index (*C.I.*) is 0.04 and the consistency ratio (*C.R.*) is 0.04. Both *C.I.* and *R.I.* values are much smaller than 1, which indicates that the degree of consistency is acceptable. The fuzzy weights of the comparison judgments regarding the goal are also shown in Figure 2. From the figure, Green building materials industry is assessed as the more important issues than Decoration design industry, Consume, and Government politics. Therefore, Green building materials industry is considered as the most important criterion, since all fuzzy weight is greater than other factors.

The second level of hierarchy with respect to the upper level elements, the local fuzzy weights of the sub-criteria are shown from Figure 3~6. In Figure 3, we can found that International standards is the most important factor comparing with Green building materials use regulations, Green Building Material Labels relief and Green Building Material Labels application procedures in the Government politics. Above results implies that International standards will promote the international standardization of green building materials standards and obtain international mutual recognition as an important objective in the Future.

As for the results of local fuzzy weight of the sub-criteria for Green building materials industry (Figure 4), it is found that Reduce environmental pollution is greater than other factors. In other words, the Reduce environmental pollution was regarded as the greater contributions to Green building materials industry.

At the level of hierarchy with Decoration design industry (Figure 5), we can see Upstream industry promotion is the most important factor, because the Upstream industry promotion has more message for Green building materials and can directly introduce to customer.

Figure 6 shows that Green building materials product type and quantity is more important than Improve the quality of living, Price considerations and Low health of human health in the level of Consumer.

Because of the Green building materials, product type and quantity offer specific benefits to the building owner and building occupants:

1. Reduced maintenance/ replacement costs over the life of the building.
2. Energy conservation.
3. Improved occupant health and productivity.
4. Lower costs associated with changing space configurations.
5. Greater design flexibility.

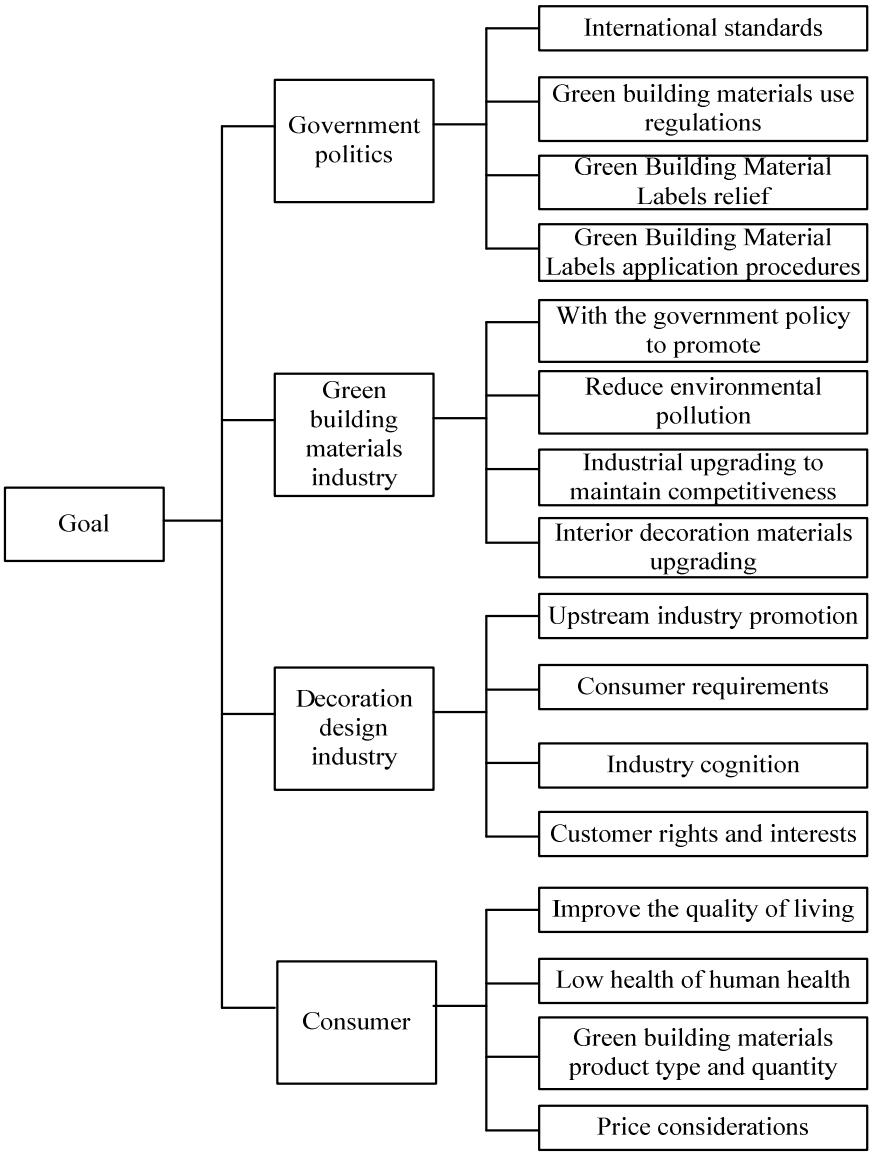

Figure 1. Decision hierarchy.

Table 1. Fuzzy comparison matrices at the first level.

Goal	Government politics	Green building materials industry	Decoration design industry	Consumer
Government politics	1.000,1.000,1.000	0.209,0.275,0.375	0.187,0.246,0.348	0.409,0.554,0.834
Green building materials industry	2.670,3.634,4.735	1.000,1.000,1.000	2.047,2.577,3.357	1.588,2.226,3.228
Decoration design industry	2.873,4.072,5.345	0.298,0.388,0.488	1.000,1.000,1.000	0.683,1.065,1.508
Consumer	1.199,1.806,2.433	0.310,0.449,0.630	0.663,0.939,1.464	1.000,1.000,1.000

Table 2: The weight value of main criteria.

Goal	weights	Ranking
Green building materials industry	w1 = 0.46	1
Decoration design industry	w2 = 0.24	2
Consumer	w3 = 0.20	3
Government politics	w4 = 0.10	4

*C.I.= 0.04 ; C.R.= 0.04.

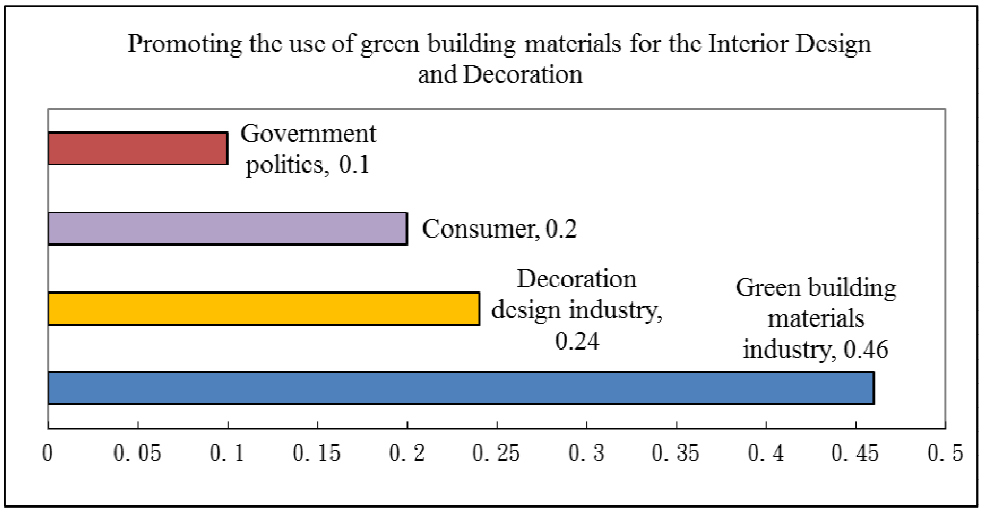

Figure 2. Fuzzy weight of the pair-wise comparisons in the main criteria.

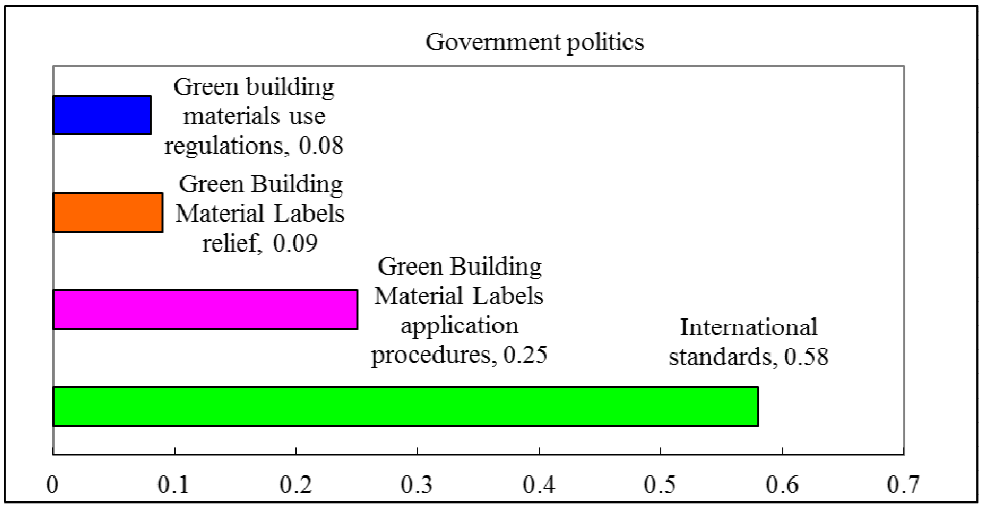

Figure 3. Local fuzzy weight of the sub-criteria for Government politics

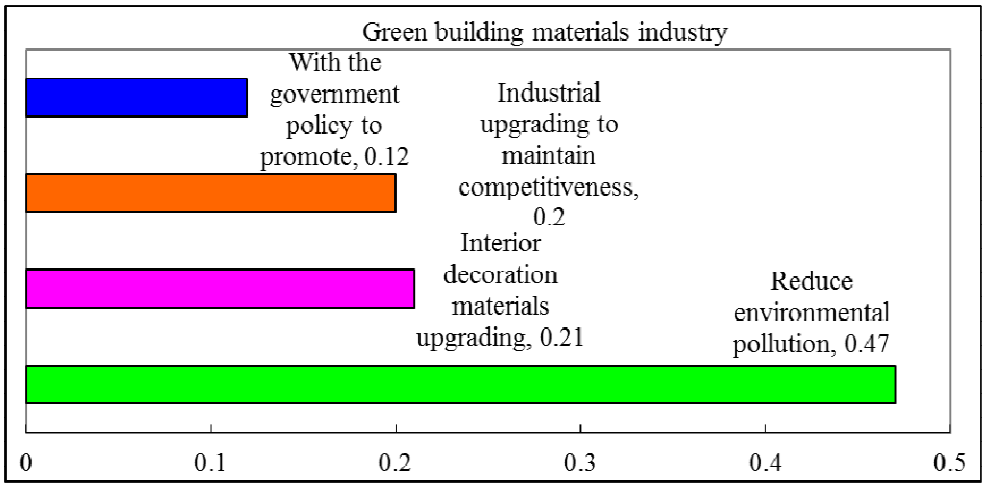

Figure 4. Local fuzzy weight of the sub-criteria for Government politics

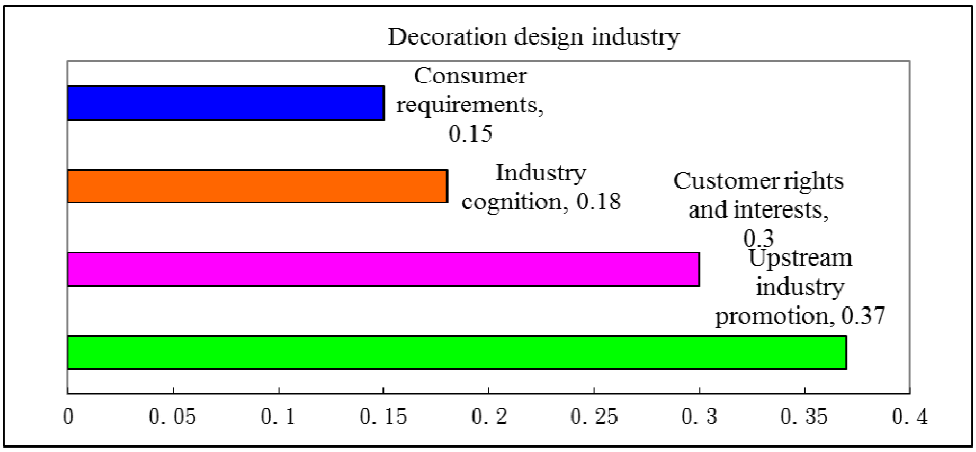

Figure 5. Local fuzzy weight of the sub-criteria for Government politics

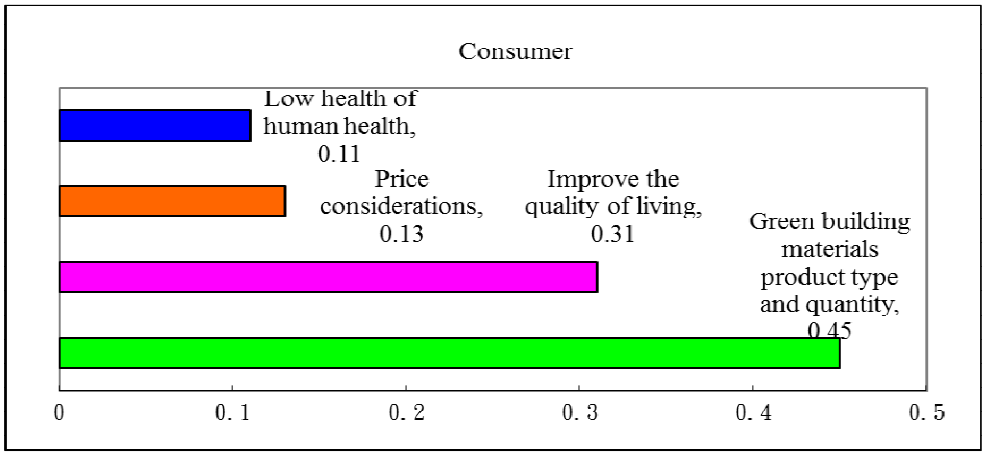

Figure 6. Local fuzzy weight of the sub-criteria for Government politics

Conclusion

This paper is aimed to evaluate the key factors to the improvement and application of green building materials in the interior decoration and its findings show that the four key factors are "reduction of environmental pollution", "re-improvement of interior decoration materials", "industrial upgrading to maintain competitiveness" and "type and quantity of green building materials" respectively.

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A STUDY OF RESIDENTS' ATTITUDES TOWARDS DEVELOPING LOW CARBON TOURISM IN LIUQIU

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Abstract

This study investigated inter-relationships between community attachment, environmental identity, perceived positive tourism impacts, perceived negative impacts, and support for developing low carbon tourism by analyzing data obtained with a questionnaire completed by residents of Liuqiu, an island of Taiwan. The findings of this study indicate that: 1. community attachment has direct, positive effects on developing low carbon tourism; 2. environmental identity has indirect positive effects on developing tourism, with such effects only becoming direct once mediated by positive tourism impacts; 3. positive and negative impacts on tourism affect residents' attitudes either positively or negatively towards developing low carbon tourism.

Keywords: resident attitude, low carbon travel development, tourism impact, environmental identity, community attachment

Introduction

Energy saving, carbon reduction and other relevant environmental issues have been emphasized in recent years due to climate change and global warming. Governments around the world have started with related policies and measures to curb global warming. In 2008, the EU (European Union) set a target of 20% carbon reduction of greenhouse gas emissions by 2020, when compared to 1990 emission levels. The Taiwanese government also promotes energy saving and carbon reduction policies throughout different industries. Tourism, being a key industry, has an increasing demand for transportation, which results in higher greenhouse gas emissions. According to statistics of UNWTO (United Nations World Tourism Organization), CO_2 (Carbon Dioxide) produced from tourist activities in 2005 accounted for 5% of human emissions, wherein transportation accounted for 75% of emissions (UNWTO 2008). With increasing tourist populations, transport such as motorbikes, cars, buses and planes are increasing. This inevitably results in higher greenhouse emissions. Consequently, concrete action to reduce these emissions is required.

Following the energy saving and carbon reduction trend, low carbon travelling options have increased in Taiwan. The New Taipei Government was the first city in Taiwan to initiate low carbon tourism. This was done by incorporating the concept of energy saving into travelling and by guiding residents to adapt to low carbon business practices. These strategies of offsetting carbon emissions have assisted in reducing the negative impacts left behind by tourists. The Ministry of Transportation and Communication also proposed a four-year plan entitled "The Eco- Tourist Island of Green Island and Liuqiu Island." A total budget of NTD 860 million was set aside to transform these two islands into low carbon eco-tourist islands. Existing fuel powered transportation and tourist motorbikes are to be replaced by electrical motorbikes, and round island buses are to be replaced by electrical vehicles. The target is to reduce 2,000 tons of carbon emission by 2012 (MOTC 2011).

According to statistics from the Tourism Bureau, the number of visitors to Liuqiu increased nearly four times from 97,226 in 2006 to 362, 764

in 2013 (Tourism Bureau 2013). This rapid growth resulted in damage to the local ecological environment. In order to reduce air pollution and damage to the environment caused by tourists, the Pingtung County Government encouraged the use of electric scooters and electric vehicles with an intention of developing Liuqiu into a low carbon tourist island. The impact on the local environment that accompanies tourism development has been a critical concern of researchers (Johnson et al. 1994; Liu &Var 1986; Jurowski et al. 1997; Andereck & Vogt 2000; Ko & Stewart 2002). Any kind of development could impact on local communities and tourism is no exception (Ou & Yen 1995). Aside from boosting local economic growth, tourism also influences other aspects within local communities. To differing extents, tourism could impact both positively and negatively on local environments and societies (Liu & Var 1986; Allen et al. 1988). The residents are the most affected by, and their support of and attitudes toward tourism development, depends on the changes in their communities, environment and economy.

When examining the relationship between residents' characteristics and their attitude toward tourism, Social Exchange Theory is usually used to explain different scenarios, for example, if residents' interests (economical) are higher than the cost (environmental or social), they would have a positive attitude toward tourism (Bryant & Napier 1981; Gursoy & Rutherford 2004; Juroski et al. 1997). McCool & Martin (1994) mention that community attachment is essential when evaluating social influence from tourism. Nunkoo & Gursoy (2012) looked at the relationship between environment identity and residents' approval of island tours. They found that environmental identity has a direct impact on residents' approval rating of island tours. When environment identity is high, the approval rating of island tours lessens. None of these would have influences on approval rating by positive or negative impacts.

Ap (1992) mentioned that residents' attitude and cognition of tourism is an important consideration for planning, regardless whether it is planning for short-term or long-term tourism development or whether it is related to marketing. In addition, residents' attitude and cognition of tourism, influences the promotion of local tourism, as well as, the quality of recreation. Thus, residents' attitudes and the cognition of tourism is also one of the indicators used to assess whether local tourism is successful or not (Ap 1992; Lankford 1994). Pearce (1981) indicated that residents' perception and

attitude is one of the factors influencing a tourism development plan, as well as, the success of its implementation. As a result, while the government is trying to make Liuqiu a low carbon model island and low carbon travel destination, understanding its residents' attitude towards developing low carbon travel in their communities is helpful to promote low carbon travel and sustainable development. So far, no research and assessment has been conducted on the impact of low carbon travel and tourism in Taiwan.

These research outcomes are summarized as following:

1. Investigating the degree of cognition of residents in Liuqiu in developing low carbon tourism.
2. Investigating the approval rating of residents in Liuqiu in developing low carbon tourism.
3. Investigate the relevance between place attachment, environmental identity, tourism impacts and approval rating, in developing low carbon tourism in Liuqiu.

The research concludes by making suggestions for developing low carbon travel in Liuqiu.

Research Method

Hypothesis Setting

Research framework (Figure 1) and research hypothesis are based on the research purpose and literature reviews. McCool & Martin (1994) stated that community attachment is essential when evaluating social influence from tourism and found that residents with high levels of community attachment have stronger positive and negative attitudes toward tourism impacts, yet, this is seldom mentioned in the field of study in tourism. Williams, McDonald, Riden, and Uysal (1995) also pointed out that residents with positive attitudes toward tourism development have higher levels of community attachment. Gursoy & Rutherford (2004) discovered that community attachment had positive influences on economic and social interests. Thus, the following hypotheses are proposed.

H1: Residents' community attachment has positive influences on positive impacts on cognition.

H2: Residents' community attachment has positive influences on negative impacts on cognition.

H3: Residents' community attachment has positive influences on approval rating of low carbon travel.

Gursoy & Rutherford (2004) found that residents who are more aware of environmental issues have influences on tourism in terms of economic benefit, social benefit and social cost. Nunkoo, Gursoy & Juwaheer (2010) stated that an individual's environmental identity influences his attitude toward tourism impacts. Thus, the following hypotheses are proposed.

H4: Residents' environmental identity has a positive influence on positive impact cognition.

H5: Residents' environmental identity has a positive influence on negative impact cognition.

H6: Residents' environmental identity has a positive influence on the approval rating regarding low carbon travel.

