

## By using method of Analytic Hierarchy Process to Search out the Key Factors Successfully Running Business Under the Legislated Regulation of Local Water Resources Development for Hot Spring at Szuchungsi in Taiwan

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**Abstract: Objective:** This study is proposed to search out the key factors of providing public clean water and sewer system to control the supplying of hot spring as well as to intensify the performance of running the sustainable business under the legislated regulation of developing local hot spring resources at Szuchungsi in Taiwan. **Methods:** Based upon local characteristics and specialties at Szuchungsi Hot Spring Area (SHSA) in Taiwan, professional interviewing questionnaire design and data analysis through Delphi method and Analytic hierarchy processing were conducted. The participated experts and academic scholars are governmental agencies and the experts served in the hot spring industry with the experience of running business more than three years. Totally sixteen people are participated for the interviewing. **Results and Discussion:** SHSA urban planning and development would be affected by the recommended key factors of providing public clean water and sewer system. Structurally, first level indicators include six items. Second level indicators includes thirty items. The most essential item of the first level indicators is the production factors. However, for second level indicators, six substantial items should be concerned which are the 1) counseling hot spring industry development of hot spring resources, 2) using of hot springs for health care consciousness enhancement, 3) increasing of potential tourism, 4) competencing authorities of supporting development of natural resources, 5) improving quality of the software and hardware, 6) developing transportation resources. **Conclusions:** Only pursuing new ideas to alter stakeholder traditional thinking and adding with the assistance of governmental authorized representative can eliminate the barriers as well as regulate hot spring waters to benefit and develop the related business. Comprehensive investigation and analysis of the recommended key factors can identify the major differences among those factors. Through statistical analysis, we realize how to balance the local stakeholders and the resources of providing public clean water and sewer system. Meanwhile, the factors relate controlling of the supplying of hot spring under the legislated regulating and developing for the take-and-supply business are demonstrated in this report. [Jui-Liang Hsu, Shwu-Tzy Wu, An-Chi Yeh, **By using method of Analytic Hierarchy Process to Search out the Key Factors Successfully Running Business Under the Legislated Regulation of Local Water Resources Development for Hot Spring at Szuchungsi in Taiwan.** *Life Sci J* 2014;10(9):622-631] (ISSN: 1097-8135). <http://www.lifesciencesite.com>. 100

**Key Words :** Delphi method, Analytic hierarchy processing (AHP)

### 1. INTRODUCTION

Essentially, hot spring needs to be cultivated. Not all natural hot water can be developed to be hot spring source. A source of hot spring needs to fit the conditions of proper well drilling and good water fetching at least. Water storage and drainage are also important conditions should be considered. Moreover, local land protection which may cause water qualitative change, water contamination, temperature decline and so on should also be concerned strictly [Hong, 2002]. The section chiefs of the Department of Water Conservancy in Ministry of Economic Affairs of Taiwan government, Xian Chen and Baowang Zhao [Chen et al., 2006] pointed out that the problems of poor collection data for survey, ambiguity of the management responsibilities, lacking of natural resource regulation and no legal service for the hot spring related business have been accumulated ever since a hundred year ago of exploitation of the hot

spring resources in Taiwan, which leads to very bad sample of domestic development and utilization of hot spring resources. Meanwhile, lack of effective management policies has even more serious damages to the long-term exploit of the hot spring resources in Taiwan. Based upon the point of view of this, Ganji Quan [Quan, 2007] reported that hot spring industry currently must to be kept as public line and to be under independent auditing so that the revenues garnered from multiplying resources of hot springs can be used to improve the dwindling risk of using resources, to agitate the idea of users pay for using and to increase SPA operation funds. Due to the Spa Method Act (SMA) proposed on July 2, 92, announced by the President on July 1, 94 and enacted by the legislate representatives, Lai Wenliang [Lai et al., 2008] reported that establishing of SMA for hot spring should approach to the goal of ensuring hot spring resources to be sustainable usage for avoiding

excessive extraction. Throughout SMA, it can guide the hot spring resources avoiding from improper use and make the hot spring resources to be conserved, developing and utilizing to achieve the best in synergy and spring quality controlled as well as environmental protected. It can have profound impacts to the culture of hot spring in Taiwan.