Many researchers, who have studied residents' perception and attitude toward the impact of tourism, conclude that residents' perception of positive tourism impacts have positive influences on the approval rating when it comes to developing tourism. On the other hand, negative tourism impacts have negative influences on the approval rating when it comes to developing tourism (Ko & Stewart 2002; Choi & Murray 2010; Perdue et al. 1990). Gursoy et al. (2002) found that positive benefits and cost affect residents' approval rating of tourism. Getz (1994) indicated that factors including the economy, society, culture and environment influence residents' perception and willingness to involve and communicate about developing tourism. Thus, the following hypotheses are proposed.

H7: Positive impacts have positive influences on the approval rating of low carbon travel.

H8: Negative impact perceptions have positive influences on residents' attitudes toward tourism.

Questionnaire

This research uses a questionnaire to evaluate residents' attitude toward low carbon travelling, their perception of the impact of tourism, as well as their approval rate of developing low carbon travel. The questionnaire is divided into five parts.

The first part of the questionnaire focuses on residents' perception of the impact that low carbon travel will have. These questions are based on relevant papers (Landford 1994; Johnson et al. 1994; Ko & Stewart 2002; Easterling 2004). The characteristics of low carbon travelling were taken into

account when compiling these questions.

In this research, the perceived impact of tourism (tourism impact perception) is divided into three parts: economy, social culture and environmental impact. There are a total of twenty-seven questions, nine for economic impact perception, ten for social culture impact perception and eight for environmental impact perception. In order to obtain quantitative data, the questionnaire adopts a five-point Likert scale. Participants were asked to respond to a series of statements about a topic, in terms of the extent to which they agree with them, from strongly disagreeing to strongly agreeing, scoring one to five respectively.

The second part of the questionnaire looked at place attachment and consisted of four questions. These questions were derived from research conducted by Kil et al. (2012). In this instance, a five-point Likert scale was also adopted where participants were required to choose from strongly disagreeing to strongly agreeing, scoring one to five respectively.

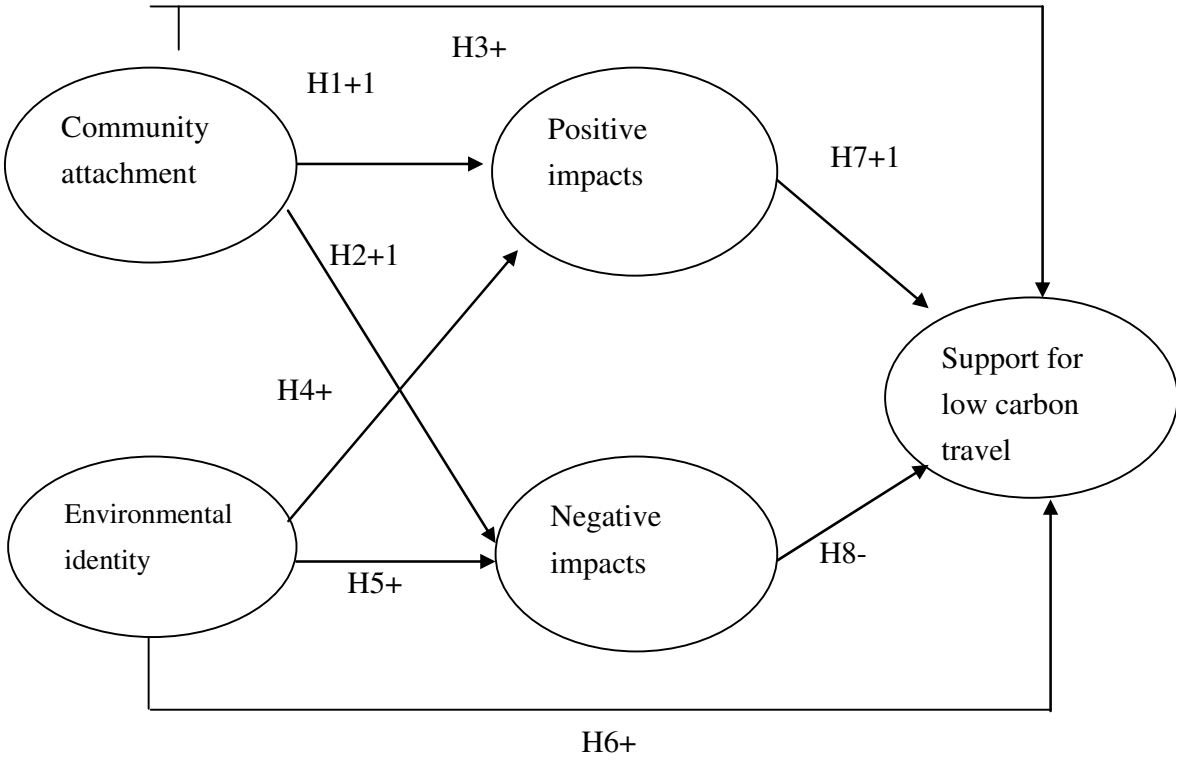
The third part of the questionnaire looked at environmental identity and consisted of a total of seven questions. These questions were derived from research conducted by Nunkoo and Gursoy (2004). This part of the questionnaire also adopted a five-point Likert scale where participants are asked to make a choice of strongly disagreeing to strongly agreeing, scoring one to five respectively.

The forth part of the questionnaire looked at the approval rate of tourism development and consisted of a total of two questions. These questions were derived from research conducted by Ko & Stewart (2002). These questions discussed residents' approval rate of developing low carbon travel in Liuqiu. This part of the questionnaire also adopted a five-point Likert scale where participants are asked to make a choice of strongly disagreeing to strongly agreeing, scoring one to five respectively.

The fifth and final part of the questionnaire was aimed at obtaining information about the characteristics of the respondents, such as their gender, age, marital status, level of education, profession, monthly income and the amount of time that they have been a resident of the area. This totals seven latent variables. This part of the questionnaire adopted a nominal scale.

Sampling Method

Figure 1: Research Framework



The questionnaires were issued using convenience sampling. A total of 300 questionnaires were issued and 184 valid samples were collected. The questionnaires were issued during the period November 28, 2013 to February 28, 2014.

Data Processing

In order to undertake model validation, data was analyzed using statistical methods, such as, descriptive statistics, reliability analysis, confirmatory factor analysis and a structural equation model (through the use of SPSS for Windows V17.0 and LISREL8.52).

Empirical Analysis And Result

Sample Structural Analysis

A total of 184 valid questionnaires were distributed to respondents. Results of their demographic characteristics are summarized below.

1. Gender: There were 105 male respondents who accounted for the majority (57.1%) of respondents.
2. Age: 52 People aged 31-40 ac-

counted for the majority (28.3%) of the respondents, followed by 46 people aged 41-50, who accounted for 25% of respondents.

3. Marital status: 108 Respondents were married and they accounted for the majority (58.7%) of respondents.
4. Professions: 71 people were government officials and they accounted for the majority (38.6%) of respondents, followed by 54 people who were employed in the service industry, who accounted for 29.3% of respondents.
5. Individual monthly income: 52 People earned around NT$ 20 001 – NT$ 30 000 per month and they accounted for 28.3% of respondents. Respondents earning above NT$ 50 001 per month accounted for 37, 20.1% of respondents.
6. Education: 73 People held bachelor degrees and they accounted for the majority (39.7%) of respondents, they were followed by 48 respondents who held high school degrees (26.1%).
7. Period of residence: 107 Respondents (58.2%) have been residing in the area for more than 21 years.

Relationship Model Analysis Of Residents' Attitude Toward Tourism

Model Test.

The following indicators were used in order to analyze residents' attitudes towards tourism:

- Goodness of Fit Index (GFI): χ^2=261.01 (df= 121),
- Chi-square value rate (χ^2/df) = 2.15, P=0.000.
- Absolute fit measure, RMSEA=0.08, RMR=0.07.
- Incremental fit measures, GFI=0.86, NFI=0.93, CIF=0.96.
- Parsimonious fit measures, PNFI=0.74and PGFI=0.61.

All of these indicators are acceptable. The standard of GFI depends on chi-square value, yet chi-square value fluctuates according to the size of the sample. Once the sample size becomes overly large, then models could be rejected (Bentler & Bonett 1980). However, chi-square value is not one of the necessary indicators used to decide whether a model is fit (Bagozzi & Yi 1988). Jöreskog & Sörbom (1996) suggested that the chi-square value be divided by the fd rate to examine whether the goodness fit is of a good standard, i.e. not over 2 or 3, and suggested that 3 is an ideal value for GFI (Hair et al. 2006). The chi-square value in this model is χ^2/df=2.15, which shows that the GFI is good.

Model Reliability and Validity

As shown in Table 1, the construct reliability of latent variables is above 0.6 and between 0.74-0.93, which shows that the internal consistency of this model is good. The Average Variance Extracted (AVE) is above the standard of 0.5. Looking at each angle of construct reliability and AVE, we can observe that the internal consistency of the model is reliable and stable.

Confirmatory Data Analysis

The results of model verification are reflected in Figure 2 below. The hypotheses and results are as follows:

Hypothesis 1: Community attachment has positive influences on positive impacts. Its parameter estimate value is γ11=0.04, t=0.05. It failed to reach statistical significance.

Hypothesis 2: Community attachment has negative influences on negative impacts. Its parameter estimate value is γ12= -0.22, t=-2.01. It reached statistical significance, which shows that the higher the community attachment, the lower the negative impacts would be.

Hypothesis 3: Community attachment has positive influences on the development of low carbon travel. Its parameter estimate value is γ13=0.35, t=-4.43. It failed to reach statistical significance, which shows that the higher the community attachment, the lower the negative impacts would be.

Hypothesis 4: Environmental identity has positive influences on positive impacts. Its parameter estimate value is γ21=0.62, t=7.39. It reached statistical significance, which shows that the higher environmental identity, the stronger the positive impact perceptions would be.

Hypothesis 5: Environmental identity has negative influences on negative impacts. Its parameter estimate value is γ22=0.02, t=0.15. It failed to reach statistical significance.

Hypothesis 6: Environmental identity has negative influences on the approval rate of the development of low carbon travel. Its parameter estimate value is γ23=0.35, t=1.61. It failed to reach statistical significance.

Hypothesis 7: Positive impacts have positive influences on the approval rate of the development of

low carbon travel. Its parameter estimate value is β11=0.42, t=4.37. It reached statistical significance, which shows that as positive impacts increase, so does the approval rate of the development of low carbon travel.

Hypothesis 8: Negative impacts have negative influences on the approval rate of the development of low carbon travel. Its parameter estimate value is β21=0.10, t=1.47. It failed to reach statistical significance.

Conclusion And Suggestions

Conclusion

According to the results of the study, conclusions made regarding the hypothesis are summarized below:

1. Residents' community attachment has negative influences on negative impacts. Community attachment has positive influences on the approval rate of the development of low carbon travel. It reveals that the stronger the attachment to a residents' community, the higher the approval rate of low carbon travel would be. Thus, by strengthening residents' community attachment, this will aid in gaining their support for the development of low carbon travel. It was also found that residents with a strong attachment to where they live have positive attitudes toward tourism (Chen & Chen 2010; Gursoy & Rutherford 2004; McCool & Martin 1994). The finding of this study also supports this argument.

Environmental identity has positive influences on positive impacts while it indirectly affects the approval rate of the development of low carbon travel. It however does not directly affect the approval rate of the development of low carbon travel - unless it is influenced by positive impacts. This shows that on the issue of developing low carbon travel, the approval rate of residents with high environmental identity depends on the positive impact that tourism has, which correlates to Nunkoo & Gursoy (2012)'s research result.

Suggestions

Take advantage of community activities to get residents involved in tourism, for example, by holding conferences or campaigns. By participating in community affairs, residents have more opportunities to understand the culture and natural environment of their living places. This has the ability to not only strengthen the relationship

between residents and the community, but it is able to strengthen residents' community awareness and attachment. The government is actively promoting energy saving ideas by promoting Liuqiu as a low carbon tourist island. As stated previously, it aims to do this by replacing gasoline-fueled scooters and buses (which are presently widely used on the island), with electrical ones. In addition to the above efforts, the government needs to educate local residents about environmental awareness in order to change residents' daily lives and their attitude toward tourism. In this way, the quality of tourism will improve and the concept of sustainable tourism can be implemented from generation to generation.

Table 1: Parameter Estimation

Dimension	Item	Item reliability			CR	AVE
		Parameter estimates	Error variances	t value		
Community attachment	x1	0.67	0.55	9.16**	0.78	0.54
	x2	0.69	0.57	8.92**		
	x3	0.85	0.29	11.97**		
Environmental identity	x4	0.92	0.15	16.17**	0.90	0.58
	x5	0.93	0.13	16.54**		
	X6	0.86	0.26	14.50**		
	X7	0.73	0.46	11.35**		
	X8	0.69	0.53	10.37**		
	X9	0.63	0.6	9.36**		
	X10	0.47	0.78	6.56**		
Positive impacts	y1	0.73	0.43	11.21**	0.78	0.55
	y2	0.78	0.4	11.41**		
	y3	0.69	0.52	9.82**		
Negative impacts	y4	0.74	0.46	9.87**	0.74	0.50
	y5	0.7	0.51	9.07**		
	y6	0.66	0.57	8.50**		
Approval rate of tourism	y7	0.94	0.11	16.05	0.93	0.87
	y8	0.92	0.15	15.51**		

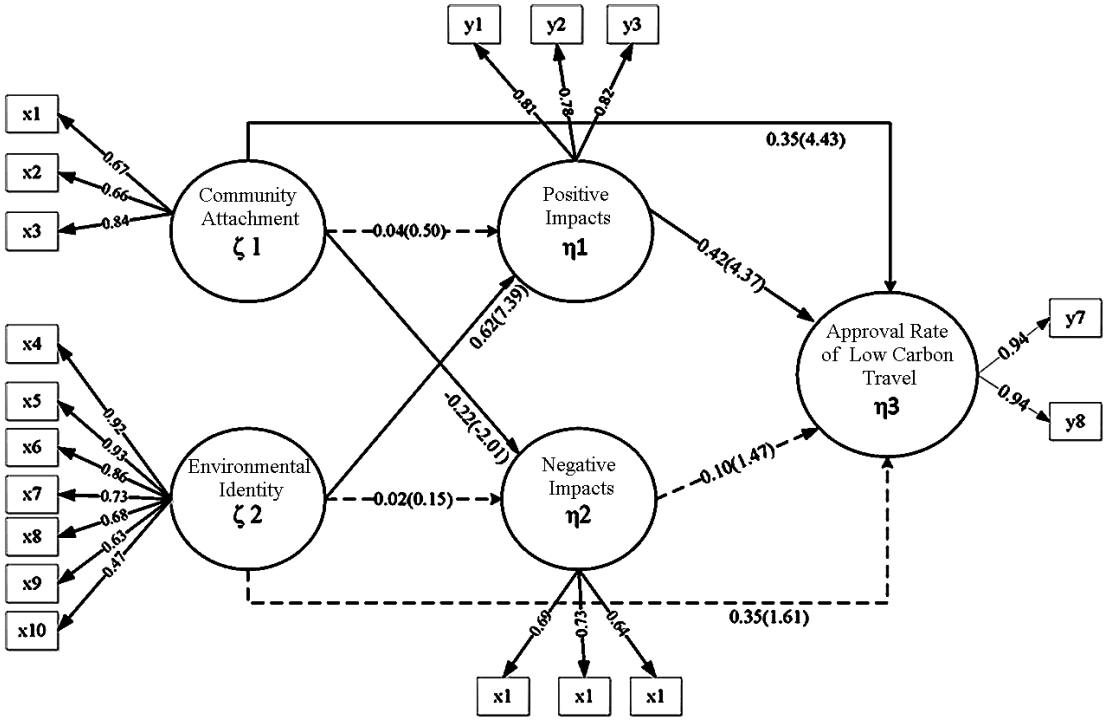


Figure 2: Result of Relationship Model

Remarks:

1. Dotted line: The path does not reach statistical significance.
2. (t value)
3. Value indicated in the figure represents estimated parameter

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GOOD JOBS IN INDUSTRIAL UPGRADING AND TRANSFORMATION

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Abstract

Given the rapid development of science and technology and the swift changes in the production process and market trends, the cultivation of related workforce and development of technology required by the industry updating and transformation need to be conducted urgently. Therefore, the establishment of Good Job competencies for key occupational talents has become a top priority. In this study, we first researched into the career development for Good Jobs required by the government to assist with industrial upgrading and transformation, and established a good job specification. The study was divided into three stages. First, an expert panel consisting of experts and scholars from industry, academia, and vocational training center was formed, who selected the Good Jobs required by industry. Secondly, Delphi technique was employed in establishing the procedure of Good Jobs promotion and the questionnaire. Finally, the major consideration factors of Good Jobs were analyzed based on the screened Good Jobs by the expert weighting method. A total of 94 jobs from 15 industries of Taiwan were examined in this study. However, only the textile industry was used as a case to create a Good Job specification assessment entry of "garment designer and pattern maker". This should provide the industries, government, academia, research institute, and vocation training center with guidance in cultivating college students, enabling the graduates to be employed successfully upon graduation with an adequate competency that meets actual workplace needs.

Keywords: Good Job, Delphi technique, expert weighting method, textile industry, upgrading and transformation

Introduction

Following the Advance Manufacturing Partnership (AMP) of the United States, Germany's Industry 4.0, Japan's Planned Human–machine Coexistence in Factories, South Korea's Next Generation Intelligent Factories, and the Made in China 2025 Plan, the world's major manufacturing countries are actively establishing intelligent production, manufacturing, and sales systems with cyber-physical integration features for the purpose of making rapid response to or predicting market demands. The vertical and horizontal digitization, intellectualization of industry supply chains have become the core of global competition for orders. According to Blumenthal and Haspeslagh (1994), industrial transformation is a course of change by means of strategies. They advocate redefinition of the corporate mission and establishment of competitiveness through strategic change to adapt to environmental changes and seize market opportunities, thereby maintaining an unassailable competitive advantage.

It is pointed out in Taiwan's industrial development strategy that, in facing the global economic integration, in particular, the regional integration in Asia, trade liberalization should be adopted to make breakthroughs to avoid further marginalization. In the past, the manufacturing industry laid more stress on the improvement of manufacturing-process efficiency, while relying on importation respecting key products and technology. This resulted in a lack of brands and channels and a relatively lower added value of our products. It is anticipated that, in the future, by upgrading traditional industries to add its products value and by expanding the growth base through manufacturing and service industry, Taiwan will cultivate new industries and optimize its industrial structure and develop soft power to shape new relative advantages of the industry (Ministry of Economic Affairs, 2017).

Low birth rates and low-wage working predicaments are two problems encountered by many countries in the past two decades. Because the main force of Taiwan's economy has been focused on equipment manufacturing, a more obvious learning–employment gap emerged when facing the rapid changing of technology. Inadequacy of jobs, talents, and technology is commonly seen in Taiwan's industries. On the other hand, college graduated students are also facing a dilemma, such as unfamiliarity with industrial environments, lack of working experience and employment information, insufficient basic capabilities, work values, and workplace ethics. The incompatibility between education received and structural changes of industry would prolong the time of students joining the workforce. This incurs losses both to the nation and society

According to Taiwan's 2011 "Survey on Employment Status of Workers Aged 15–29," the main concerns respecting young workers' employment consist of salary, benefits, and job stability. They also lay emphasis on knowledge and skills they may learn at work and the possibilities to apply what they have learned in school to the work, as well as their future prospects and pro-

motion opportunities, and the challenges of the job. Young workers stated that the main challenge encountered in their initial job searching is from their lack of experience, followed by their inability to discern suitable jobs. Among the reasons that young workers quit their first jobs, low salaries and poor benefits rank first, followed by a lack of development prospects (Ministry of Labor, 2011). A survey on the employment status of workers aged 15 to 24 in 2016 indicated that job priorities are "salary and benefits", "work stability", and "personal development prospects". Among the problems they encountered, low salaries and poor benefits ranked first, followed by concerns about lacking special expertise (Ministry of Labor, 2016).

According to the International Labour Organization (2010) ,the world economic crisis has a more palpable effect on unemployment rates for young adults than for middle-aged and older adults. Globally, young people face the same problems in transitioning from school to society, which underscores the urgency to promote youth employment. The job desirability indexes by Jencks, Perman & Rainwater.(1988) defines a "Good Job" as the most desirable job based on characteristics such as salary, additional benefits, and working hours, etc. As indicated in an official survey made in Taiwan, people from enterprises are generally of the opinion that youth employability requires improvement, holding that, apart from professional competence, employability requires various personal traits to be strengthened, including stability, the ability to work under pressure, work ethic, and interpersonal communication (National Youth Commission, 2009). Another official survey indicated that university graduates' initial employment considerations mainly include salary and benefits, followed by work stability and the knowledge and skills learned (Ministry of Labor, 2012). The job specification table by Dessler (2013) presents what multiple work descriptions indicate regarding the qualifications and conditions a worker should possess to perform a job well, which often includes knowledge, skills, and capabilities. According to Chun and Chou (2014), Japanese companies offer solid on-the-job training, in contrast with students' professional knowledge obtained in universities, they lay more stress on personality traits such as flexibility, endurance, embracing challenges, and teamwork.

The structural optimization and transformation of Taiwan's industries are implemented along the main lines of revitalizing traditional industries, consolidating major industries, and cultivating emerging industries, al well as the four major strategies, namely (1) high value and quality promotion to improve product quality and value, (2) key complementation to establish a complete industrial supply chain system, (3) system development to establish system solutions to project competency, and (4) innovative incubation to accelerate the development of new industries (Figure 1). The aim of these policies is to encourage enterprises to achieve high quality business connotation, featured by intelligence, green technology, and culture and creativity (Ministry of Economic Affairs, 2017). In addition, 17 key industries and 9 highlighted industries were proposed and recommended taking consideration of objective conditions, such as output scale, number of employees, and national development trends, as shown in Table 1.

This study underwent three stages. Firstly, we invited a great number of

Table 1. Correspondence Table for Industrial Upgrading and Transformation Categories, and the Industries Recommended by Taiwan Government (Industrial Development Bureau, Ministry of Economic Affairs, 2017)

Industrial Upgrading and Transformation Categories	Key Industries of Industrial Development Bureau	Highlighted Industries Recommended by Industrial Development Bureau
1. Key complementation (establish a complete industrial supply chain system)	Semiconductor industry	⦿
	Display industry	
	LED industry	
	Machine tool industry	⦿
	Electronic equipment industry	
	Bicycle industry	⦿
	Information service industry	
2. High value/quality promotion (improve product quality and value)	Steel industry	⦿
	Mechanical industry	
	Food industry	
	Petrochemical industry	⦿
	Textile industry	⦿
3. New industry incubation (accelerate the promotion of new industries)	Communications industry	⦿
	Biopharmaceutical industry	
	Cloud and big data industry	⦿
4. System development (establish systematic solution capabilities)	Digital content (including digital learning) industry	
	Design service industry	⦿

senior experts and scholars from the industries, universities, research institutes and vocational training centers to attend our panel, screening out the Good Job items. In the second stage, with Delphi method, we conducted deep-interviews with the experts and defined the Good Job items and establish the corresponding work instructions within the range of the key industries. Based on these works, we formulated relevant working instructions and questionnaires analysis of Good Jobs. In the third stage, we employed the expert weighting approach to assess the prominence of each item, in

Revitalizing traditional industries by means of high value/quality.	Incubating emerging industries.
◆High value petrochemical products. ◆High value metal products. ◆High value textile products. ◆Safe and secure food system. ◆Aerospace materials/components. ◆Deep seawater application. ◆Intelligent energy-saving motor/home appliances. ●Generic drugs internationalization.	◆B4G/5G communication systems. ◆New medicine and medical supplies. ◆3D printing and manufacturing. ◆Next-generation electronic equipment and manufacturing process. ◆●Electric car and energy storage system. ◆●Smart city and smart networking. ◆●Cloud industry and big data analysis. ●Digital content. ●Strategic service industry. ●Design industry. ●Intelligent automation engineering technology.
Consolidating major industries by key complementation.	Consolidating major industries by system development.
◆Tools and controllers. ◆Flat panel display materials. ◆Semiconductor materials. ◆High-end industrial process equipment. ◆Advanced electronic components. ◆Bicycle electronic actuators. ◆●Key silicone intellectual property and chip system. ●Wireless broadband application. ●Energy technology service industry. ●Information service industry.	◆●Intelligent automated production programs. ◆●Cloud data center solution. ◆●Green energy system integration and operations. ◆●Package plant export. ●Lifestyle innovation services. ●Energy information and communication services. ●Wholesale and retail. ●Food and beverage. ●Logistics. ●E-commerce. ●Health promotion.

Figure 1. Four major strategies for industrial structure optimization and transformation (Industrial Development Bureau, Ministry of Economic Affairs, 2017) ◆Manufacturing industry ●Service industry

which the assessment weights were used as the basis for screening. Finally, the work instructions were revised according to suggestions collected from students and industry human resource (HR) personnel. This study aims to develop a youth career vision, and to introduce Good Jobs to students, industries and universities. Earlier Good Job career development would enhance the awareness of job specifications, provide relevant opportunities and guide student's employment in concert with enterprises. distinct national conditions, industrial environments, and personal perceptions, the definition of a Good Job is a complex matter.

According to Hellriegel et al.(2001), competency refers to a combination of knowledge, skills, behaviors, and attitude, which helps improve an individual's work effectiveness, thereby drives the economic impact and competitiveness of an enterprise. Spencer and Spencer (1993) and Cooper (2000) discovered, that, based on the experience of different organizations, competency-based recruitment and selection models can assess the suitability of a job applicant or his potential to engage in a particular job. Introducing the competency method into the recruitment process not only assists enterprises in finding more potential personnel, but also improves the quality and competitiveness of the working force.

The "Industrial 4.0" was put forward by Germany in 2011 to promote the construction of "intelligent factory" with Cyber-Physical System as the core, so as to maintain her leading edge in the global manufacturing field. The technology strategy of the intelligent factory takes the category of Internet of Things (IOT) and the Internet of Ser-

Literature Review

The term "Good Job", encompassing "job", refers to both "work" and "occupation". It indicates the effort or activity of a mental or physical effort to produce or accomplish something (work), and a craft, trade, or profession performed for remuneration (occupation). The effort exerted and the compensation received by people engaged in the same jobs varies with different industries and countries. Because of vice (IOS), her development level integrates the value network, end-to-end process, vertical integration of manufacturing network, workstation base and Cyber-Physical System (CPS), in order to maintain the competitive advantage of Germany in the global manufacturing industry (Science and Technology Journal of Executive Institute, 2015).

The U.S. government proposed an Advanced Manufacturing Partnership (AMP) plan in 2011, the projects promoted by the development of technology include the enhancing of advanced materials, production technology, advanced process, data, design and other common basic capabilities of industries; the National Network of Manufacturing Institute (NNMI) is established to promote the cooperation of manufacture and research, to accelerate the implementation of government research achievements in industrial applications, and to enhance the international competitiveness and innovation ability (Official Abroad Report Information Network, 2012).

In 2013, Japanese government proposed Japanese Industrial Revitalization Plan to revitalize the manufacturing industry by taking advantage of equipment, research and development

to promote the investment. In 2015, the Japanese new robot strategy was proposed, the policy focused on the future factory of man-machine symbiosis, the technical strategy is the development of sensor, system control and drive, cloud computing, artificial intelligence robot. The robots can connect the Internet with each other to meet the needs of Japan's aging society, at the same time to revive the manufacturing industry - the pillar of Japan's economy (Science and Technology Journal of Executive Institute, 2015). The planning technical field includes information processing technology, precision machining technology, manufacturing environment technology, joint and assembly technology, stereo shaping technology, surface treatment technology, mechanical control technology, composite new functional materials technology, materials processing technology, biological technology and measurement technology.

In 2014, the Korean government put forward the "3.0 Policy of Manufacturing Innovation" to encourage the transformation and development of the manufacturing industry in Korea, and help the small and medium-sized manufacturing industry to establish an intelligent and optimized production process. The policy shall lead the innovation, creation and integration of manufacturing industries. The goal is to strengthen the core competitiveness of major industries by developing technologies such as strategic key materials and software integrating components. Besides the continuous strengthening on the support of the entrepreneurship research and development, social welfare, small and medium-sized backbone enterprise, the important development goal of industrial development is focused on the knowledge and innovation, through a series of industrial integration, innovation and promoting the global growth of domestic enterprises, to create economic power and enhance the competitiveness of the domestic industries. The industrial science and technology development in the future emphasizes the development of cross industry integration, and the layout shall be focused on the cross industry integration, especially IT industry. Based on the creation and integration, to promote the integration of IT industry, main industry and new industry to develop towards the "age of integration revolution".

Taiwan's 2014 "Study on Good Job Opportunities in Industrial Transformation" first defined Good Jobs from the perspectives of national and social development promotion as a working item that measures multiple aspects including contribution to promote a country's development, workers' personal development , assistance to manage employers' business, as well as salaries, compliance with industrial development, additional benefits, working hours, and contribution to society.

According to the "Research and Analysis of Good Job Items and Development of Career Information" (2015) ,"Good Job" was defined as "a work that matches the intrinsic and external conditions of job applicants' expectations among the work required for national economic development". The intrinsic conditions are attributes, such as personality traits, interests, capabilities, work values, and life values, whereas the external conditions involve an objectively established screening mode. The five indexes of Good Job are (1) satisfactory compensation and benefits, (2) development potential and prospects, (3) exhibition of personal capabilities at work while maintaining a

work–life balance, (4) accumulation of work experience and skills in line with personal career development plans, and (5) the presence of international perspective.

Based on the screening mechanisms for industrial Good Jobs established in 2015, the "Good Jobs Information Collection" (2016) ,regarding the industrial trend and government policy direction, defined that Good Jobs should contribute to promoting national economic and social development, assisting employers' business management and development, and promoting workers' personal career development. It offered seven dimensions according to this definition: (1) satisfactory compensation, (2) development prospects within the industry, (3) job security and promotion, (4) competency demonstration at work while maintaining a work–life balance, (5) nature of the work, (6) work relations, and (7) international perspectives.

The Occupational Competency Standard (OCS) is the competence combination, which is developed by the central competent authority or relevant entrusted units, to complete the specific occupation or job category's tasks including major tasks, corresponding behavior pointer, work output, knowledge, technology, attitude and other function connotations. In short, OCS is the "talent standard" established by the government. The competency classification is the professional function, which is the ability required for employees to engage in specific professional work (in accordance with the department). In the connotation of industrial Occupational Competency Standard, the establishment of competency shall consider the foresight and futurity of industrial development, and take into account the commonality of ability of professionals required by different enterprises in the industry, as well as the competence necessity of the occupation in this career (professional). Therefore, OCS is not limited by the specific tasks, but taking a number of OCS units and occupation or job category as the scope, to frame its work scope description, and develop its task, which presents the commonality and necessity of ability connotation required by the industry (Labor Development Department of the Ministry of Labor, 2017).

To promote industrial upgrading the advanced manufacturing countries have already established competency standards and industrial competency or skill standards to realize the convergence of talent development with industrial activities and business needs. Given the rapid changes in industry and the increasing global competition faced by enterprises, students should be encouraged to put their efforts in the Good Jobs required for industrial upgrading and transformation, which can not only drive the industries to develop towards the direction of manufacturing high value-added products and to mitigate the youth unemployment pressure. Therefore, this study, using the advanced method 2.0 employed in the United States, aims to guide students into AMP industries, and to outline the relevant occupations in the advanced manufacturing industry. The work content, salary, education level, and training required for promotion to the next level for each occupation were also introduced for the purpose of assist more talents in participating in the advanced manufacturing industry and shaping career development visions. In addition, this study, by preferring to the O*NET OnLine database, uses the work description for the different knowledge, skills, and capabilities required by each

occupation as the preliminary draft of this study.

This research is confined to the 17 most important industries supervised by Taiwan government, and the questionnaire surveyed the flag manufacturers' senior directors who have more than 10 years of service and experience.

Research Method

Figure 2 presents the research procedure used in this study, which consists of expert panel, Good Job establishment procedure, expert weighting methods, and questionnaire design.

Expert Panel

The first stage of the expert panel determined the preliminary potential items for Good Jobs. The panel comprised of experts from academia (science and technology university, innovation and incubation center), industry (IPO company or flagship company), research institute (Industrial Technology Research Institute, Institute for Information Industry, and Metal Industries Research and Development Center), vocational training center (Taiwan Printed Circuit Board College and 1111 Job Bank). The second stage implemented the Delphi method, in which the experts completed the Good Job screening questionnaire, aiming to prompt further discussion. Finally, the demanded Good Job was then established by the expert panel.

Procedure for Establishing Good Jobs

(1) Establish Screening Mechanisms

Candidate Good Jobs were selected from the recruitment divisions of major companies in each industry to develop the screening questionnaire including weighting factors. Employee individually completed a questionnaire using Likert 5-scale evaluation criteria, with experts from each industry answering the questionnaire, screening the candidate Good Jobs, and conducting an expert panel to discuss and establish the demanded Good Job.

(2) Defining Good Job Items

Industry, university, employment counseling and career development experts were invited to recommend the Good Job based on the candidate list, after which a consensus was reached through joint discussion whereby Good Jobs from each industry were selected.

(3) Developing Job Description Information

i. Collecting Good Job Information

Based on the selected Good Job items for each industry, relevant employment information from the Occupational Information Network in the United States, Taiwanese job banks and the Ministry of Labor were collected. The collected information included job titles, suitable industries, job content and work condition, educational background, relevant majors, and salary and benefits. Description of information was compiled for reference purpose in the expert interviews.

ii. Interviewing Experts on Good Job Practices

In-depth interview method was employed, by which at least two outstanding personnel and corporate HR managers were interviewed for each job to understand actual job contents and work condition, career development and

views from enterprises regarding Good Job.

iii. Composing Good Job Description Information

The template for collecting the content of Good Job is shown in Table 2.

Table 2. Good Job Item Template

Items	Content
Title of Good Job	
Suitable industry	
Job content and work condition	
Required qualifications and relevant majors	
Required knowledge and skills (compulsory and desirable)	
Average salary range	
Future development prospects	
Learning resource recommendations	

(4) Design Talent Training Programs

The focus of this step was the cultivation of required knowledge and skills for Good Jobs and the various corresponding learning resources. For example, the main cultivation sites for elementary assembly workers are vocational high schools, with enterprises providing 3–6 months of orientation and on-the-job training. Government- subsidized training programs include university improvement courses sponsored by the Ministry of Education that cultivate in-school students. The Workforce Development Agency has funded university employment programs for in-school students counseling and sponsored on-the job training programs, to assist vocational training centers in training the unemployed graduates. The Ministry of Economic Affairs has also sponsored programs to encourage engineering staff and the unemployed to partake in vocational training in the relevant industries.

(5) Promoting Career Information

This involves university career activities that help to promote the introduction to career information concerning Good Job, providing college students with the necessary contents to understand Good Job and begin planning their personal careers as soon as possible. Good Job career promotions were also aimed at career development personnel or companies involved in promotion activities for the youth to disseminate Good Job information and career concepts, such as the UCAN (University Career and Competency Assessment Network, UCAN) university employment and competency platform by the Ministry of Education. Career development lectures in vocational high schools were also integrated to introduce Good Jobs and establish student career visions, while illustrating the Good Jobs provided by enterprises. In addition, approaches such as constructing websites, producing manuals, and establishing Facebook fan pages were also employed to encourage participation of the youth.

Expert Weighting Method

The assessment methods for multiple variable weightings still have some tricky problems, and the setting of variable weightings has undergone considerable discussions in the literature. However, Dyson and Thanassoulis (1988), Thompson et al. (1990), Wong and Beasley (1990), and Bao et al. (2015) have argued that the weights of each variable should be determined according to experts' own knowledge of the problem.

Assuming variable *s* exists, the average for the importance of variable *i* can be calculated based on *s* ratio.

The expert weighting method is defined as follows. "The importance of variable *i*" is divided by "the importance of variable *j*", and the ratio is the degree by which "*i* overrides *j*". If "*i* overrides *j*" > 1, the importance of variable *i* is greater than that of variable *j*, and vice versa.

The method is implemented as follows.

(1) On a 5-point Likert scale, k experts were requested to give scores as to the importance of variable s to establish the importance relationship matrix X.

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1s} \\ x_{21} & x_{22} & \cdots & x_{2s} \\ \cdots & \cdots & \cdots & \cdots \\ x_{k1} & x_{k2} & \cdots & x_{ks} \end{bmatrix}$$

(2) The *j* rows of elements in Matrix X are divided by the *i* elements in the other rows, from which *s* "relative importance" matrices are derived, *i*, *j* = 1, …, s. The k rows of elements in s matrices are added and arranged in the following matrix T.

$$T = \begin{bmatrix} t_{11} & t_{12} & \cdots & t_{1r} & t_{1s} \\ t_{21} & t_{22} & \cdots & t_{2r} & t_{2s} \\ t_{r1} & t_{r2} & \cdots & t_{rr} & t_{rs} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ t_{s1} & t_{s2} & \cdots & t_{sr} & t_{ss} \end{bmatrix}$$

The first column of elements in matrix T refers to the sum of all columns after dividing the elements in the first row of matrix X by those in the other rows, and the data in other columns is analogized in similar approaches. The data t_{ij} in each column represents the importance ratio of the variable *i*-th in relation to the variable *j*-th, and a greater t_{ij} indicates that the importance of the variable *i*-th overrode that of the variable *j*-th by a greater degree. Furthermore, t_{rj} represents the degree by which the variable *r*-th is overridden by the variable *j*-th, and a greater t_{rj} indicates that the importance of variable *j*-th is greater than that of the variable *r*-th.

(3) Each variable *r* overrides variable *j* to some degree (t_{rj}), though it also possesses a degree of being overridden by variable *j* (t_{jr}), thus 〔 $t_i1 / t1_i$, $t_i2 / t2_i$,…. , t_is / ts_i 〕, *i* = 1, …, s. The elements in this vector could be expressed as variable *i* divided by the degree to which variable *i* overrides variable *j*. The sum of the elements in each *i* column is calculated, with a greater value indicating a higher importance for the variable *i*-th in relation to the other variables.

Questionnaire Design

(1) International Social Survey Program (ISSP) Questionnaire by the Organization for Cooperation and Development (OECD)

According to the ISSP questionnaire developed by the OECD, Good Job are defined by using factors such as compensation, working hours, job development and security, job difficulty, job content, and interpersonal relationships at work (Chang and Fu, 2003).

(2) Good Job Ranking by the US News

The Good Job ranking by the US News selected the top 100 good jobs in the United States using seven indicators, including median annual salary (30%), career prospects (20%), employment rate (20%), growth of number of job openings in 10 years (10%), and growth of ratio of job openings in 10 years (10%), stressed level (5%), and work–life balance (5%) (Inside, 2014).

(3) People Security Surveys (PSSs) by the International Labor Organization

The International Labor Organization conducts transnational Good Job surveys using the PSSs questionnaire, which investigates several aspects, such as salaries, benefits, nature of work, autonomy, opportunities for upgrading skills, and promotion opportunities (Ritter and Anker, 2002).

In this study, we devised the questionnaire for screening Good Jobs using some of the topics from the ISSP work orientation. From Taiwanese Edition of the ISSP Work Orientation III Questionnaire 2005, the 50th question (50a–h) was adopted and measured using a 5-point Likert scale (Chang, 2005).

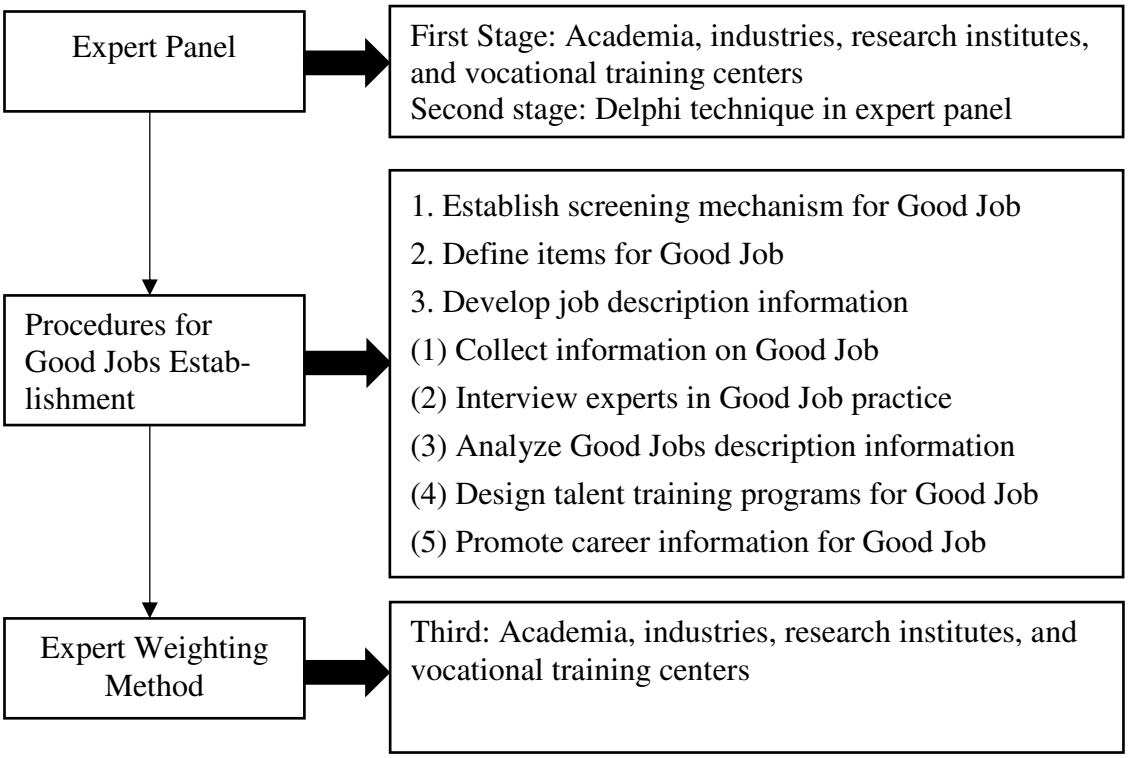

Figure 2. Research procedure used in this study

Combining these dimensions for Good Job as defined by various countries, in total, seven dimensions were examined as the indicators for selecting Good Jobs: satisfactory compensation, development prospects within a specific industry, job security and promotion, ability to demonstrate one's competency while maintaining a work–life balance, nature of work, work relations, and international perspective.

Case Study: Textile industry

Good Job Screening

The first stage of selecting 42 items of Good Jobs involved in textile industry as shown in Table 3. The screening was conducted based on the research by various countries and international organizations, expert opinions being duly considered, from which the Good Jobs in Taiwan were developed. Eight experts from academia, industries, research institutes, and vocational training centers formed the panel. Their discussions yielded six Good Jobs in the first stage.