According to "Resources research and development and utilization project survey for hot spring water in Taiwan from the year of 2000-2003" commissioned to industrial technology research institute by the department of water conservancy, it has shown that the Szuchungsi stream was over developed [Chen et al., 2005] with violating the legislated regulations of long-term protection of sustainable utilization of hot spring resources act and has become the most important concern since then.

By effective implementation and application of using hot spring resources for quality and environmental management, only sustainable using of natural resources to activate the local hot spring industry and drive the prosperity of the local industry to promote the sustainable development of hot springs are the key factors need to be concerned. Therefore, for assisting hot spring related enterprises, it must through the public line for Szuchungsi stream at Taiwan with controlling of the hot spring resources and improving the operation performance to reach to the goal of sustainable development of the

take-and-supply business..

## 2. Methods

Delphi method has been used to identify the key factors of affecting development of how to regulate the criterion of reusing analysis hierarchy process method (AHP) to assess the order of the factors. Using of the identified development regulation to find the key factors for evaluation indicators, we developed the strategy to reach the ultimate goal of how to use the hot spring resources sustainably.

### 2-1 Structure of observed indicators

In this study, we did a lot of surveys of experts and academic scholars and organize the suggestions about the leisure design and sight-seeing plan in the field of hot spring management to specify the key factors of success of running associated take-and-supply business. Meanwhile, we use the Diamond theory in the management proposed by Michael Porter as the base to develop an idea structure of observed indicators as shown in Fig. 1

### 2-2 The Process and Steps for the Analysis

The process and steps for our study is shown in Figure 2 and as follows. The details of the statistical calculation would be demonstrated in the following sections. Meanwhile, the analysis of the data would be also presented in the following tables.