Further discussions were conducted in the second stage, in which the top two jobs were appraised as Good Jobs openings whose development is the most urgent priority. The Good Jobs in each industry were imparted relative importance following the discussions by the experts, scholars, and IPO representatives in the expert panel. The Good Job obtained the highest score was garment design and pattern making, followed by materials R&D personnel, as indicated in Table 4. (Note: Please see Tables 4 - 9 at the end of this article.)

Job Specification Entries

In the process of Good Job establishment, a job specification entry was produced in the second stage, 12 presented themselves at the panel and discussed the Good Job description items relating to the textile industry by Delphi approach. In the case of garment pattern makers, its Good Job was occupation code 12 in the apparel and clothing accessory manufacturing industry (excluding fashion accessory manufacturing), as announced by the government (Accounting and Statistics Office, 2017). A job specification entry for garment pattern making was produced in accordance with this process (Table 5).

Screening of Good Job Demands

To determine the priority consideration factors of Good Jobs in the textile industry at the third stage, we invited 12 experts from the industries, academia, research institutes, and vocational training centers and conducted discusses for the purpose of pinpointing the most crucial requirements. An expert questionnaire containing 7 requirements and 21 item questions was distributed to these 12 experts. In spite of the small sample, the experts who answered the questionnaire were highly qualified. The measured results are included in the "Summary Scale for Expert Requirement Opinions" in Table 6. After the 12 returned-questionnaires were scored, the relationship matrix was calculated using the expert weighting method, and the relative importance of Good Job requirements in the industry was obtained. First, the data in Table 6 was subjected to the expert weighting method to determine the importance relationship matrix T suitable for each industry requirement, as shown in Table 7. From Tables 7 and 8, the importance sequence of the experts' requirements was then calculated by the expert weighting method, as shown in Table 9.

Table 9 shows the importance matrix of the experts' Good Job requirements. The ranking in the penultimate row was obtained using the values from the sums of data from each column, with "nature of work," "satisfactory compensation," and "development prospects in the industry" having the highest weighting. "Ability to demonstrate competency while maintaining a work–life balance" and "work relations" ranked sixth and seventh, respectively, having the two lowest weightings.

Career development map

The career development map of the study is based on the second stage of the expert forum by Germany, Philippines and France to discuss the high-class work instruction items of textile industry. Based on the example of pattern maker and in accordance with high-class work instruction, the career development map can be summed up. The career development map is divided into management career, professional career, interdisciplinary career and similar industries, which can make the high-class work industry develop vertically and horizontally. The career development map is the innovative idea summarized in this paper, in order to provide guidelines for young students to engage in superior work, and to provide quality jobs and guide the employment for young students in cooperation with enterprises as shown in Figure 3.

Conclusion

This study has established a screening mechanism to determine relevant information about the Good Jobs in key industries, providing college students with a reference to guiding them into Good Jobs. It is hoped this can compensate for the talent and technology gap that must be bridged to implement industrial transformation and upgrading.

Good Jobs in the textile industry were researched as a case study. Five Good Jobs were screened from 42 job candidates by two expert panels and through Delphi method interviews. The jobs of fashion design and pattern maker were analyzed using expert weighting method, which indicated the crucial factors that took priority over consideration was the "nature of work," whereas "work relation" was the factor of least importance.

From the primary requirements made in this study, job specification entries for Good Jobs in key industry were developed. Similarly, the Ministry of Economic Affairs has published a total of 94 Good Jobs from 15 industries online (2017) with the purpose of enabling college students to find employment after graduation and meet actual workplace needs.

Suggestions

Due to the rapid changes in industrial technology and market demand, as well as the government's rolling adjustments toward labor and employment strategy, researchers are encouraged to lay more stress on the research in this direction. It is hoped that this study will furnish a starting point for in-depth investigations of the mentioned key industries and Good Job items, as well as the gaps between education and industrial performance so that universities and industries can collaborate more effectively in talent trainings.

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Table 3. Candidates of Good Jobs in Textile Industry

No.	Textile Industry-Related Job Openings	No.	Textile Industry-Related Job Openings	No.	Corresponding Job Openings for Textile Technology Development and Application
1	Process engineer	13	Material analysis researcher	26	Industrial fabric development
2	Color control specialist	14	Special dyeing and finishing researcher	27	Nonwoven development technology
3	Manufacturing process development	15	Ecology researcher	28	Fabric membrane manufacturing process and application development technology
4	Production management engineer	16	IE engineer	29	Biomaterial development technology
5	Environmental, safety, and health administrator	17	Knitting developer	30	Optoelectronic products and systems development
6	Mathematics assistant researcher	18	Chemical engineer	31	System automation and integration development technology
7	Materials R&D personnel	19	Textile engineer	32	Dyeing and finishing technology and services
8	Physics assistant researcher	20	Instrument control electrical technician	33	Yarn and key components development technology
9	Chemistry assistant researcher	21	Mechanical engineer	34	Development of textile professional information systems
10	Textile chemical engineer	22	Substitute service in textile fabric R&D	35	Innovative inkjet printing design and services
11	Chemical engineer	23	Electrical engineer	36	Energy saving and carbon reduction application technology and services
12	Raw materials researcher	24	Digital printing production engineer	37	Ester-based moisture-permeable and waterproof textile development technology
		25	Fabric design	38	Polymerization and spinning technology
				39	Functional master batch/fiber development
				40	Functional materials development technology
				41	Fabric surface treatment technology
				42	Fabric design and development

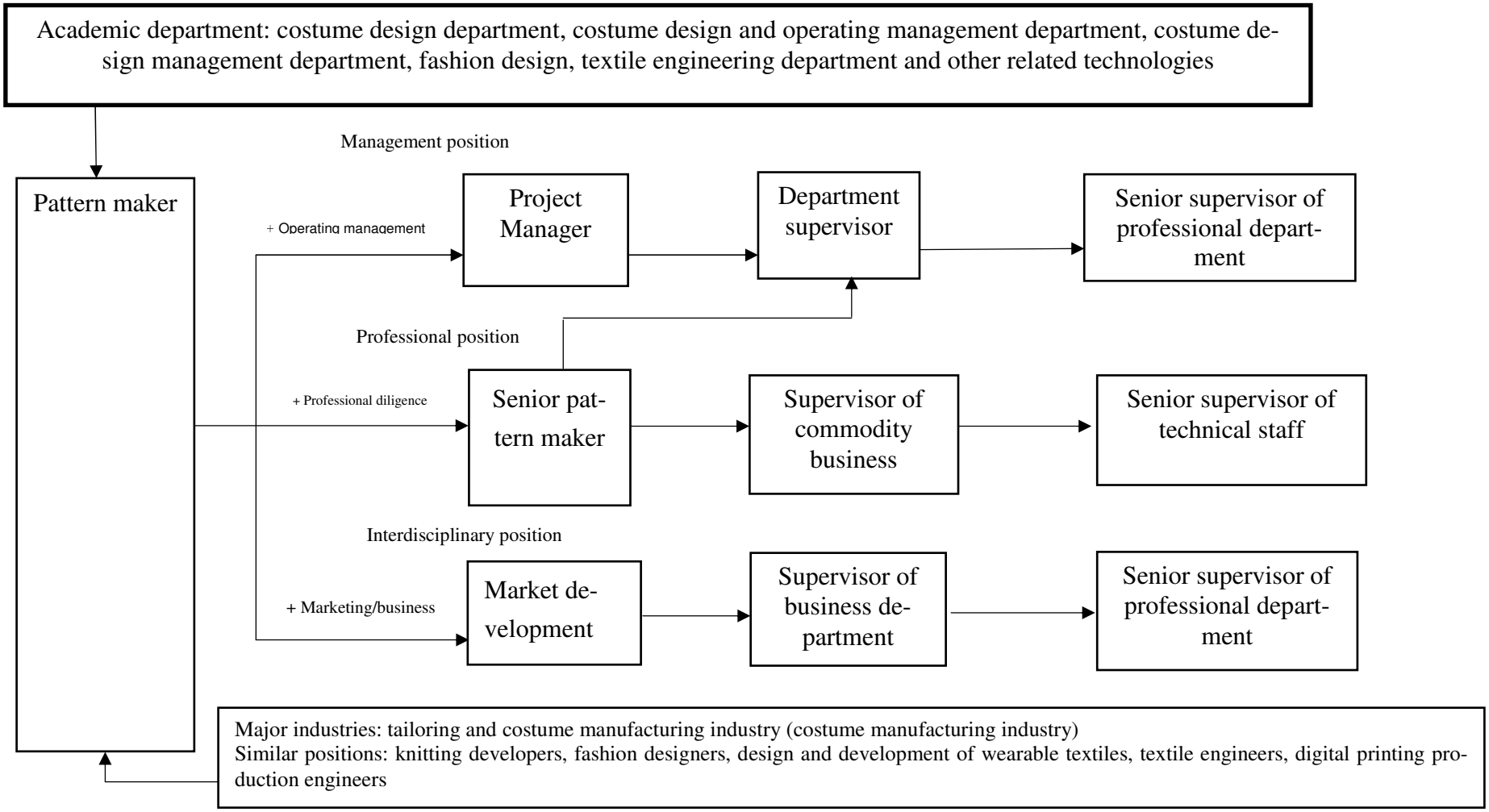

Figure 3. Career Chart

Table 4. Good Job Top 5 Rankings in Textile Industry

Textile Industry Good Jobs	Mean	Weighted Score	Ranking
Special Dyeing and Finishing Researcher	75.43	3.64	5
Textile Chemical Engineers	77.27	3.71	3
Materials R&D Personnel	78.33	3.79	2
Development Process Engineer	76.56	3.71	4
Garment Design and Pattern Making	80.47	3.86	1

Table 5. Good Job Specification Item Example: Garment Pattern Maker

Items	Content
Good Job Title	Garment Pattern Maker
Suitable Industry	Apparel and clothing accessory manufacturing (not including fashion accessories)
Job Content and Work Condition	The basic job of a garment pattern maker is to accurately draw apparel patterns in 2D, whether in traditional or digital media, based on fashion designers' finished design drafts. produce sample and product versions based on the designers' draft, which involves communication with the designers regarding design details, and production methods with the sample makers, and coordinating apparel-related problems at the business end to successfully complete sample production and control its progress. The main job contents and responsibilities are: 1. Realizing fashion designers' design drafts through hand-drawn or computer-drawn pattern-making (including: men's and women's shirts, underwear, jeans, suit pants, casual pants, waterproof pants, skirts, jackets, snow suits, down jackets, dust coats, jackets, suits, children's wear, casual sportswear, dresses, gowns, and swimsuit), and 3D tailoring work. 2. Pattern-making of woven and knitted garments, marking, estimated fabric consumption, and follow-up corrections. 3. Describing the contours and details of each part of the garment, indicating wrinkles, button holes, and other functional parts using a computer. 4. Proposing detailed design drafts indicating the materials, colors, sizes, processing methods, and necessary aspects of the pattern design. 5. Integrating clothing production processes such as pattern-making, tailoring, sewing, and beadwork, and solving problems encountered during platemaking and sewing.

	6. Quarterly clothing product planning, fabric planning, style design, fabric selection, and decorative accessories, and draw sketches. 7. Managing clothing production samples and junior pattern makers, ensuring full communication with clothing OEM for the successful completion of the sample production 8. Analyzing market trends, conceiving product styles based on popular trends and implementing development and design.
Academic Requirements and Relevant Majors	Bachelor's degree or above; the relevant majors include fashion design, fashion design and operations management, fashion design management, fashion and stylist design, and textile engineering.
Knowledge and Skills Required	Knowledge: 1. Material (cloth) characteristics 2. Production process management 3. Quality management 4. Customer satisfaction 5. Marketing and strategy 6. Statistical applications 7. Art 8. Aesthetics 9. Chromatics
	Skills: 1. Operation of pattern making software (Gerber, Docad, Lectra), system operation, marking, computer layout, drawing, magnification 2. Draft production and interpretation 3. Sample testing 4. Apparel pairing skills 5. Market trend analysis 6. Clothing design performance capabilities 7. Sales control 8. Customer needs assessment
	Personal Attitudes and Traits: 1. Communication skills 2. Problem solving 3. Self-development 4. Active listening 5. Quality-oriented 6. Ability to work under pressure 7. High EQ 8. Emphasis on teamwork
Average Salary Range	Starting salary with bachelor's degree: NT$ 28,000–NT$ 31,000 monthly; NT$ 29,500 on average; Monthly salary after 3 years: NT$ 37,000–NT$ 41,000; NT$ 39,500 on average Starting salary with master's degree: NT$ 32,000–NT$ 37,000 monthly; NT$ 35,000 on average

	Monthly salary after 3 years: NT$ 39,000–NT$ 42,000; NT$ 41,000 on average
Future Career Development	Senior supervisor, design director, planning manager, senior garment pattern maker, knitting developer, fashion designer, wearable textile design and development, textile engineer, digital printing production engineer, etc.

(Editor's Note: See Table 6. below).

Table 7. Analysis of Importance Relationship Matrix T Using Expert Weighting Method

12	12.9455	14.8939	15.1388	12.0609	15.514	14.166
11.9394	12	13.1639	14.2288	11.6978	14.8765	14.1392
11.4758	11.5105	12	13.5295	11.4149	14.4343	13.8052
10.5529	10.7578	11.6495	12	10.4223	12.8688	12.4329
12.2219	12.842	14.7985	15.1158	12	15.4931	14.2843
9.89127	10.2246	11.4936	11.6994	9.75559	12	11.4369
10.5035	11.4892	13.6993	13.3357	10.4494	13.3218	12

Table 8. Transposed Matrix T^t of Matrix T

12	11.9394	11.4758	10.5529	12.2219	9.89127	10.5035
12.9455	12	11.5105	10.7578	12.842	10.2246	11.4892
14.8939	13.1639	12	11.6495	14.7985	11.4936	13.6993
15.1388	14.2288	13.5295	12	15.1158	11.6994	13.3357
12.0609	11.6978	11.4149	10.4223	12	9.75559	10.4494
15.514	14.8765	14.4343	12.8688	15.4931	12	13.3218
14.166	14.1392	13.8052	12.4329	14.2843	11.4369	12

Table 6. Summary Scale of Experts' Opinions

	Satisfactory compensation	Development prospects within the industry	Job Security and promotion	Ability to demonstrate competency while maintaining a work–life balance	Nature of work	Work relations	International perspective
1	12	6	3	5	11	7	13
2	9	9	9	9	9	9	9
3	12	15	14	12	14	11	9
4	12	11	11	9	10	10	9
5	12	13	12	12	13	11	12
6	15	15	15	7	15	7	11
7	9	12	10	10	12	8	7
8	14	11	15	12	10	8	8
9	15	15	15	15	15	15	15
10	14	10	11	13	14	10	13
11	11	14	12	14	12	11	10
12	12	13	13	9	13	12	12

Table 9. Importance Matrix and Ranking Using Expert Weighting Method

1	1.08427	1.29785	1.43457	0.98683	1.56845	1.34869	8.72065	0.173	2	Satisfactory salaries
0.92228	1	1.14364	1.32264	0.91091	1.45497	1.23065	7.98509	0.158	3	Development prospects in the industry
0.77051	0.8744	1	1.16138	0.77135	1.25585	1.00774	6.84124	0.136	4	Job security and promotion
0.69707	0.75606	0.86104	1	0.6895	1.09996	0.9323	6.03593	0.120	6	Ability to demonstrate one's competency while maintaining a work–life balance
1.01335	1.09781	1.29642	1.45033	1	1.58812	1.367	8.81304	0.175	1	Nature of work
0.63757	0.6873	0.79627	0.90913	0.62967	1	0.85851	5.51846	0.109	7	Working relationship
0.74146	0.81258	0.99232	1.07262	0.73153	1.1648	1	6.51531	0.129	5	International perspective
							50.4297			

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MANAGERIAL OVERCONFIDENCE AND EARNINGS MANAGEMENT

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Abstract

Overconfident executives tend to make their firms' financing and investment decisions irrationally. Thus, we predict that overconfident managers will be prone to have earnings management behavior. We analyze whether executive overconfidence affects earnings management, including accrual-based and real earnings management. Using quantile regression model and ordinary least squares model, the evidences indicate that managerial overconfidence is positively associated with accrual-based earnings management based on the 744 public listed companies from 2006 through 2012 in Taiwan. However, according to the results of quantile regression under different quantile, real earnings management and accrual-based earnings management has substitute relationship (negative association) in the lower overconfident quantile and has complementary relationship (positive association) in the higher overconfident quantile. The results support that managers with more overconfidence are inclined to use both kinds of earnings management compared with less overconfidence managers.

Keywords: Managerial overconfidence, Real earnings management, Accrual-based earnings management

Introduction

This study investigates whether and how managerial overconfidence affects firm's earnings management behavior. We use two kinds of earnings management measurement methods including real earnings management and accrual-based earnings management and especially focus on whether there exists complementary (or substitute) relationship between these two methods of earnings management in the different quantile level of managerial overconfidence.

Overconfident managers tend to make their firms' financing and also investment decisions aggressively and even irrationally based on prior research. Their aggressive or irrational managerial behaviors includes overestimating future investment projects (Heaton, 2002; Malmendier and Tate, 2005a, 2005b, 2008, 2011, 2015), lower dividend payout (Deshmukh, Goel and Howe, 2013), higher frequency of management forecast (Hribar and Yang, 2016; Libby and Rennekamp, 2012). More specifically, earnings management is viewed as playing a very important role in corporate decision (e.g., Xie, Davidson, and DaDalt, 2003; Cornett, Marcus, and Tehranian, 2008; Adam, Fernando, and Golubeva, 2015).

Investigating the effects of overconfidence on corporate policies, especially in accounting policies, is also important because overconfidence can induce decisions that destroy firm value. For example, Roll (1986) argues that managerial overconfidence (or hubris explains the reason why firms engage in value-destroying mergers or acquisitions. Similarly, distortions in other investment, financing, or accounting policies can be costly (Malmendier and Tate,2005, 2008; Ben-David, Graham, and Harvey, 2010).

Recently, a stream of accounting research focuses on the impact of overconfidence on the likelihood of AAER (Schard and Zechman, 2011), and financial restatement (Presley and Abbott, 2013). Since earnings management has become one of the most important issues in accounting theory and corporate governance, therefore whether overconfidence interacts with earnings management deserves further investigation. As such, extending this line of research, the purpose of this research is to investigate the effects of firm's managerial overconfidence on earnings management. We hypothesize that if overconfident managers overestimate future returns from their firms' project, they are likely to have earnings management behavior.

In this paper, we examine how manager's overconfidence affects both real and accrual-based earnings management activities. Our tests are based on a sample of 20,832 firm-years over 2006-2012 from public listed companies in Taiwan that have the available data needed to carry out our tests. Our primary measure of overconfidence is based on the managers' holding of shares following Malmendier and Tate (2005b).

The empirical results show that managerial overconfidence is negatively correlated with the real earnings management, meaning that overconfident managers seem to have less earnings management behavior.

However, managerial overconfidence is positively and significantly correlated with the accrual-based earnings management, supporting those overconfident managers may still manage earnings using some other method. Therefore, in order to clarify the relationship between accrual-based and real earnings management, we further investigate the interaction of accrual- based and real earnings management under different quantiles. The evidence show that when using absolute value of discretionary accruals as a proxy of earnings management, real earnings management and accrual-based earnings management has negative association (substitute relationship) in the lower overconfident quantile of 0.1 and even 0.5 but has positive association (complementary relationship) in the higher overconfident quantile of 0.9, 0.95, and 0.99.

The remainder of this paper is organized as follows. Section 2 reviews related literature and *develops hypotheses. Section 3 describes empirical design including empirical models, measures of overconfidence and earnings management, and description of data and sample. Section 4 analyzes the empirical results and provides sensitivity analysis. Section 5 concludes the paper.*

Literature Review and Hypotheses

Overconfidence and other self-serving biases have received significant attention for many decades in the social and experimental literatures (for example, Miller and Ross 1975; Svenson 1981; Alicke 1985). Based on prior research of behavioral finance, overconfidence refers to the tendency of people to overestimate their know- ledge and information accuracy. Overestimation of their ability leads to erroneous decisions and over-optimism. For example, older managers tend to be more conservative (Bertrand and Schoar, 2002).

Ahmed and Duellman (2013) investigate the relation between managerial overconfidence and accounting conservatism. Hsieh, Bedard, and Johnstone (2014) investigate the relation between CEO overconfidence and earnings management during shifting regulatory regimes. Hribar and Yang (2016) found that overconfidence managers increased optimism in voluntary disclosure, leading to overestimation of manager expectations and greater earnings management. Schrand and Zechman (2012) argue that managerial overconfidence increases the likelihood of manipulating financial reporting fraud and has unrealistic beliefs about future performance.

Prior research has found that there are certain relationship between real earnings management and accrual-based earnings management. For example, Kim, Wang, and Zhang (2016) examines the association between chief executive officer (CEO) overconfidence and future stock price crash risk. Enomoto, Kimura, and Yamaguchi (2015) show that managers in countries with stronger investor protection tend to engage in real earnings management instead of accrual-based earnings management. Alhadab, Clacher, and Keasey (2015) find that IPO firms experience a higher probability of IPO failure and lower survival rates in the post-IPO period when greater

real earnings management takes place during the IPO as compared to accrual earnings management. Li and Hung (2013) claim that there is moderating effects of family control on the relation between managerial overconfidence and earnings management. Braam, Nandy, Weitzel, and Lodh (2015) examines whether the trade-off between real and accrual-based management strategies differs between firms with and without political connections.

Based on these above prior research, the following hypotheses are developed.

H1a: Managerial overconfidence is associated with accrual-based earnings management.

H1b: Managerial overconfidence is associated with real earnings management.

H2: Under different quantile level of managerial overconfidence, real earnings management and accrual-based earnings management has substitute or complementary relationship.

Data and Methodology

Sample Selection and Variable Definitions

Our sample period is from 2006 to 2012. The source of stock price and accounting variable is taken from Taiwan Economic Journal (TEJ). Our sample covers firms using calendar year and excludes those firms in the financial related industry or with insufficient data. Consequently, the final sample consists of 20,832 observations from 744 public listed companies. Table 1 includes definitions of all variables.

Quantile Regression

Quantile Regression as introduced by Koenker and Bassett (1978) seeks to complement classical linear regression analysis. Quantile regression model is to investigate whether the explanatory variables have different effects on the conditional distribution of the explanatory variables under different quantiles. Given regression parameter, quantile regression model is robust and is not easily affected by outlier or extreme value. We use quantile regression model as shown in Koenker and Hallock (2001) in the research.

Measurement of Real Earnings Management

Following the strategy of measuring real earnings management by Roychowdhury (2006) and also Cohen, Deyand, and Lys (2008), we consider three types of real activities as proxies including sales manipulation, reduction of discretionary expenses and overproduction. Then, following the regression model of Cohen et al. (2008), we use year-specific and industry- specific differentiation to calculate abnormal cash flows from operation, abnormal production costs and abnormal ruling costs based on residual values. The empirical models are shown as follows.

Table 1. Definition of Variables

Variable	Code	Definition
Real Earnings Management	REM	An composite indicator consists of sales manipulation, reduction of discretionary expenses and overproduction
Discretionary Accruals	DA	Discretionary Accruals are calculated following Kothari et al.(2005)
Absolute Discretionary Accruals	|DA|	Absolute value of discretionary accruals
Managerial Overconfidence	OC	Indicator variable equal to one if the manager of the firm increasingly purchases his own firm's stock over the past 4 quarters and zero otherwise.
Firm Size	Size	The natural logarithm of firm's asset
Return on Assets	ROA	The ratio of return after tax on total assets
Debt Ratio	LEV	The ratio of total debt on total assets
Market to Book Ratio	MB	The ratio of market value on book value
Ratio of Outside Director	Outside	The ratio of outside director in the board
Shareholding of Institution Investor	INSR	The ratio of shareholding owned by institution investor
Board Size	Bsize	Indicator variable equal to one if the size of the board is greater than the median of all sample firm and zero otherwise.
Shareholding of Board of Directors	Hold	The ratio of shareholding owned by board of directors

(Editor's Note: the following sections are in single column format to allow for easier reading).

Calculating abnormal cash flow from operating activities

$$\frac{CFO_{it}}{A_{i,t-1}} = a_0 + a_1\left(\frac{1}{A_{i,t-1}}\right) + a_2\left(\frac{S_{it}}{A_{i,t-1}}\right) + a_3\left(\frac{\Delta S_{it}}{A_{i,t-1}}\right) + \varepsilon_{i,t} \quad (1)$$

$$\frac{\widehat{CFO}_{it}}{A_{i,t-1}} = \hat{a}_0 + \hat{a}_1\left(\frac{1}{A_{i,t-1}}\right) + \hat{a}_2\left(\frac{S_{it}}{A_{i,t-1}}\right) + \hat{a}_3\left(\frac{\Delta S_{it}}{A_{i,t-1}}\right) \quad (2)$$

$$Abn\_CFO_{i,t} = \frac{CFO_{it}}{A_{i,t-1}} - \frac{\hat{CFO}_{it}}{A_{i,t-1}} \quad (3)$$

Where $CFO_{i,t}$ is the cash flows from operating activities of current year; $A_{i,t-1}$ is the total asset of previous year; $S_{i,t}$ is net income of current year; $\Delta S_{i,t}$ is the current year's net income minus the prior year's net income; $\varepsilon_{i,t}$ is the residual term. And finally, $\mathbf{Abn\_CFO}_{i,t}$ is the abnormal cash flow from operating activities.

Calculating abnormal production costs

$$\frac{COGS_{i,t}}{A_{i,t-1}} = \beta_0 + \beta_1\left(\frac{1}{A_{i,t-1}}\right) + \beta_2\left(\frac{S_{i,t}}{A_{i,t-1}}\right) + \varepsilon_{i,t} \quad (4)$$

Where $COGS_{i,t}$ is cost of goods sold of current year; $A_{i,t-1}$ is the total asset of previous year; $S_{i,t}$ is net income of current year; $\varepsilon_{i,t}$ is the residual term.

$$\frac{\Delta INV_{i,t}}{A_{i,t-1}} = \beta_0 + \beta_1\left(\frac{1}{A_{i,t-1}}\right) + \beta_2\left(\frac{\Delta S_{i,t}}{A_{i,t-1}}\right) + \beta_3\left(\frac{\Delta S_{i,t-1}}{A_{i,t-1}}\right) + \varepsilon_{i,t} \quad (5)$$

Where $\Delta INV_{i,t}$ is the current year's ending inventory minus the prior year's ending inventory; $A_{i,t-1}$ is the total asset of previous year; $\Delta S_{i,t}$ is the current year's net income minus the prior year's net income; $\varepsilon_{i,t}$ is the residual term. Because the production cost is the sum of the cost of goods sold (3.4) and the number of changes in inventory (3.5), hence, $Abn\_PROD_{i,t}$ is the abnormal production cost.

$$\frac{PROD_{i,t}}{A_{i,t-1}} = \beta_0 + \beta_1\left(\frac{1}{A_{i,t-1}}\right) + \beta_2\left(\frac{S_{i,t}}{A_{i,t-1}}\right) + \beta_3\left(\frac{\Delta S_{i,t}}{A_{i,t-1}}\right) + \beta_4\left(\frac{\Delta S_{i,t-1}}{A_{i,t-1}}\right) + \varepsilon_{i,t} \quad (6)$$

$$\frac{\hat{PROD}_{i,t}}{A_{i,t-1}} = \hat{\beta}_0 + \hat{\beta}_1\left(\frac{1}{A_{i,t-1}}\right) + \hat{\beta}_2\left(\frac{S_{i,t}}{A_{i,t-1}}\right) + \hat{\beta}_3\left(\frac{\Delta S_{i,t}}{A_{i,t-1}}\right) + \hat{\beta}_4\left(\frac{\Delta S_{i,t-1}}{A_{i,t-1}}\right) \quad (7)$$

$$Abn\_PROD_{i,t} = \frac{PROD_{i,t}}{A_{i,t-1}} - \frac{\hat{PROD}_{i,t}}{A_{i,t-1}} \quad (8)$$

Where $PROD_{i,t}$ is the sum of the cost of goods sold and the number of changes in inventory; $A_{i,t-1}$ is the total asset of previous year; $S_{i,t}$ is net income of current year; $\Delta S_{i,t}$ is the current year's net income minus the prior year's net income; $\varepsilon_{i,t}$ is the residual term.

Calculating abnormal discretionary expenses

$$\frac{Disexp_{i,t}}{A_{i,t-1}} = \gamma_0 + \gamma_1\left(\frac{1}{A_{i,t-1}}\right) + \gamma_2\left(\frac{S_{i,t-1}}{A_{i,t-1}}\right) + \varepsilon_{i,t} \quad (9)$$

$$\frac{\hat{Disexp}_{i,t}}{A_{i,t-1}} = \hat{\gamma}_0 + \hat{\gamma}_1\left(\frac{1}{A_{i,t-1}}\right) + \hat{\gamma}_2\left(\frac{S_{i,t-1}}{A_{i,t-1}}\right) \quad (10)$$

$$Abn\_Disexp_{i,t} = \frac{Disexp_{i,t}}{A_{i,t-1}} - \frac{\hat{Disexp}_{i,t}}{A_{i,t-1}} \quad (11)$$

Where $Disexp_{i,t}$ is the sum of research and development costs, advertising costs, sales and management costs; $A_{i,t-1}$ is the total asset of previous year; $S_{i,t}$ is net income of current year; is the residual term.

Calculating real earnings management index

Following Roychowdhury (2006) and Cohen et al. (2008), we consider that the sign of the impact direction about abnormal cash flow from operating activities, abnormal production costs, and abnormal discretionary expenses on earnings management is different. The measurement of real earnings management (*REM*) is measured as follows.

$$REM = (-1)Abn_{CFO_{i,t}} + Abn_{PROD_{i,t}} + (-1)Abn\_Disexp_{i,t} \quad (12)$$

Where REM is real earnings management, $Abn\_CFO_{i,t}$ is abnormal cash flow from operating activities, $Abn\_PROD_{i,t}$ is abnormal production costs, $Abn_Disexp_{i,t}$is abnormal discretionary expenses.

Calculating discretionary accruals

Following Kothari et al. (2005), we use discretionary accruals (DA) as the proxy of earnings management (Jones 1991; Defond and Jiambalvo 1994; Subramanyam 1996; Becker et al. 1998; Francis et al. 1999). We estimate discretionary accruals using cross-sectional data with same year and same industry. The estimating model is as follow.

$$\frac{TA_{i,t}}{A_{i,t-1}} = \alpha_0 + \alpha_1\left(\frac{1}{A_{i,t-1}}\right) + \alpha_2\left[\frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{A_{i,t-1}}\right] + \alpha_3\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right) + \alpha_4 ROA_{i,t-1} + \varepsilon_{i,t} \quad (13)$$

Where $TA_{i,t}$ is total accruals, $A_{i,t}$ is asset, $\Delta REV_{i,t}$ is change in sales, $\Delta REC_{i,t}$ is change in account receivable, $PPE_{i,t}$ is property, plant and equipment, $ROE_{i,t}$ is return on assets, $\varepsilon_{i,t}$ is the residual term.

First, we use ordinary least squares method to estimate the normal level of company's $\hat{\alpha}_0$, $\hat{\alpha}_1$, $\hat{\alpha}_2$,$\hat{\alpha}_3$, and $\hat{\alpha}_4$ from same industry (according to TEJ classification). Then, using specific firm's $\left(\frac{1}{A_{i,t-1}}\right)$, $\left[\frac{\Delta REV_{i,t}-\Delta REC_{i,t}}{A_{i,t-1}}\right]$, $\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right)$, and $ROA_{i,t-1}$ to calculate equation (13) in order to compute the perdition normal level of non-discretionary accruals as shown in equation (14).

$$\frac{NDA_{i,t}}{A_{i,t-1}} = \hat{\alpha}_0 + \hat{\alpha}_1\left(\frac{1}{A_{i,t-1}}\right) + \hat{\alpha}_2\left[\frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{A_{i,t-1}}\right] + \hat{\alpha}_3\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right) + \hat{\alpha}_4 ROA_{i,t-1} \quad (14)$$

Where $NDA_{i,t}$ is non-discretionary accruals. Finally, the difference between the actual total accruals and the estimated non-discretionary accruals results in the discretionary accruals as shown in equation (17).

$$\frac{DA_{i,t}}{A_{i,t-1}} = \frac{TA_{i,t}}{A_{i,t-1}} - \frac{NDA_{i,t}}{A_{i,t-1}} \quad (16)$$

Measuring Overconfidence

Following Malmendier and Tate (2005b), managerial overconfidence is defined that whether manager increasingly purchases his own firm's stock over the past 4 quarters. OC is an indicator variable equals to one if manager increasingly purchases his own firm's stock over the past 4 quarters and zero otherwise.

Empirical Models

In order to test whether real earnings management and accrual-based earnings management are affected by the managerial overconfidence, and also whether there is substitute or complementary relationship between real earnings management and accrual- based earnings management under different quantile level of managerial overconfidence. The empirical model are as follows.

$$\begin{aligned} REM_{i,t} &= \beta_0 + \beta_1 OC_{i,t} + \beta_2 Size_{i,t} + \beta_3 ROA_{i,t} + \beta_4 Lev_{i,t} \\ &+ \beta_5 MB_{i,t} + \beta_6 Outside_{i,t} + \beta_7 INSR_{i,t} + \beta_8 Bsize_{i,t} \\ &+ \beta_9 Hold_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (16)$$

$$\begin{aligned} DA_{i,t} &= \beta_0 + \beta_1 OC_{i,t} + \beta_2 Size_{i,t} + \beta_3 ROA_{i,t} + \beta_4 Lev_{i,t} \\ &+ \beta_5 MB_{i,t} + \beta_6 Outside_{i,t} + \beta_7 INSR_{i,t} + \beta_8 Bsize_{i,t} \\ &+ \beta_9 Hold_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (17)$$

$$\begin{aligned} |DA_{i,t}| &= \beta_0 + \beta_1 OC_{i,t} + \beta_2 Size_{i,t} + \beta_3 ROA_{i,t} + \beta_4 Lev_{i,t} \\ &+ \beta_5 MB_{i,t} + \beta_6 Outside_{i,t} + \beta_7 INSR_{i,t} + \beta_8 Bsize_{i,t} \\ &+ \beta_9 Hold_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (18)$$

$$\begin{aligned} REM_{i,t} &= \beta_0 + \beta_1 DA_{i,t} + \beta_2 OC_{i,t} + \beta_3 (DA_{i,t} * OC_{i,t}) + \beta_4 Size_{i,t} \\ &+ \beta_5 ROA_{i,t} + \beta_6 Lev_{i,t} + \beta_7 MB_{i,t} + \beta_8 Outside_{i,t} \\ &+ \beta_9 INSR_{i,t} + \beta_{10} Bsize_{i,t} + \beta_{11} Hold_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (19)$$

Empirical Findings

Descriptive Statistics

Table 2. shows the descriptive statistics of variables used in this study.

Table 2. Descriptive Statistics

Variable	Mean	Median	Standard deviation	Min	Max
REM	0	0.121	1.775	-21	18.19
DA	0	0	0.052	-0.97	1.15
|DA|	0.033	0.022	0.04	0	1.15
OC	0.04	0	0.196	0	1
Size	15.257	15.06	1.299	12.09	21.26
ROA	0.014	0.013	0.028	-0.55	0.717
LEV	0.357	0.351	0.157	0.006	0.97
MB	1.693	1.32	1.45	0.17	46.41
Outside	0.368	0.375	0.168	0	1
INSR	0.338	0.298	0.214	0	0.98
Bsize	0.453	0	0.498	0	1
Hold	0.217	0.189	0.124	0	0.789

Table 3. OLS And Quantile Regression Results of Real Earnings Management Model

$$REM_{i,t} = \beta_0 + \beta_1 OC_{i,t} + \beta_2 Size_{i,t} + \beta_3 ROA_{i,t} + \beta_4 Lev_{i,t} + \beta_5 MB_{i,t} + \beta_6 Outside_{i,t} + \beta_7 INSR_{i,t} + \beta_8 Bsize_{i,t} + \beta_9 Hold_{i,t} + \varepsilon_{i,t}$$

Panel A: lower quantile

Variable	OLS	Quantile Regression (Lower Quantile)			
		q(0.01)	q(0.05)	q(0.10)	q(0.05)
Constant	0.465**	-10.9***	-5.36***	-2.9***	0.143
	(0.013)	(0.000)	(0.000)	(0.000)	(0.349)
OC	-0.042	-0.239	-0.108	0.032	0.027
	(0.500)	(0.523)	(0.490)	(0.814)	(0.538)
Size	-0.019	0.482***	0.265***	0.159***	0.023**
	(0.122)	(0.000)	(0.000)	(0.000)	(0.018)
ROA	-2.01***	-1.471	-0.941	-0.648	-3.69***
	(0.000)	(0.451)	(0.558)	(0.466)	(0.000)
Lev	0.99***	-2.096**	-1.16***	-0.481*	0.48***
	(0.000)	(0.019)	(0.000)	(0.007)	(0.000)
MB	-0.15***	-0.81***	-0.58***	-0.42***	-0.18***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Outside	-0.45***	2.375**	-0.044	-0.86***	-0.51***
	(0.000)	(0.017)	(0.869)	(0.000)	(0.000)
INSR	-0.48***	-0.309	-0.534	-0.594**	-0.32***

	(0.000)	(0.620)	(0.129)	(0.002)	(0.000)
Bsize	-0.062**	-0.354	-0.007	0.087*	0.052**
	(0.013)	(0.180)	(0.932)	(0.076)	(0.010)
Hold	0.55***	0.628	0.881**	0.257	0.206**
	(0.000)	(0.616)	(0.026)	(0.303)	(0.033)
Adjust R^2	0.04	0.057	0.05	0.046	0.027

Panel B: higher quantile

Variable	OLS	Quantile Regression (Lower Quantile)			
		q(0.99)	q(0.95)	q(0.90)	q(0.05)
Constant	0.465**	10.1***	5.49***	3.68***	0.143
	(0.013)	(0.000)	(0.000)	(0.000)	(0.349)
OC	-0.042	-0.74***	-0.202**	-0.091	0.027
	(0.500)	(0.000)	(0.037)	(0.206)	(0.538)
Size	-0.019	-0.50***	-0.26***	-0.17***	0.023**
	(0.122)	(0.000)	(0.000)	(0.000)	(0.018)
ROA	-2.00***	4.09***	-0.375	-2.413**	-3.69***
	(0.000)	(0.000)	(0.581)	(0.016)	(0.000)
Lev	0.99***	5.6***	2.93***	2.05***	0.48***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	-0.15***	0.077	0.015	-0.05***	-0.18***
	(0.000)	(0.278)	(0.675)	(0.000)	(0.000)
Outside	-0.45***	-1.02***	-0.51***	-0.43***	-0.51***
	(0.000)	(0.008)	(0.000)	(0.000)	(0.000)
INSR	-0.48***	-0.579	-0.022	0.038	-0.32***
	(0.000)	(0.326)	(0.873)	(0.727)	(0.000)
Bsize	-0.062**	-0.66***	-0.37***	-0.19***	0.052**
	(0.013)	(0.000)	(0.000)	(0.000)	(0.010)
Hold	0.55***	3.78***	0.73***	0.82***	0.206**
	(0.000)	(0.002)	(0.004)	(0.000)	(0.033)
Adjust R^2	0.04	0.137	0.07	0.038	0.027

1. In parentheses is the p-value.
2. *, **, ***, indicate statistical significance at the 0.1, 0.05, and 0.01 level, respectively.

Empirical Results

Table 3. shows OLS and Quantile regression results of real earnings management model. Panel A is for lower quantile and Panel B for higher quantile. Using OLS model, the association between overconfidence and real earnings management is not significant. The results indicate that H1a

is not supported. However, in the higher overconfidence quantile (0.99 and 0.95), the coefficients of OC are both negative and significant, meaning that overconfident manager may not use real earnings management as a tool to manage earnings.

Table 4. shows OLS and Quantile regression results of accrual-based earnings management model. Using OLS model, the coefficients of OC are both positive and significant, meaning that H1b is supported. Table 5. shows OLS and Quantile regression results of absolute accrual-based earnings management model. Using OLS model, the association between overconfidence and absolute accrual-based earnings management is not significant.

Finally, Table 6. shows Complementary and substitute effects of overconfidence on real earnings management using OLS and quantile regression. Both in the OLS model and the quantile regression model, accruals - based earnings management (DA) is positively associated with earnings management, indicating that there may be a complementary relationship between these two different approaches. However, the coefficient of absolute DA (|DA|) is negatively associated with earnings management in the lower (0.1 and 0.5) quantile, meaning that there may be substitute relationship between them. Also, there is significantly positive association in the higher quantile of 0.9, 0.95, and 0.99, meaning that there may be complementary relationship between them.

Concluding Remarks

This study investigates whether and how managerial overconfidence affects firm's earnings management behavior. The empirical results show that managerial overconfidence is negatively correlated with the real earnings management, meaning that overconfident managers seem to have less earnings management behavior.

However, managerial overconfidence is positively and significantly correlated with the accrual- based earnings management, supporting those overconfident managers may still manage earnings using some other method. Therefore, in order to clarify the relationship between accrual-based and real earnings management, we further investigate the interaction of accrual-based and real earnings management under different quantiles.

The evidence shows that when using absolute value of discretionary accruals as a proxy of earnings management, real earnings management and accrual-based earnings management has negative association (substitute relationship) in the lower overconfident quantile of 0.1 and even 0.5 but has positive association (complementary relationship) in the higher overconfident quantile of 0.9, 0.95, and 0.99.

The main contribution of this paper is to distinguish that whether and how managerial overconfidence affects earnings management. We use both two different measure of earnings management and distinguish how earnings management method is used in different status. This paper complements research on managers' earnings management behavior.