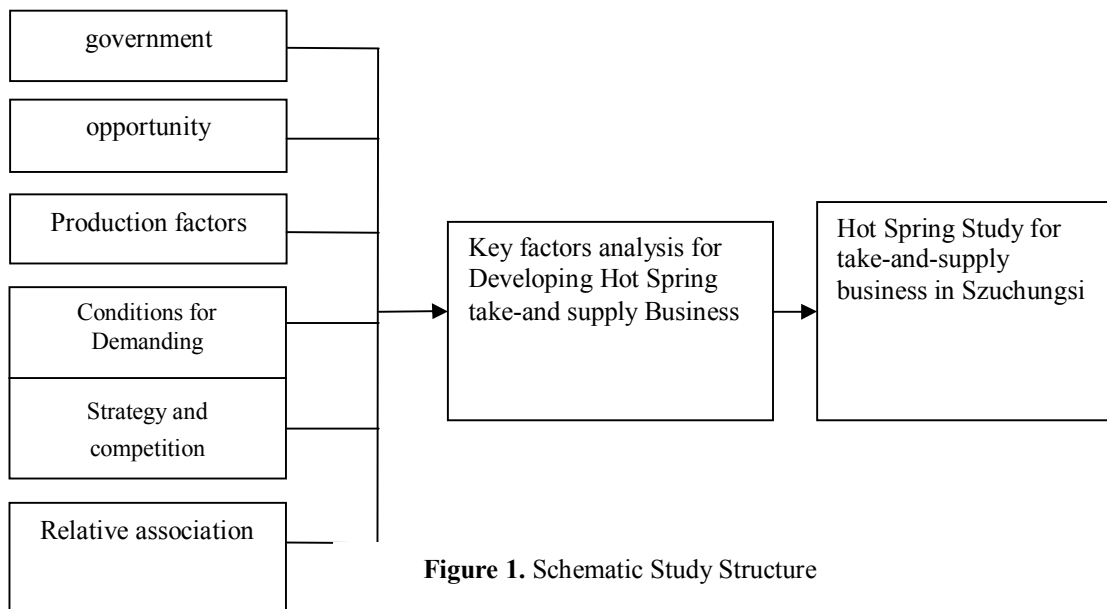
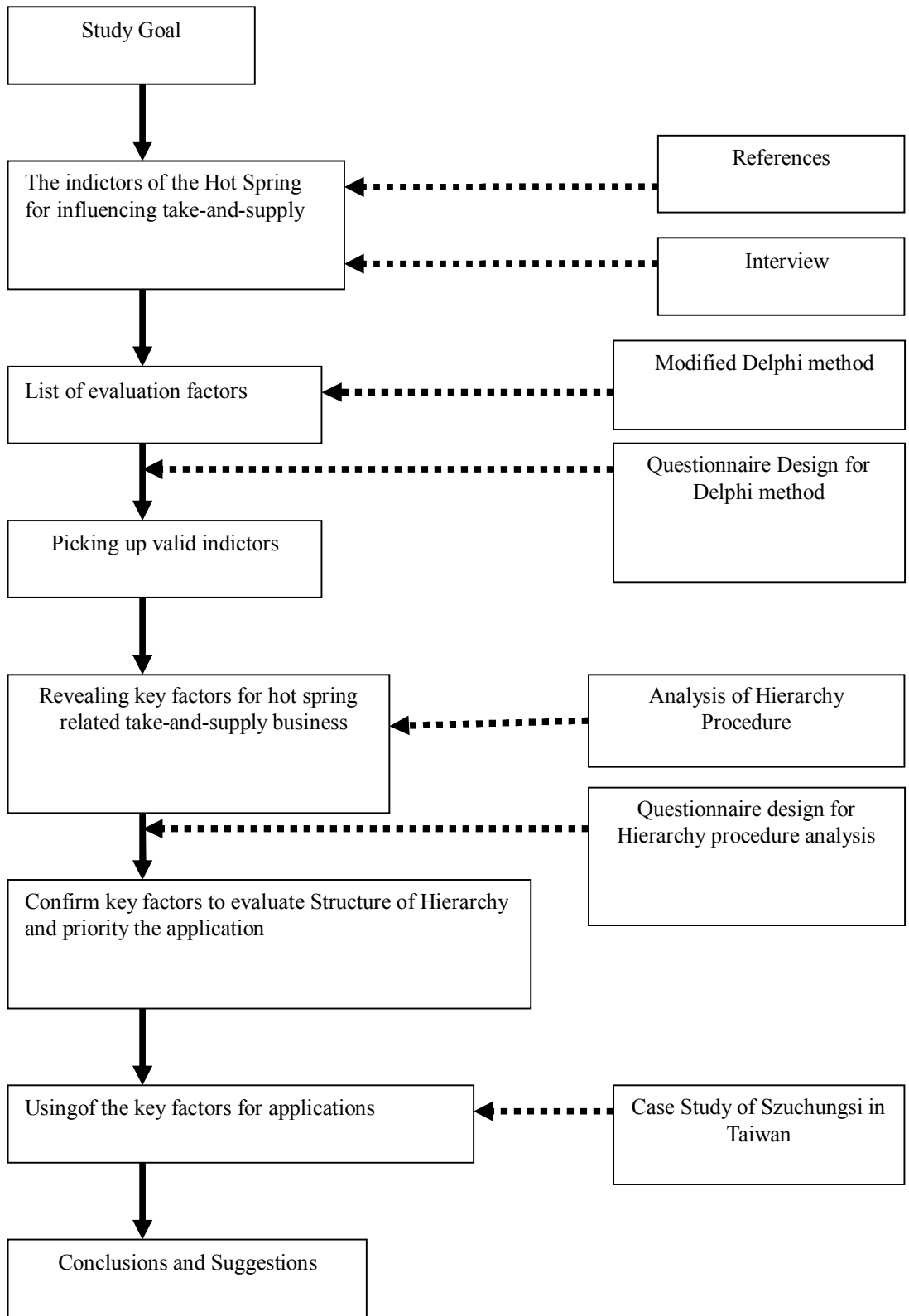


Figure 1. Schematic Study Structure



**Figure 2.** Process and Steps for Hot Spring related take-and-supply business

## 2-3 Research of Hot Spring Related Take-And-Supply Business

### 2-3-1 Scope of the Research

Due to the local specialties and the correlations, Hot Spring Related Take-And-Supply Business (TASB) Study in Szuchungsi is designated. The scope of this study is to reveal several key factors that would affect successfully the take-and-supply business at Szuchungsi in Taiwan.