Table 4. OLS and Quantile regression results of discretionary accruals model

$$DA_{i,t} = \beta_0 + \beta_1 OC_{i,t} + \beta_2 Size_{i,t} + \beta_3 ROA_{i,t} + \beta_4 Lev_{i,t} + \beta_5 MB_{i,t} + \beta_6 Outside_{i,t} + \beta_7 INSR_{i,t} + \beta_8 Bsize_{i,t} + \beta_9 Hold_{i,t} + \varepsilon_{i,t}$$

Panel A: lower quantile

Variable	OLS	Quantile Regression (Lower Quantile)			
		q(0.01)	q(0.05)	q(0.10)	q(0.05)
Constant	-0.002	-0.34***	-0.13***	-0.08***	0.001
	(0.638)	(0.000)	(0.000)	(0.000)	(0.762)
OC	0.002**	0.005	0.002	0.002	0.003***
	(0.031)	(0.694)	(0.482)	(0.267)	(0.001)
Size	0.000	0.018***	0.007***	0.004***	0.000
	(0.4)	(0.000)	(0.000)	(0.000)	(0.304)
ROA	0.625***	0.523***	0.559***	0.531***	0.494***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lev	0.020***	-0.12***	-0.05***	-0.03***	0.0137
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	-0.01***	-0.009*	-0.01***	-0.01***	-0.01***
	(0.000)	(0.072)	(0.000)	(0.000)	(0.000)
Outside	-0.01***	-0.023	-0.02***	-0.02***	-0.01***
	(0.000)	(0.155)	(0.000)	(0.000)	(0.000)
INSR	-0.01***	-0.05***	-0.03***	-0.02***	-0.01***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Bsize	-0.001	0.012**	0.01***	0.01***	-0.001
	(0.403)	(0.031)	(0.003)	(0.000)	(0.332)
Hold	0.004	0.007	-0.006	-0.002	0.005*
	(0.18)	(0.745)	(0.531)	(0.785)	(0.055)
Adjust R^2	0.099	0.083	57	0.046	0.037

Panel B: higher quantile

Variable	OLS	Quantile Regression (Lower Quantile)			
		q(0.99)	q(0.95)	q(0.90)	q(0.05)
Constant	-0.002	0.190***	0.142***	0.094***	0.001
	(0.638)	(0.000)	(0.000)	(0.000)	(0.762)
OC	0.002**	-0.002	0.005*	0.003	0.003***
	(0.031)	(0.780)	(0.050)	(0.147)	(0.001)
Size	0.000	-0.01***	-0.01***	-0.01***	0.000
	(0.400)	(0.000)	(0.000)	(0.000)	(0.304)
ROA	0.625***	0.962***	0.734***	0.667***	0.494***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lev	0.02***	0.153***	0.088***	0.067***	0.013***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	-0.01***	0.012***	0.003**	0.000	-0.01***
	(0.000)	(0.000)	(0.017)	(0.934)	(0.000)
Outside	-0.01***	0.000	-0.005	0.003	-0.01***
	(0.000)	(0.984)	(0.328)	(0.411)	(0.000)
INSR	-0.01***	-0.002	0.010**	0.002	-0.01***
	(0.000)	(0.903)	(0.043)	(0.597)	(0.001)
Bsize	-0.001	-0.02***	-0.01***	-0.01***	-0.001
	(0.403)	(0.000)	(0.000)	(0.000)	(0.332)
Hold	0.004	0.033**	-0.007	0.003	0.005*
	(0.18)	(0.026)	(0.367)	(0.585)	(0.055)
Adjust R^2	0.099	0.168	0.109	0.079	0.037

1. In parentheses is the p-value.
2. *, **, ***, indicate statistical significance at the 0.1, 0.05, and 0.01 level, respectively.

Table 5. OLS and quantile regression results of absolute value of discretionary accruals model

$$|DA_{i,t}| = \beta_0 + \beta_1 OC_{i,t} + \beta_2 Size_{i,t} + \beta_3 ROA_{i,t} + \beta_4 Lev_{i,t} + \beta_5 MB_{i,t} + \beta_6 Outside_{i,t} + \beta_7 INSR_{i,t} + \beta_8 Bsize_{i,t} + \beta_9 Hold_{i,t} + \varepsilon_{i,t}$$

Panel A: lower quantile

Variable	OLS	Quantile Regression (Lower Quantile)			
		q(0.01)	q(0.05)	q(0.10)	q(0.05)
Constant	0.063***	0.001	0.003**	0.006***	0.040***
	(0.000)	(0.126)	(0.013)	(0.000)	(0.000)
OC	-0.001	0.000	0.000	-0.001	-0.001
	(0.405)	(0.777)	(0.316)	(0.170)	(0.316)
Size	-0.01***	0.000	0.000*	0.000***	-0.01***
	(0.000)	(0.227)	(0.070)	(0.002)	(0.000)
ROA	0.080***	0.000	-0.007	-0.007	-0.003
	(0.000)	(0.959)	(0.214)	(0.354)	(0.835)
Lev	0.034***	0.000	0.002***	0.003***	0.018***
	(0.000)	(0.645)	(0.000)	(0.000)	(0.000)
MB	0.002***	0.000	0.000	0.000***	0.001***
	(0.000)	(0.638)	(0.107)	(0.004)	(0.000)
Outside	0.006***	0.000	0.001***	0.001**	0.007***
	(0.001)	(0.909)	(0.004)	(0.033)	(0.000)
INSR	0.004**	0.000	0.001	0.001	0.004***
	(0.022)	(0.253)	(0.251)	(0.329)	(0.002)
Bsize	-0.01***	0.000	0.000	0.000	-0.01***
	(0.000)	(0.850)	(0.182)	(0.175)	(0.000)
Hold	0.003	0.000	0.000	-0.001	0.002
	(0.294)	(0.365)	(0.680)	(0.418)	(0.256)
Adjust R^2	0.035	0.001	0.001	0.001	0.011

Panel B: higher quantile

Variable	OLS	Quantile Regression (Lower Quantile)			
		q(0.99)	q(0.95)	q(0.90)	q(0.05)
Constant	0.063***	0.44***	0.208***	0.150***	0.04***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
OC	-0.001	-0.017*	0.002	0.003	-0.001
	(0.405)	(0.055)	(0.768)	(0.410)	(0.316)
Size	-0.01***	-0.02***	-0.01***	-0.01***	-0.01***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA	0.080***	0.045	-0.037	-0.017	-0.003
	(0.000)	(0.134)	(0.261)	(0.513)	(0.835)
Lev	0.03***	0.15***	0.09***	0.07***	0.02***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	0.01***	0.01***	0.01***	0.005***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Outside	0.01***	-0.03**	0.014	0.011***	0.007***
	(0.001)	(0.031)	(0.103)	(0.009)	(0.000)
INSR	0.004**	0.028	0.025***	0.019***	0.004***
	(0.022)	(0.361)	(0.000)	(0.000)	(0.002)

Bsize	-0.01*** (0.000)	-0.02** (0.014)	-0.01*** (0.000)	-0.01*** (0.000)	-0.01*** (0.000)
Hold	0.003 (0.294)	0.003 (0.925)	0.000 (0.967)	-0.001 (0.797)	0.002 (0.256)
Adjust R^2	0.035	0.076	0.051	0.043	0.011

1. In parentheses is the p-value.
2. *, **, ***, indicate statistical significance at the 0.1, 0.05, and 0.01 level, respectively.

Table 6. Complementary and substitute effects of over-confidence on real earnings management using OLS and quantile regression

$$REM_{i,t} = \beta_0 + \beta_1 DA_{i,t} + \beta_2 OC_{i,t} + \beta_3 (DA_{i,t} * OC_{i,t}) + \beta_4 Size_{i,t} + \beta_5 ROA_{i,t} + \beta_6 Lev_{i,t} + \beta_7 MB_{i,t} + \beta_8 Outside_{i,t} + \beta_9 INSR_{i,t} + \beta_{10} Bsize_{i,t} + \beta_{11} Hold_{i,t} + \varepsilon_{i,t}$$

Panel A: discretionary accruals model in lower quantile

Variable	OLS	q(0.01)	q(0.05)	q(0.10)	q(0.05)
Constant	0.51*** (0.002)	-9.53*** (0.000)	-4.28*** (0.000)	-2.3*** (0.000)	0.103 (0.432)
DA	18.1*** (0.000)	15.26*** (0.000)	18.28*** (0.000)	18.1*** (0.000)	18.9*** (0.000)
OC	-0.100* (0.059)	0.043 (0.940)	0.003 (0.984)	-0.108 (0.191)	-0.052 (0.208)
DA*OC	2.50** (0.037)	8.32*** (0.000)	1.411 (0.627)	3.272** (0.036)	-0.246 (0.879)
control variables			Omitted		
Adjust R^2	0.292	0.133	0.151	0.162	0.193

Panel B: discretionary accruals model in higher quantile

Variable	OLS	q(0.99)	q(0.95)	q(0.90)	q(0.05)
Constant	0.51*** (0.002)	8.82*** (0.000)	3.91*** (0.000)	2.81*** (0.000)	0.103 (0.432)
DA	18.1*** (0.000)	20.32*** (0.000)	18.9*** (0.000)	18.8*** (0.000)	18.9*** (0.000)
OC	-0.10* (0.059)	-0.73*** (0.000)	-0.181** (0.047)	-0.150** (0.023)	-0.052 -0.208
DA*OC	2.5** (0.037)	-2.17 (0.534)	0.899 (0.320)	0.899 (0.717)	-0.246 (0.879)
control variables			omitted		
Adjust R^2	0.035	0.076	0.051	0.043	0.193

1. In parentheses is the p-value.
2. *, **, ***, indicate statistical significance at the 0.1, 0.05, and 0.01 level, respectively.

Table 6. (Continued)

$$REM_{i,t} = \beta_0 + \beta_1 |DA_{i,t}| + \beta_2 OC_{i,t} + \beta_3 (|DA_{i,t}| * OC_{i,t}) + \beta_4 Size_{i,t} + \beta_5 ROA_{i,t} + \beta_6 Lev_{i,t} + \beta_7 MB_{i,t} + \beta_8 Outside_{i,t} + \beta_9 INSR_{i,t} + \beta_{10} Bsize_{i,t} + \beta_{11} Hold_{i,t} + \varepsilon_{i,t}$$

Panel C: absolute discretionary accruals model in lower quantile					
Variable	OLS	q(0.01)	q(0.05)	q(0.10)	q(0.05)
Constant	0.48**	-6.32***	-3.07***	-1.72***	0.215
	(0.011)	(0.000)	(0.000)	(0.000)	(0.169)
|DA|	-0.153	-29.7***	-22.8***	-19.6***	-1.99***
	(0.625)	(0.001)	(0.000)	(0.000)	(0.001)
OC	0.071	0.332	0.63***	0.29***	0.046
	(0.401)	(0.606)	(0.000)	(0.001)	(0.446)
|DA|*OC	-3.76**	-18.26*	-19.3***	-9.78***	-1.395
	(0.048)	(0.097)	(0.001)	(0.000)	(0.595)
control variables			omitted		
Adjust R^2	0.04	0.152	0.128	0.114	0.027
Panel D: absolute discretionary accruals model in higher quantile					
Variable	OLS	q(0.99)	q(0.95)	q(0.90)	q(0.05)
Constant	0.48**	6.65***	3.09***	2.05***	0.215
	(0.011)	(0.000)	(0.000)	(0.000)	(0.169)
|DA|	-0.153	44.3***	24.2***	19.5***	-1.9***
	(0.625)	(0.000)	(0.000)	(0.000)	(0.001)
OC	0.071	-0.096	-0.156	-0.079	0.046
	(0.401)	(0.690)	(0.167)	(0.282)	(0.446)
|DA|*OC	-3.76**	-23.8***	-1.725	-2.857	-1.395
	(0.048)	(0.005)	(0.710)	(0.317)	(0.595)
control variables			omitted		
Adjust R^2	0.04	0.270	0.172	0.128	0.027

1. In parentheses is the p-value.
2. *, **, ***, indicate statistical significance at the 0.1, 0.05, and 0.01 level, respectively.

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HOME-BASED LONG-TERM CARE SERVICES IN TAIWAN: DEMAND AND EFFECTS

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Abstract

In Taiwan, which has become an aging society, the Long-term Care Service Act was formulated to create a complete long-term care service system, ensure the quality of long-term care services, and develop diversified and affordable services. The main purpose of this study is to investigate the public's future need for autonomous choices for home-based long-term care services. In this study, we conducted a questionnaire survey to collect data and performed statistical analyses. Between July and October of 2015, we recruited survey participants who were seeking medical treatment in a hospital in central Taiwan and the valid sample size of this study was 510. Baseline comparison was made using a t-test and regression. The research results showed that the perceived severity of the long-term care issue has statistically significant effects on economic safety services, free services, personal care services, medical services, home safety services, and spiritual services. Moreover, demographic variables also affect the public's need for long-term care services. The government should provide sufficient services to enable the public to choose and ensure a good quality of life for the elderly.

Key Words: Long-term Care, Home Care, Perceived Seriousness

Introduction

According to a 2015 United Nations report, the number of people considered elderly, aged 60 years or older, has increased substantially in recent years in most countries and regions, and that growth will only accelerate in the coming decades. The size of the oldest age group, people age 80 and over, is growing even faster. A 2016 analysis of the population structure of Taiwan found that the number of people over 65 years old reached 3, 106, 105, accounting for 13.20% of the population, indicating that Taiwan has become an aging society (Ministry of the Interior, Department of Statistics, 2017).

People's health needs tend to become more complex as they age, with a general trend toward declining capacity and increased likelihood of having one or more chronic diseases. Health services are often designed to cure acute conditions and tend to manage health issues in disconnected and fragmented ways that lack coordination across care providers, settings, and time. Health services systems need to ensure affordable access to evidence-based medical interventions that respond to the needs of older people and can help prevent care dependency later in life (WHO, 2017).
At present, most long-term care plans for the elderly are designated for those with disabilities and dementia. However, scholars have pointed out that, to offer excellent care to the elderly, services must be planned while the elderly are still healthy. Different care models should match the different health statuses of the elderly, which could help them, avoid entering the stages of disability and dementia, reduce long-term expenditures, and enhance quality of life (Lyu, 2016). Individuals are more influenced by the perceived seriousness of their problems than the actual severity of those problems (Ghimire and Mohai, 2005).A previous study pointed out that, when they sensed the urgency and seriousness of a topic, the public would take relevant counter-measures (Dagher and Itani, 2014). Therefore, this study explores whether awareness of the seriousness of long-term care would influence people's selection of long-term care. Previous scholars have assumed that the variable of population influences attitudes regarding the long-term care of the elderly (Wu and Chu, 1995) ; thus, population is considered as a variable in this study.

Recent studies have focused on the long-term care of the elderly with disabilities (Huang et al., 2014) and family caregivers of the disabled elderly people (Wu and Lin, 1999; Yu and Chih, 2015) based on their experiences with the long-term care systems of various countries. These values and attitudes regarding long-term care services offer important references (Wu and Chu, 1995) that affect both the content and quality of services (Wu and Chu, 1995). Through knowledge of disease prevention and health maintenance, people could learn the medical treatments required by the elderly, make care plans as soon as possible, and provide various long-term services. Flexible services should be applied to help the elderly take better care of them and avoid entry into institutions due to disability, such as nursing homes, or increased burden on those who care for them. People are ad-

vised to make long-term medical care plans for the elderly as soon as possible to reduce the burden on medical resources and government finances. The purposes of this study: first, this study probes into the factors influencing the selection of long-term care services; second, this study examines the influence of social-economic variables on the needs of caring for the elderly.

Methodology

Sample and ethical clearance

Between July and October of 2015, we recruited survey participants who were seeking medical treatment in a hospital in central Taiwan and asked them to indicate their agreement with various statements. The valid sample size of this study was 510. The average age of participants in the sample was 40.54 (SD=12.87). Most of the subjects were female (381; 74.70%). Most of the subjects were college graduates (264; 51.76%) ; 317 were married (62.15%), nearly 60% had children (57.05%), and 314 (61.56%) had elderly family members needing care at home.

The participants were all adults (older than age 20) and were informed that their participation was voluntary. This study did not collect participants' private data, and informed consent was obtained from all participants. Ethical considerations for this study were reported to Cheng Ching Hospital (HP150030_CCGH IRB).

Measures

The variables in this study included demographic variables: age, gender, education levels, marital status, number of children, and number of the elderly needing care at home. For constructs of the services of long-term care, this study referred to the long-term care items provided by the Department of Nursing and Health Care, Ministry of Health and Welfare in Taiwan. There were economic safety services, free services, housework services, personal care services, medical services, home safety services, and spiritual services (Department of Nursing and Health Care, Ministry of Health and Welfare, 2015). This study used a 7-point Likert scale (1=strongly disagree/not needed; 7=strongly agree/need) for measurement. For the construct of severity of long-term care issues, this study measured the public's perceived severity of long-term care issues, modified from Kaman Lee (2008), with a total of four items. The items were, "Do you think about how severe the long-term care issue of the elderly is in Taiwan?" "Do you think about how emergent it is to attach importance to the long-term care issues of the elderly in Taiwan?" "I think that the long-term care issue of the elderly in Taiwan is aggravating, " and "The long-term care issue of the elderly in Taiwan is threatening our health."

Analyses

This study used Cronbach's alpha to test reliability and used the statistical software SPSS18.0. Baseline comparison was made using a t-test and regression. The Cronbach's alphas of the overall constructs are between 0.78 to 0.97.

The measurement of the model showed that reliability was good.

Results

Gender had a significant influence on economic safety services (p=0.010), housework services (p=0.011), personal care services (p=0.001), medical services (p=0.046), and home safety services (p=0.047) of long-term care needs. The needs of female subjects were all higher than those of male subjects, and the difference reached statistical significance. Marital status had a significant influence on the economic safety services (p=0.005) and housework services (p=0.022) of long-term care needs. The needs of participants without a partner were higher than the needs of those with partners, and the difference reached statistical significance.

The number of children had a significant influence on economic safety services (p=0.003), housework services (p=0.005), personal care services (p=0.033), and medical services (p=0.020) of long-term care needs. The needs of participants without children were higher than the needs of those with children, and the difference reached statistical significance.

Age had a significant influence on economic safety services (p<0.001), free services (p=0.036), housework services (p<0.001), personal care services (p<0.001), medical services (p<0.001), home safety services (p<0.001), and spiritual services (p=0.003) of long-term care needs. The perceived long-term care needs of the young population were higher than that of the elderly population, and the difference reached statistical significance.

The needs of the public who were caring for elderly relatives were higher than the needs of those who were not caring for elderly relatives. Those caring for elderly relatives had a significantly higher level of long-term care needs on economic safety services (p<0.001), free services (p=0.019), housework services (p=0.024), personal care services (p<0.001), medical services (p=0.019), and home safety services (p=0.004).

Moreover, this study further performed regression analysis on the relationships between the public's perceived severity of long-term care issues and the various constructs of long-term care services. The results showed that the higher the public's perceived severity of long-term care issues, the more importance they attached to various constructs, such as economic safety services (Estimate value=0.249, p<0.001), free services (Estimate value=0.276, p<0.001), personal care services (Estimate value=0.287, p<0.001), medical services (Estimate value=0.181, p=0.019), home safety services (Estimate value=0.258, p=0.001), and spiritual services (Estimate value=0.184, p=0.024), and the results reached statistical significance. However, housework services (Estimate value=0.162, p=0.065) did not reach statistical significance with the severity of perceived long-term care.

Discussion and Conclusion

This research studied the influ-

ence of people's awareness of the seriousness of long-term care and the population variable regarding their selection of long-term care services. The results show that when citizens attach greater importance to long-term care, they tend to have a higher demand for services, with the exception of housework services. According to the theory of risk as feelings (Loewenstein et al., 2001), emotions influence decisions according to the various events one experiences in life. When the public senses the severity of aging and the inadequacy of long-term care for the elderly, as provided by the current social system, their awareness influences their behavior. That is, they would have stronger needs for long-term care, consistent with the results of this study.

A previous study (Katz et al., 2000) found that gender has a significant influence on the long-term care needs of the elderly. This result is consistent with the findings of this study. Our results showed that female participants' long-term needs for care services were inclined toward economic safety, housework services, personal care, medical services, and home safety services. Because women live longer than men (Gruneir et al., 2013), an elderly life free of economic stress is a very important basic living condition for women. Therefore, as compared with men, women attach more importance to ensuring a stable income. In addition, Gruneir et al. (2013) indicated that elderly women in Canada were more inclined than men to use family care services, suggesting that Western and Eastern women's long-term care needs for services are consistent. The current study found that female participants' long-term needs for care services were inclined toward personal care services, such as regular home-cleaning services, postoperative medical care, home respite services, home nursing services, and the service of securing a barrier-free home environment. The reason may be that women generally play the role of caregiver in the home (Gruneir et al., 2013). Therefore, when they experience physical issues, their care needs in this regard will be higher.

Moreover, this study also found that those without partners were more inclined to use economic safety and housework services, and they tended to hope that a government pension system would guarantee basic economic standards for elderly life and the provision of cleaning services. Due to gender stratifications in society, women tend to face greater constraints, have fewer resources, and face more unfavorable effects than men, resulting in more severe poverty for elderly women (Ministry of Health and Welfare, 2016). In addition, Asian women traditionally do the bulk of the housework, including buying groceries and cooking, and take care of their spouses (Chen & Tai, 2009) ; however, when they became single again, they prefer to avoid heavy housework.

In addition, those without children want economic security and have high expectations for daily life coordination and medical care; thus, they have greater demands for economic safety, housework, personnel care, and medical services. According to one survey (Huang, 2012) conducted in Taiwan, nearly half of the elderly (47.6%) with-

out children prefer to live in their own homes, surrounded by their own furniture and books, close to familiar shops and parks, and to have housekeeping staff working in their homes. Similarly, the results of this study show that respondents prefer to have staff come into their homes to provide housekeeping and medical services.