### 2-3-2 Objectives of the Study

1. Deep interviews for the related field academic scholars :The hot spring TASB study is designated for developing the key factors of setting up a successfully hot spring related business. Because it is a specific group study, a small sample was designated nine people including professional experts, businessman, governmental officers and academic scholars for interviewing.

2. Interviews with experts and professionals (selected and analyzed the interview data by using of Modified Delphi method and level hierarchy procedure analysis): The purpose of using of Modified Delphi method and level hierarchy procedure program is to get the consistent results of the statistical analysis for specific group of objects. In order to have better quality and prospective study, selecting qualified experts for the questionares is an important factor [Li et al., 2007]. In the researcg article [Smith et al., 1995], it was suggested that the background of experts and scholars should be diversified. And thus, the risk of statistical error can be reduced. If the backgrounds

of the experts are too similar, they are unable to reach the effect of brainstorming. In the reference [Rowe et al., 1991], it is reported that experts must have a considerable understanding in specific areas of study and possess professional knowledge and technology for statistical investigations. In this study, three years' experience in related business or working as the researcher for governmental agencies in hot spring industry is the basic requirements for selecting to be as experts and scholars. Lastly, total of 16 people were selected.

### 2.4 Statistical Tools

This research integrated the methods of depth interviews, literature analysis, formal Delphi and hierarchy process analysis to conduct the analysis. Thus, the key factors affecting development of evaluation index for legisterated regulating TASB can be successfully completed.

#### 2-4-1 Design of Questionnaires

Through the results of interview, collecting sightseeing leisure resources, key success factors of enterprise management, hot springs and regulation and licensees related literature with Delphi expert questionnaire effective evaluation indexes of 30 questions factor; Afterwards, and then to establish a analysis hierarchy process (AHP) questionnaire, confirm development licensees key success factors important priority order of evaluation index, questionnaire design as shown in Figure 3.

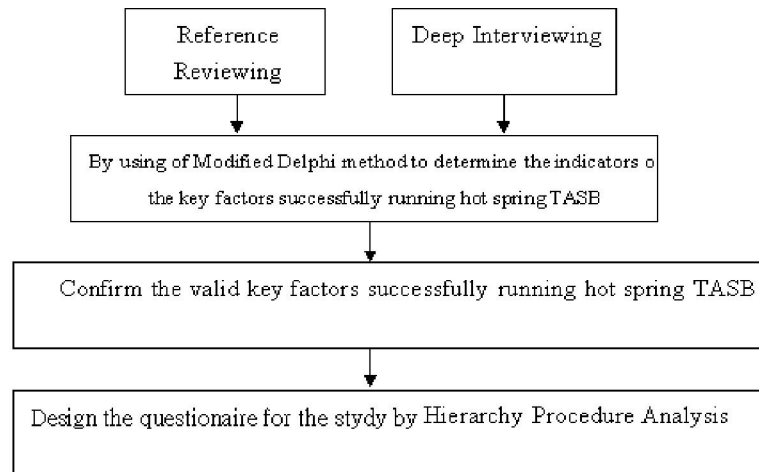


Figure 3 Flow chart of AHP

**1. Reliability Analysis** To understand the validity of the questionnaire designed for our study, it is necessary to analyze the reliability of the test. From the reference [Gay, 1992], it was argued that if any

test or scale of the reliability coefficient (Cronbach's  $\alpha$ ) is equal to 0.90 or above, the scale reliability is good. Based upon the references, [Devellis, 1991] and [Nunnally, 1978], they were debated that if the

Cronbach's  $\alpha$  is above 0.70 which the reliability is acceptable. However, if the Cronbach's  $\alpha$  is below 0.60, it should be revised and the research tools should be go over for suitable correction. In this study, the Cronbach's  $\alpha$  value for government is 0.9782, for opportunity is 0.7243, for production factor is 0.8411, for demanding is 0.7311, for structure of the enterprise strategy and competition level is 0.8798 and for related and supporting industries is 0.7380, all the

factors in the table 1 are shown to be higher than 0.60 which is on behalf of different points of view and indicators of the decision being trusted.