This study further analyzed whether age had a significant influence on long-term needs for care services. The results show that the long-term care needs for all services were significantly higher for participants under the age of 55 than for the elderly (aged 55 and above). The reason may be that, in Taiwan, the responsibility of taking care of the elderly is mainly borne by family members. Furthermore, given their limited incomes, the elderly are choose their long-term care needs more carefully. However, Taiwan is currently facing many influences, such as a decreased birth rate and increased infertility (Ministry of the Interior, 2017). Moreover, as younger citizens are capable of making money, their needs for future self-care are higher. Therefore, they are inclined toward the provision of complete long-term care.

In this study, we found that those who have to take care of elderly relatives have a greater need for long-term care services, with the exception of spiritual services, than those who do not. Filial piety and obligation to the elderly have always been taken for granted in Asian societies. The results of this study show that those who have taken care of their elders have higher demands for long-term medical care than those without such experience. Presumably, these people had to adjust their lifestyles, relationships, and leisure activities to do so, and experienced significant physical, psychological, and economic effects while providing care for their elders; thus, they tend to seek external help in order to reduce pressure. Regarding the limitations of this study, as the samples are mainly patients, the results are limited. Thus, this study suggests that further research can expand the samples.

Long-term home care has been implemented in Taiwan for many years. Thus, this study aims to identify the services actually needed by the public and aspires for limited resources to be applied to the service items required by the public. Our results show that the perceived severity of the long-term care problem would affect the need for long-term care for the elderly in Taiwan. Among respondents, women were more inclined toward personal care services, and singles tended to look for economic safety services. Citizens without children sought personal care and home nursing services. People cared less about receiving spiritual services. Overall, demographic variables and perceived seriousness of long term care will affect the availability of long-term care services for people in need. The most two important long-term care needs are economic safety and housework services.

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NOVEL METHOD OF DIAGNOSING BREAST MASSES IN DIGITAL MAMMOGRAPHY

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Abstract

Breast cancer is a malignant tumor that develops from the cells of the breast. The incidence of breast cancer in women has increased considerably in recent years. Methods that can accurately predict breast cancer are urgently required, and developing suitable models for predicting breast cancer has become a key research topic. Here, a new method is proposed for diagnosing breast cancer accurately, in which the Wilcoxon statistic was used to compare the average AUC (area under curve) values obtained using the classifiers tested; the dataset used contained identified data on full-field digital mammograms collected at the Institute of Radiology of the University of Erlangen-Nuremberg between 2003 and 2006. The results show that feature selection can help improve predictive accuracy and thus provide clinicians with insight into their datasets. Furthermore, higher performance scores were obtained using the pro-

posed method than with methods based on other classifiers, indicating that using the proposed method enhances the accuracy of breast cancer diagnosis, and may lead to an increase in the understanding of disease manifestation.

Keywords: diagnosis; breast cancer; mammography; classification; prediction

Introduction

Breast cancer is a major health problem that is a critical concern for women and their physicians worldwide (Razavi, Gill, Åhlfeldt, & Shahsavar, 2007). Breast cancer, which is one of the most common cancers that afflicts women, refers to the uncontrolled growth and proliferation of cells that originate in the breast tissue. A group of rapidly dividing cells may form a lump or mass of extra tissue called a tumor, which can either be malignant or benign. A malignant tumor grows rapidly and invades surrounding tissues and sometimes metastasizes. In the early stages of breast cancer, the tumors are small and therefore treatable, but unfortunately the cancer produces no symptoms at this stage. Because the long-term survival rate for women with breast cancer improves when the disease is diagnosed at an early stage (Brenner, 2002), early detection of breast cancer, though challenging, is critical.

In the earliest stages of breast cancer, physicians can detect potentially cancerous (malignant) lumps by feeling the lump during physical examinations or by using imaging tests. Although several imaging techniques are used to evaluate palpable breast masses, the most commonly used method is mammography, which is most effective in the early detection of non-palpable breast lesions (Vyborny, & Giger, 1994; McLelland, 1990).

Mammography is a specialized X-ray procedure used to create detailed images of the breast, and can be ordered by a physician for detection of a variety of breast disorders (Rijnsburger, van Oortmarssen, Boer, Draisma, To, Miller et al., 2004; Bjurstam, Björneld, Warwick, Sala, Duffy, Nystrom, Walker et al., 2003; Nystrom, 2002). X-rays are used in both digital and film mammography to produce an image of the breast, and although mammography detects breast cancers at early stages more reliably than other currently available methods, traditional film-screen mammography has a limited ability to detect certain types of cancer, particularly cancers occurring in women with radiographically "dense" breasts. Therefore, extensive research has been devoted to improving mammography. Digital mammography offers several advantages compared to film-screen mammography for detecting cancers. In digital mammography, images are stored and transmitted electronically, which is an improvement over the image storage and transmission methods used in film-screen mammography. Moreover, using digital mammography, more detailed images of breast tissue can be obtained than with film-screen mammography; this is particularly useful for women with dense breasts. When a breast cancer is detected in its earliest stages, a pathologist can determine whether the tumor is cancerous or benign, and if the tu-

mor is cancerous, the exact cell type and tumor grade can be identified, which provides an estimate of the degree of malignancy.

Detecting breast cancer early and accurately not only allows the disease to be prevented by appropriate treatment, but also prevents unnecessary biopsies. Diverse statistical methods have been developed for mammographic diagnosis of breast cancer (Chhatwal, Alagoz, Lindstrom, Kahn, Shaffer, & Burnside, 2009; Rakowski, & Clark, 1998; Heine, Deans, Cullers, Stauduhar, & Clarke, 1997; Priebe, Lorey, Marchette, Solka, & Rogers, 1994; Karssemeijer, 1993). Rakowski and Clark adopted a multiple logistic regression to select significant correlates of screening mammograms and used a classification tree to combine the correlates into exclusive and exhaustive subgroups (Rakowski, & Clark, 1998). Moreover, Chhatwal and colleagues showed that the logistic-regression model can help to discriminate between benign and malignant tumors during early detection of breast cancers and can also identify the most critical features associated with breast cancer (Chhatwal et al., 2009). Heine et al. demonstrated that parametric statistical methods can be useful for identifying normal tissues in mammograms (Heine et al., 1997).

Classifier systems are increasingly used in medical diagnosis. Evaluation of patient data and the decisions of experts are the most crucial factors that influence diagnosis, and predicting the outcome of a disease is an interesting and challenging task. Researchers have applied data-mining techniques for diagnoses based on digital mammography (Meenalosini, & Janet, 2012; Acharya, Ng, Chang, Yang, & Kaw, 2008); for such diagnostic classification, data-mining techniques offer precise, accurate, and fast algorithms, in which dimensionality reduction, feature extraction, and classification routines are used. Neural networks have improved the accuracy rate for classifying benign and malignant patterns in digital mammography (Brijesh , 2008; Verma, & Panchal, 2006; Rafayah, Qutaishat, & Abdallah, 2005). Classification systems can help minimize possible errors in diagnosis and also enable quick and thorough examination of the medical data (Luo, & Cheng, 2012; Huang, Liao, & Chen, 2008). Recently, the widely used support vector machine (SVM) has been applied for prognosis and has been shown to improve the diagnosis of breast cancer (Li, Liu, & Hu, 2011; de Oliveira, Junior, Correa, de Paiva, & Gattass, 2009).

Because effective diagnosis models are required for physicians to make accurate decisions, the development of accurate models is a key research topic. In this report, a new method is proposed that can be used to diagnose breast cancer and predict results accurately. With the proposed method, the least critical features of breast cancer are omitted to determine whether the prediction of breast cancer is improved, and the degree-of-importance ratings of various features of breast cancers are calculated.

Methods

Database Overview

The database used in this study included modern full-field digital mammograms collected between 2003

and 2006 by Prof. Dr. Rüdiger Schulz-Wendt at the Institute of Radiology of the University Erlangen-Nuremberg (Elter, Wendtland, & Wittenberg, 2007). The database was used to predict the severity (benign or malignant) of mass lesions detected in mammograms, and the prediction was based on the attributes of the breast-imaging reporting data system (BI-RADS) and the age of patients. BI-RADS, which was developed by the American College of Radiology, provides a standardized classification for mammographic studies: BI-RADS was designed to the reduce variability in mammography practice and is used in numerous computerized mammography-tracking systems. Moreover, BI-RADS is a quality-assurance tool that helps interpret breast-imaging data accurately and facilitates outcome monitoring. For each tumor, the database contained a BI-RADS assessment, the age of the patient, and 3 BI-RADS attributes (mass shape, mass margin, and mass density); the database comprised 961 records, each with one dependent and five independent variables, and a total of 516 benign and 445 malignant masses were included. However, the database does not reflect all the variables that were collected by radiologists during mammography, which is a limitation of this work.

The Hybrid Diagnosis Method

A hybrid diagnosis method was developed in this study to help physicians and scientists make accurate diagnostic decisions. The workflow of the proposed method is the following:

Stage 1: Collection and input of the raw data (mammographic mass dataset). In this stage, raw data were collected, the required data were selected, and the features that influence the diagnosis of breast cancer were identified.

Stage 2: Preprocessing of datasets: This stage included two steps. First, the datasets were processed to recover the original missing values. Second, two feature-selection methods were used, forward selection (FS) and backward selection (BS), to eliminate irrelevant features, and the features were ranked using information gain (IG), gain ratio (GR), and chi squared (CHI) values of the mammographic mass dataset.

Stage 3: Building classification models: Several well-known and one new classifier developed in this study (CEC) were used to build classification models from the dataset. The proposed classifier is described in detail in the next section.

Stage 4: Model evaluation: In this stage, a 10-fold cross-validation method was used to evaluate the accuracy, sensitivity, specificity, and AUC (area under curve) of the results obtained, and the comparisons of the calculated results were listed. The classifier was evaluated using AUC, which has values between 0.0 and 1.0 and a practical lower-bound value of 0.5 (chance diagonal). The AUC can be interpreted as the probability with which the classi-

fier accurately sorts positive examples and negative cases.

Results

In this study, two feature-selection methods, FS and BS, were used to eliminate features irrelevant to breast cancer diagnosis and thereby improve the accuracy of breast-cancer prediction. The experimental results showed that both FS and BS selected the four features and reduced the feature Density. In addition, three feature-ranking approaches, IG, GR, and CHI, were used to rank features from the mammographic mass dataset. Table 1 shows the calculated ranking results obtained using the three approaches; the features are ranked according to average weights and the numbers in parentheses represent the degree of importance. The results reveal that BI-RADS is the key feature, ranked first using the three methods; by contrast, all values of weight for Density approach zero, identifying this feature as being the least critical.

Next, an experiment was conducted to compare the four classifiers: SVM-sequential minimal optimization (SVM-SMO), K-nearest neighbor (KNN), naive Bayes (NB), and the proposed classifier (CEC). The comparison was based on a 10-fold cross validation, and the statistical results for each classification model were based on 30 runs of the 10-fold cross validation. Table 3 shows the results obtained using SVM-SMO, KNN, NB, and CEC for five features, and for four features (Density omitted). The items in the tables include total accuracy (i.e., the percentage of correctly classified patterns), sensitivity (i.e., the probability that a case identified as malignant was indeed malignant), and specificity (i.e., the probability that a case identified as benign was indeed benign). Furthermore, previous performance results obtained using NN-VP (Papadopoulos, 2011) and Bagging SVM-SMO (Luo, & Cheng, 2012).

Table 1. The calculated and ranking results of ranking methods

Features	Ranking Methods		
	Info Gain	Gain Ratio	Chi Squared
BI-RADS	0.354 ± 0.012 (1)	0.366 ± 0.012 (1)	330.387 ± 9.783 (1)
Margin	0.279 ± 0.006 (2)	0.191 ± 0.004 (3)	152.279 ± 7.663 (3)
Shape	0.267 ± 0.010 (3)	0.196 ± 0.008 (2)	256.512 ± 8.962 (2)
Age	0.162 ± 0.009 (4)	0.098 ± 0.012 (4)	152.279 ± 7.663 (4)
Density	0.000 ± 0.000 (5)	0.000 ± 0.000 (5)	0.000 ± 0.000 (5)

Note: The numbers in parentheses are the degree of importance

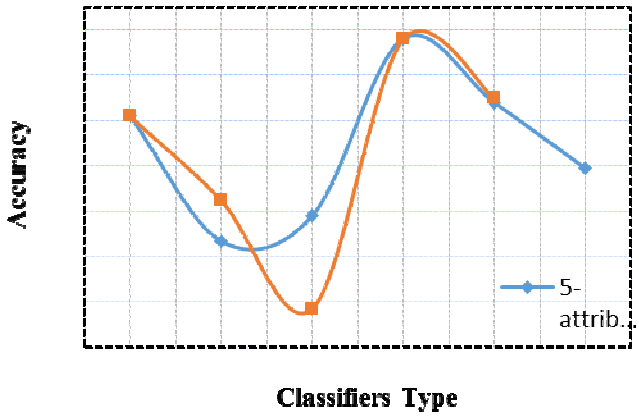

Figure 1. The compared accuracy result of using different classifiers

were compared with the results of other classifiers. CEC exhibited the highest prediction performance (0.846) among all the classifiers tested (Figure 1).Classification-learning algorithms are typically used to build a classifier from a set of training examples with class labels, with the goal being to develop a classifier that can predict the unseen test examples accurately.

However, the accuracy measurement does not consider the probability of the prediction: if the class with the largest probability estimation is the same as the target, the prediction is considered accurate. Therefore, Accuracy ignores probability estimations of classification in favor of class labels. Recently, AUC has been used to evaluate classifiers, and in this study, ACU was interpreted statistically to be the probability of the classifier accurately classifying malignant and benign cases. AUC was obtained by using a non-parametric method based on the Wilcoxon statistic to approximate the area, and AUC was used to compare two ROC curves generated from the same sample cases.

Table 2 shows the average AUC value ($\overline{AUC}$), the corresponding standard error (S.E., derived from 30 AUC values), and the 95%-confidence interval obtained using the four classifiers. Moreover, the reported prediction performances of CBR (Elter et al., 2007) and Bagging SVM-SMO (Luo, & Cheng, 2012) are compared with the performances of other methods. The results show that the predictions obtained using CEC were more accurate than those obtained using the other classifiers (0.869 for 5 attributes, 0.886 for 4 attributes); the accuracy performances of the classifiers are compared in Figure 2.

Discussion

Because breast cancer is an extremely common and serious cancer that affects women worldwide, convincing clinicians of the usefulness of a clinical prediction model is critical. Clinicians can provide patients with effective health care when they possess comprehensive knowledge of specific disease domains and also have extensive clinical experience. Nevertheless,

predicting breast cancer is a challenging problem that has been researched extensively. The problem of diagnosing breast cancer lies within the scope of the more general and widely discussed problem of classification. For treating breast cancer, early detection and accurate diagnosis are critical. Over the past decade, breast cancer outcomes have improved because of the development of effective diagnostic techniques and improvements in treatment methodologies. The long-term survival rate has increased for women in whom breast cancer has not metastasized, with the majority of these women surviving many years after diagnosis and treatment Feature selection in data mining has been studied extensively, with the main goal being to identify a subset of features that enables accurate classification. The underlying idea in feature selection is to choose a subset of input variables by eliminating features with little or no predictive information. Feature selection can substantially improve the comprehensibility of the classifier models generated and enable the development of models that predict unseen samples effectively. Thus, a model may identify a subset of features that forms high-quality clusters by using a given number of clusters.

Table 2. Comparison of the $\overline{AUC}$ using the different classifiers

Classifiers	Estimated $\overline{AUC}$		95% Confidence Intervals	
	5-attributes	4-attributes	5-attributes	4-attributes
SVM-SMO	0.813 (0.005)	0.813(0.004)	0.811-0.815	0.812-0.814
KNN	0.802(0.005)	0.815(0.015)	0.800-0.804	0.810-0.820
NB	0.781(0.001)	0.747(0.001)	0.780-0.781	0.746-0.747
CEC	**0.869(0.008)**	**0.886(0.005)**	0.866-0.872	0.884-0.888
Bagging SVM-SMO	0.867(0.005)	0.869(0.005)	0.865-0.869	0.865-0.869

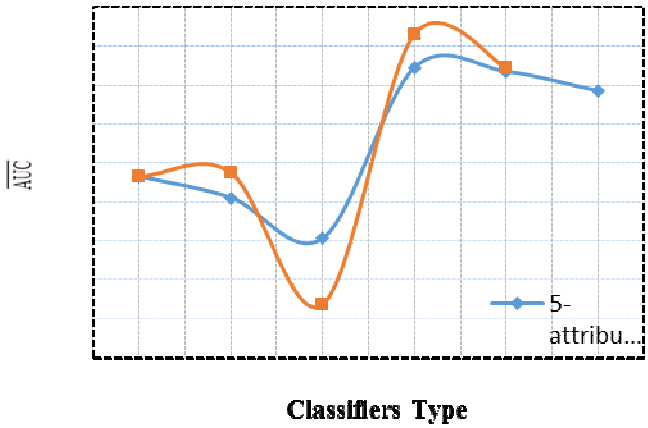

Figure 2. The compared $\overline{AUC}$ result of using different classifiers

Feature-selection methods that select highly representative variables improve the accuracy of the prediction made using a model. Many feature-selection approaches cannot filter the irrelevant or correlated information used for representing samples, and therefore the quality of the data affects the performance of the model. In the proposed method, using the FS and BS feature-selection methods eliminated an irrelevant feature and enhanced the accuracy of breast cancer prediction. Both FS and BS selected the four features and reduced the feature Density. The results shown in Figures 2 and 3 indicated that the predictions with four attributes were more accurate than with five attributes, although the SVM-SMO classifier was equally accurate and the NB classifier was slightly less accurate with five attributes. In this work, using feature selection helped predict breast cancer accurately. Thus, the proposed method can provide clinicians with insight into their databases and enhance their understanding of the manifestation of the disease.

Determining the importance of features is critical for clinical diagnosis. However, understanding how crucial a factor may be is challenging, and physicians estimate how much a specific attribute affects a disease based on their own clinical experience, examination of patients, and pathological analysis of biopsies. Therefore, evaluating disease attributes to make predictions is critical for treating disease. Feature ranking is a problem encountered in diverse fields, and increasing numbers of studies are being conducted to identify effective strategies to determine how critical features are. In previous methods used for diagnostic prediction based on digital mammography, the importance of features was not calculated using feature-ranking methods, the key shortcoming that was addressed in this study. In this study, IG, GR, and CHI were used to rank features obtained from the mammographic mass dataset, and all three methods identified Density as the least critical feature. This aspect of the proposed method can help clinicians evaluate their knowledge of the mammographic mass being examined.

Effective prediction methods help physicians make accurate decisions, and increasing numbers of researchers are seeking to identify prediction strategies by using prediction models. In previous studies, several alternative models, traditional statistical methods, and artificial-intelligence methods were developed for predicting breast cancer. The experimental results of this study revealed that CEC, the proposed classifier, outperformed other tested classifiers. The advantage of using CEC is that the clustering technique helps select a smaller set than the original dataset for training with the classifiers, which substantially reduces the number of support vectors without reducing training accuracy. The results also support the conclusion that reducing the number of training examples lowers computational time and increases the efficiency of data classification. Furthermore, bagging lowered the generalization error by reducing the variance of the base classifiers. Thus, the results show that the proposed method can predict breast cancer accurately and indicate that the method can be implemented effectively.

Conclusion

Evaluation and prediction of diagnosis are critical for treating diseases. Therefore, reliable evaluation methods are required and effective prediction models must be developed. In this study we developed a hybrid diagnosis technique to help physicians diagnose breast cancer accurately. In the proposed method, two feature-selection methods, FS and BS, were used to eliminate irrelevant features (in this study, Density) and thereby predict breast cancer accurately. Moreover, three feature-ranking methods, IG, GR, and CHI, were used to rank the importance of features of breast cancer, which demonstrated that the BI-RADS is the most critical feature and Density is the least critical feature in the mammographic mass dataset. Feature ranking can thus provide clinicians with insight into their databases and lead to further understanding of the manifestation of the disease. These results indicate that the problem of predicting breast cancer can be solved efficiently by implementing the proposed method.

Future research will address two areas. First, three techniques can increase prediction accuracy, artificial features, kernels, and virtual samples, which will be considered for improving the performance of the proposed method. Second, although using the proposed method with the mammographic mass dataset provided accurate prediction results, whether the method can be used with other datasets is unknown. Datasets from diseases such as cancers of the lung, prostate, skin, and ovaries could be used for predicting cancer diagnosis by employing the proposed "intelligent" model, and additional attributes that influence the importance of a disease could be considered for ranking features objectively. Therefore, in future studies, medical datasets in addition to the one examined here will be used to investigate whether the proposed method can help increase prediction accuracy in problems related to diseases other than breast cancer.

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AN ACTION RESEARCH OF NATURE SCIENCE EDUCATION IN JUNIOR HIGH SCHOOLS FOCUSING ON INFLUENCE OF PLAY-ORIENTED COOPERATIVE LEARNING

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Abstract

This research aims to investigate the possibilities to improve students' motivation and willingness through combining cooperative learning and play-oriented method and achieve the learning goals. The action research is applied in this study and analyzed by quantitative and qualitative methods, and it has found that after the implementation of play and cooperative learning, students with poorer academic results became more active in class and willing to take part in discussion. Group discussions made them more interested in new information and opened up a new way of learning. Teachers have to spend more time on designing activities and questions in order for play to

reach the target educational goals. The results shows that Participating students were found to gain higher self-referenced motivation, which consequently made them more curious and interested in learning and discussions.

Key Words: Action research, nature science education, cooperative learning, motivation, junior high school

Introduction

Under the pressure of diplomatism secondary education (junior high school) in Taiwan relies mostly on traditional approaches of lectures and copious written tests, which aim to enhance students' familiarity with the curriculums through rote learning and testing. At present there is increasing doubt due to the drawbacks of these techniques, such as discouraging the motivation to learn and personal interests.

Constructivism believes that students should play an active role in constructing knowledge during the process of learning. Learning, in this sense, is to integrate new information with previously existing one. The goal of teachers in a constructivist classroom is therefore to facilitate students' autonomous learning, while creating a suitable environment for them to do so and providing guidances and explanation when needed (Appleton,1993; Staver, 1998). Play is by nature to require active participation. Using play as an educational tool provides a viable way to evoke motivation to learn and a positive attitude towards learning. Interactive play also helps participants with their skill development, whilst diversifying techniques available for teaching a class (Ebner and Holzinger, 2007; Yu, Han and Chan, 2008; Wang, 2013; Fan, Xiao and Su, 2015).

Nowadays, it remains a challenge to effectively teach a class consisting of students with varying needs and abilities (Zakaria and Iksan , 2007). A number of prior studies confirmed the positive influence of cooperative learning in science education on students' learning performance (Lazarowitz, Hertz - Lazarowitz Baird, 1994; Chang and Mao, 1999; Bilgin, 2006; Zakaria and Iksan, 2007). It was also found to promote creativity and problem-solving skills (Effandi, 2005), as well as the concept of learning (Tandogan and Orhan, 2007). Based on previous findings and intended to counter the unfavourable effects of diplomatism on students' motivation and ability to learn, this research proposed a new approach that combines play with cooperative learning and put it

in real practice in natural science education of junior high school level. While giving special attention to its influence on students' motivation and academic performance, this research also noted the difficulties play-oriented cooperative learning encountered in real classrooms and sought solutions to such problems.

Literature Review

Cooperative Learning

Ben and Kedem-Friedrich (2000) believed that an individual's continued interaction with his/her environment is crucial to the development of cognitive understanding. Following this theory, cooperative learning is deemed as an effective approach to strengthen the collective thinking of educators and learners, as well as that of students working in teams (Johnson and Johnson, 2004; Slavin, 1995; Slavin, 1996). Cooperative learning has its theoretical foundation based on a variety of theories, such as cognitive developmental theory (Johnson and Johnson, 2002; Morgan, 2003; Scardamalia, 2002), social interdependence theory (Johnson and Johnson, 2002) and behavioural learning theory (Johnson and Johnson, 2004; Slavin, 1995). This educational approached is well-organized, centered on learners and applicable to various curriculums and age groups (Slavin, 1985; Nattiv, 1986). According to Johnson and Johnson (1999), cooperative learning emphasizes the essentials of learning, including interdependent thinking, face-to-face interaction, individual accountability, social skills and teamwork. In practice, educators separate learners into heterogeneous groups according to their abilities, gender and age. Each group member is assigned with specific tasks and encouraged with points or rewards to learn while completing the goals set up for their team. Group discussions allow team mates to share ideas and information, as well as to challenge and correct each other, which help to reach a higher-level of cognitive understanding. In addition, through discussing and arguing they learn to respect each other's different points of view, and to practice and improve on their communicative skills (Parker, 1985; Nijhot and Kommers, 1985; Nattiv, 1986; Kalkowski, 1988; Hilke, 1990; Adams and Hamm, 1996; Arends, 2004).

Teach through Play

Playing comes spontaneously and is often adopted as an immediate response to stress. Play gives an individual the chance to have fun, to find satisfaction and a sense of success, through which it helps the ability to learn and the formation of character (Elkind, 1989). Piaget (1962) regarded play as a way for

an individual to understand the outside world and a tool to improve his/her cognitive development. Smilansky (1968) credited play with the value of enabling people to organize their behaviors. According to Bruner (1972) and Vygotsky (1976), play promotes an individual's mental growth and is beneficial to an individual's cognitive learning and social participation. A number of studies also found teaching through play helps students' physical and psychological developments by allowing a first-hand experience with science and encouraging cognitive, emotional, skill-related and linguistic growths (Eisert and Lamorey, 1996; Frost, 1992; Guttfried, 1986).

According to Aufschnaiter and Schwedes (1989), play-oriented teaching is marked with four main qualities: appropriate challenge, competition and cooperation, opportunity, fun and education. Through actions and feelings experienced during play, students can learn in a systematic and objective way, conceptualize their learnings and improve their problem-solving skills. Besides, play works to inspire curiosity, a willingness to face challenges and take control of a situation. It also presents the opportunities of interaction, cooperation, competition and mutual recognition — all of which can become internalized motives for learning. Students who are motivated tend to spend more time and energy on learning, which helps them to achieve better results. Given the opportunities of collaboration, information-sharing and discussion, students can benefited from cooperative learning with improved communicative and social skills (Malone and Lepper, 1987; Sandford and Williamson, 2005).

Action Research

Action research stresses its link with real issues (Elliott, 1992; Altrichter, Posch and Somekh, 1993), paying more attention to the application of theories for the purpose of problem solving. It is facilitated by the need to resolve problems encountered during a working process (Adlam, 1997). After coming up with possible solutions, it tests the feasibility of proposed measures by putting them into real practice. The test results are then reviewed to provide referential basis of modification or improvement, with the aim to finally solve the target problems (McKernan, 1996; Kemmis and McTaggart, 1988). Action research is set out to minimize the gap between practice and theory by adjusting theories based on realistic applications of the latter (McNiff, Lomax and Whitehead, 1996; O'Hanlon, 1996).

In the field of education, action research is conducted by educators who

also take part in teaching. They are as much the researchers as they are the participants of the practice, gathering information in a systematic way, analyzing problems, proposing ways of improvement, implementing proposed measures, and testing the results of the implemented changes (Stenhouse, 1975; Elliott, 1992). The end is to ameliorate the quality of education and look for answers to unusual situations and individual issues. In this sense, action study is especially suited for exploring complicated classroom scenarios (Stringer, 2007).

Action research can be divided into scientific, practical and critical approaches. A scientific action research focuses on quantitative analysis of data and the construction of a fixed model for reference (Mckernan, 1991; Borg, 1981) with the end of furthering researchers' self-development. The practical approach stresses the importance of experience and sets out to better understand how things work in reality. It looks to solve actual problems (Mckernan, 1991) and finds in its scientific counterpart possible flaws in overlooking an issue's social and cult rural factors (Elliott, 1992). Critical action research regards doing research as a way for researchers to reflect on themselves. Its main purpose is to understand the scenarios involving an individual's work in practice, in order to improve workplace fairness and justice (Carr and Kemmis, 1986). In the domain of education, critical action research combines the concept of the practical approach and tries to pinpoint the restrictions and problems that frustrate teachers' efforts, hamper rational action and disrupt fairness in education (Mckernan, 1991). Stenhouse (1981) argued that educators should conduct research planning and self-criticism in a systematic way, while Mckernan (1996) stressed that research results should pass the test of public criticism and real practice.

Methods

This research was conducted from August 2014 to February 2015 over a period of 7 months. The sample consisted of 24 second-year junior high school students, aged between 14 and 15. 13 of them were male, 11 female. Before the research commenced, they were divided into 6 groups according to gender and their natural science scores in the last semester. This was to ensure a even distribution of sexes and abilities across the groups.

Action research with a critical approach was adopted as the method, in addition to the quantitative and qualitative analyses of data. Data was gathered via the following sources: teaching ob-

servation form, student feedback form, peer observation feedback form, natural science's term examination results and the scale of students' motivation toward science learning (SMTSL). The forms of student feedback and peer observation used the samples provided by the Ministry of Education (http://teachernet.moe.edu.tw/MAIN/index.aspx) and were modified according to the research's teaching material. Students' motivation toward science learning (SMTSL) was measured using the scale developed by Tuan, Chin and Shieh (2005). This scale includes six factors: self-efficacy (SE), active learning strategies (ALS), science learning value (SLV), performance goal (PG), achievement goal (AG) and learning environment stimulation (LES). In addition, to understanding students' inner motives, we consulted Hogan's approach (1999) to include none performance goal (NPG) as an additional factor. Finally, to decide the influence of play-oriented cooperative learning on academic achievement, the exam results of every student from the same school year were collected to provide a comparison with those of our sample.

The technique of triangulation was adopted for data validation during the process of qualitative analysis (Denzin, 1978; Patton, 1999). Other teachers from the same school, experts and scholars were invited to check the information gathered from the teaching observation, student feedback and peer observation forms following the principles of theory triangulation, methodological triangulation and investigator triangulation. The science learning motivation scale adopted the SPSS for Windows 18.0 for its qualitative analysis. Pre-tests including item analysis and factor analysis were conducted to ensure the validity of the scale, which were then tested again using Cronbach's α coefficients. According to item analysis, every item and their total achieved the coefficients higher than 30 and critical ratios (CR values) over 3.5. No removal of items was necessary. Before analyzing the factors, the suitability of factor analysis were confirmed using KMO and Bartlett tests (Kaiser, 1974). The results were positive: KMO value was 0.761; Chi-Square value as 1302.007 in the Bartlett spherical test (degree of freedom: 595). Factors were subsequently extracted via principal component analysis. Using Varimax factors with eigenvalues higher than 1 were kept for orthogonal rotations and those with a factor loading lower than 0.45 were removed (Tabachnick and Fidell, 2001). All items in this research had factor loadings higher than 0.45. The construct validity of questionnaire was confirmed, as all initial items were kept in the finalized version. Finally, in credibil-

ity test the questionnaire achieved an overall Cronbach's α values of 0.886, with each construct showing a higher than 0.70 Cronbach's α value. The results proved the internal consistency and credibility of the questionnaire (Guilford, 1965). Before and after participating in play-oriented cooperative learning, students were asked to fill in forms regarding learning motivation for comparison.

Bearing in mind the qualities of teaching through play—challenge, competition and cooperation, opportunity, fun and education (Aufschnaiter, Prum and Schwedes,1984; Aufschnaiter and Schwedes 1989), this research prepared four educational games targeting the respective subjects of sound and air, transmission of light and light speed, reflection of light and mirrors, and tinted light and color. All of them required students to work in teams as a way to encourage cooperation. To pose sufficient challenges each play was designed to include different levels, each of which can only be passed when a team gathered sufficient scores to move on to the next. After the experiment, the term exam results of students taking part were compared with those in the standard class. t-Tests were used to measure any significant difference to determine the influence of play-oriented cooperative learning on motivation.

Results & Discussion

The difficulties play-oriented cooperative learning encountered and the solutions. In a critical action research educators need to keep adjusting their techniques in response to ever- changing classroom situations (Stenhouse, 1981; Mckernan, 1996). To achieve this, this research used teaching observation and student feedback forms not only to record but also to facilitate reviews, discussions and improvements. These records help to first identify the problems before finding a way to solve them. The section below lists the problems faced by our educational activities as well as our corresponding solutions.

Problem1: During the process of play students were asked to complete their personal learning lists and compose a shared work list for the team. The latter task tended to intervene with the former, as more attention was paid to scoring for the team (Teaching Observation Form-20140902).

Solution 1: Ask students to finish the learning list before starting the game. Separate the two activities and include the learning list in the final score as an incentive.

Problem 2: Questions tended to be difficult, causing some groups to fail com-

pletion within time or rash completion with poor results (Teaching Observation Form-20140905).

Solution 2: Adjust the level of difficulty and reduce the number of questions to allow sufficient time for discussion. Besides, a preview of the next course, i.e. new subjects and upcoming activities, gives students a chance to prepare in advance and to do better in class. Preparation should benefit their learning performance.

Problem 3: During the session of group discussion not everyone was as engaged as they could be. Some students looked absent-minded or disinterested. A few even started chatting with someone from a different group (Teaching Observation Form-20140911).

Solution 3: Score the performance of group discussion and set up guidelines in advance. The standards and goals for group discussion should be as clear as possible. Take time during class breaks to talk to students who seemed bored or easily distracted to understand the underlying causes.

Problem 4: Some students struggled to express themselves in group discussion. Occasionally members of the same team argued with each other when in disagreement (Teaching Observation Form-20141027).

Solution 4: Provide lessons on cooperation. Teaching students' ways to work with each other and simple communicative skills. For instance, tips on how to ask questions, how to answer, how to respond with a positive feedback.

Problem 5: There should be more explanation of the rules and more time for discussion (Teaching Observation Form T03).

Solution 5: Ensure every student is familiar with the rules before starting. Allow ample time for discussions to allow every student the chance to learn and think during the process.

Problem 6: Distribution of work was unclear, leaving some members of the same group less involved than others. In some cases, a team was dominated by one or two leading figures, or left to one or two members to take care of everything for everyone (Teaching Observation Form T11).

Solution 6: Before each activity makes sure every student knows his/her responsibilities. During play, teachers should keep an eye on how each group works together and whether every member takes charge of their given tasks. Include

individual participation in the overall scores of a team's performance.

Effects on Learning Motivation

Students' science learning motivation was recorded before and after the experiment using self-completed forms. t-Tests subsequently measured the differences of significance between these two sets of results to confirm the influence of play-oriented cooperative learning on motivation. Table 4-1 list the test results.

As seen in Table 4-1, the averages of the scale and each construct were up after the experiment. t-Test statistics showed that considering the criteria of 95% confidence interval and .05 significance level, there was only the exception of non-performance construct that did not reveal statistical significant differences ($p<.05$). This suggested students' internal motivation was elevated, and as the insignificant statistics of the non-performance factor indicated, such elevated motivation was self-referenced, instead of responding to social expectation.

Looking for the causes of enhanced learning motivation, we compared information gathered from the forms of teaching observation, student feedback and peer observation feedback to draw the following conclusions:

Play-oriented cooperative learning is able to evoke interest and curiosity, which serve as the drive for learning. Student feedback below showed exactly how play made them feel more curious about the subject and more interested in know more about it.

Because people are curious about new things (Student Feedback Form-S03).

More hand-on experience made me feel more like learning (Student Feedback Form-S17)

Well-designed rules of play and good guidance raised students' interest (Peer Observation Feedback Form-T11) Want to know more about the science our play involved (Student Feedback Form-S13)

Play and cooperative learning provide the drive for students to play an active role in learning. During play, competition stimulates their desire to win making them even more competitive and keen on winning. This desire helped further their active quest for knowledge and a higher-level of learning.

Table 4-1 Test Result

		Mean	N	SD	SE
Group 1	Total after experiment	3.65	24	.327	.066
	Total before experiment	3.28	24	.225	.046
Group 2	SE after experiment	3.33	24	.403	.082
	SE before experiment	2.96	24	.609	.124
Group 3	ALS after experiment	3.77	24	.670	.136
	ALS before experiment	3.45	24	.364	.074
Group 4	SLV after experiment	3.66	24	.436	.089
	SLV before experiment	3.40	24	.270	.055
Group 5	NPG after experiment	3.41	24	.452	.092
	NPG before experiment	3.20	24	.545	.111
Group 6	AG after experiment	3.81	24	.568	.116
	AG before experiment	3.40	24	.571	.116
Group 7	LES after experiment	3.90	24	.634	.129
	LES before experiment	3.29	24	.429	.087

The feeling of competition made me feel more energized and willing to join the class (Student Feedback Form-S24).

Rewards for winning made me feel more motivated to learn (Student Feedback Form-S21).

Play-oriented cooperative learning boosted attention and participation motivated by curiosity. It also affected positively on the initiative to think and learn. Teachers' timely instruction and guidance during the process of an activity helped students' willingness to participate and motivation to learn.

Teachers went to each group to offer help and advice during the process. (Peer Observation Feedback Form-T03).

Visual aids worked well in catching students' attention for a higher degree of class engagement (Peer Observation Feedback Form-T07).

Advanced preparation helped teaching to run more smoothly and to keep students more interested (Teaching Observation Form- 20141106).

To gather more points during play each team tends to try and discuss more (Teaching Observation Form-20140909).

Feeling more like taking part (Student Feedback Form-S07).

Group discussions and doing experiments together made me feel engaged (Student feedback form-S11).

Participation and response rates among students were high (Peer Observation Feedback Form-T12).

Time control put a little pressure on teams to finish their tasks, at the same time promoting a degree of participation (Peer Observation Feedback Form-T04).

Play-oriented cooperative learning encourages a group's teamwork and collective learning. Each group shared a goal, and in order to reach it together as a team, members had to exchange opinions, communicate with each other, share what they know, reflect on their own, detecting the blind spots of their thinking. Peer interaction shaped and re-built personal views through a meaningful way of learning.

Observe each group's interaction during discussion time and provide timely instructions can create a favorable environment for discussion and the smooth running of activities (Teaching Observation Form-20140905)

Time limits promoted the eagerness to reach the finishing line. To complete the given tasks within limited time, students carried out discussion more effectively and spent less time on unrelated distractions (Teaching Observation Form-20141031).

Keep a close eye on each group during group activities, compliment good behavior and reward them with extra points. This creates positive incentives (Teaching Observation Form-20140912).

The Influence of Play-oriented Cooperative Learning on Learning Achievement

The experiment was carried out from August 2014 to February 2015. To see its influence on academic achievement, end of term exam results in June 2014 were taken as reference to compare the results of exams after the experiment done in October and December 2014. All numbers were translated into t-scores for comparison, as seen in Table 4-2.

Table 4-2

	T-Scores	SD	Rank
Jun 2014	50.45	20.43	2
Oct 2014	52.15	10.39	1
Dec 2014	52.35	9.68	1

Table 4-2 showed that the t-scores of students participating in play and cooperative learning were higher. The difference of averages on the other hand dropped from 10.43 to 10.39 and further to 9.68 over the period of three exams. The performance gaps among students seem to have reduced. To pinpoint the reasons behind these trends, we drew the following conclusions based on information gathered via teaching observation, student feedback and peer observation feedback forms.

Play-oriented cooperative learning improves a students' ability to understand and think through competition and problem-solving. It inspires interest in learning and gives them the opportunity to apply what they learn in solving problems in the context of play, which also helps the memory of new information.

The combination of play with teaching helped me better understand the content (Student Feedback Form-S24).

Play allowed students to apply their learning and encourage them to re-think what they learned in the classroom (Peer Observation Form-T03).

Questions presented in the scenarios designed by teachers were effective in evoking students' interest and applicable to real situations in life (Peer Observation Form-S11).

Every team discussed the concepts introduced by their teacher and presented their conclusions on stage,

helping each other notice their own logic flaws (Teaching Observation Form-20140909).

Play was fun and helped the memory (Student Feedback Form-S03).

Play-oriented cooperative learning encourages discussions among students — a stark contrast to passively listening to lectures in a traditional classroom. Students can interact and work together to gain better scores for their teams. The fast-learners and high-achievers also had a chance to help those lagging behind in a way to reduce the learning gaps among students.

Able to discuss with peers of different levels. Those who learn better can help with those lagging behind (Student Feedback Form-S21).

Saw students actively involved in discussion and deduction — beneficial to their learning results (Peer Observation Form-T04).

Some students who used to daze or chit-chat with neighbors became more interested and concentrated on the course. They also started discussing with peers and expressing their opinions (Teaching Observation Form-20140902).

In order to gain more points teams were more eager to take on challenges and participate in active discussion. Sometimes they argued but then also learned to reach consensus. It was clear that students started to know the skills of cooperation (Teaching Observation Form-20140909).

Summary and Conclusions

In traditional class rooms students are usually the passive recipients of information provided by teachers. This passivity is believed to contribute to a lower motivation to learn and a poorer performance. Play-oriented cooperative learning works not only to elevate internal motivation, but also improve on the results of learning. This research's experimental teaching covers four natural science subjects: sound and air, transmission of light and light speed, reflection of light and mirrors, and tinted light and color. Action research was adopted to ensure a continued adjustment of teaching technique in response to problems encountered during the process.

Play-oriented cooperative learning was shown in this research to

raise learning motivation and results. Participating students were found to gain higher self-referenced motivation, which consequently made them more curious and interested in learning and discussions. Their participation in teamwork and educational activities also helped improve their academic achievement as revealed in their exam results. In addition to higher individual scores and rankings, the performance gaps among students participating in this research were reduced. This suggests that they were doing better as a whole, as play and cooperation became beneficial not only to personal growth by encouraging independent thinking, but also to the collective progress of the whole class through group discussion and collaboration.

In conclusion, this research has found that after the implementation of play and cooperative learning, students with poorer academic results became more active in class and willing to take part in discussion. Group discussions made them more interested in new information and opened up a new way of learning. Teachers, of course, have to spend more time on designing activities and questions in order for play to reach the target educational goals.

Based on these findings, it is recommended to set out clear rules before introducing play as a teaching technique and implement these rules thoroughly to ensure fair play. There should be intervals between teaching activities and play. The game design should avoid questions that are too difficult and allow plenty of time for discussion. To encourage active discussion, teachers can consider scoring the performance of team discussions, ensuring every member of a team is assigned a task, paying attention to those easily distracted, assisting them if necessary and intervening in time to help settle disputes within groups.

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