## 2. Sample Distributions

The total experts involved are 16 people including business experts, academic professionals and officers. The distribution of the experts is listed in Table 1.

**Table 1.** AHP Ratio of Experts

Expert	Ratio
Hot Spring Related Industry Business	37.50%
Academic	31.25%
Governmental Officer	31.25%

**3. Consistency test** In this study, all the statistical results should pass the consistency test. Taking the average of the total and computing Consistency Index (C.I.) and Consistency Ratio (C.R) to check the matrix consistency are based on the research of Satty published in 1980. If  $C.R. > 0.1$ , the

error is not acceptable. All our 16 questionnaires of AHP are valued and the C.I. is smaller than 0.1 which presented the assessment for the topics are good matching to the theory, internally in consistency. The results are shown in Table 2.

**Table 2.** AHP Questionnaire Test Table

Level	C.R. 值	Consistency Test
First Level Indicator	0.0821	OK
Second Level Indicator	government	0.0993
	opportunity	0.0678
	Production factor	0.0782
	Demonding Conditions	0.0596
	Enterprise structure and Competition Strategy	0.0663
	Related business supporting	0.0541

## 2-4-2 Data Analysis

For the design of questionnaires, Microsoft Excel was used to calculate the geometric mean of the data for each question and the weighting value for each paired comparison matrix as well as all levels and overall level of consistency index and consistency ratio. The standard of the CI and CR are based on Satty (1980)'s study of argument. If C.R. value  $> 0.1$ , the error falls within the scope of the unacceptable, the data would be deleted. The weighted proportional factors were used for analyzing the priority of the comprehensive factors.

## 3. Results and Discussions

### 3-1 Analysis of First Level Weighting Factor

The purpose of Analysis of First Level Weighting Factor is to evaluate the key factors that can be employed successfully to develop TASB recommended business for Szuchungsi hot spring. The first level indicators of the assessment include government, opportunity, production factor, demanding conditions, the related supporting industries and structure strategy of the enterprise and competition. Through the analysis, we got AHP weighting factor listed in Table 3.

**Table 3.** Evaluation of the first level indicators

Objective	First level variables	Weighting Factor	C.R.	Sequency
Key factors successfully develop TASB for Szuchungsi hot spring in Taiwan	Production factor	0.3021	0.0821	1
	Demonding Conditions	0.2824		2
	government	0.2001		3
	opportunity	0.1237		4
	Enterprise structure And Competition Strategy	0.0534		5
	Related business supporting	0.0383		6

**3-2 Weighting Factor Analysis in Second Level**

**3-2-1 Government**

Under the indicator of government, the second level indicators include counseling hot spring industry development with proper use of hot spring resources, design of hot spring developing area, Land use and

modification of levying legislation, the government leading OT and BOT design for TASB recommendation, water resource controlling and governmental leading of using water. All the calculated weighting factors are listed in Table 4.

**Table 4.** Weighting factors, C.R. and Sequence ordering of the second level indicators under first level indicator government

First Level indicator	Second Level indicators	Weighting Factor	C.R.	Sequency ordering
Government	Counseling hot spring industry development with proper use of hot spring resources	0.2797	0.0993	1
	Design of hot spring developing area	0.2111		2
	Land use and modification of levying legislation	0.1763		3
	the government leading OT and BOT design for TASB recommendation	0.1134		4
	water resource controlling	0.1109		5
	governmental leading of using water	0.1086		6

Our study has shown that counseling the businessman to develop hot spring industry may help the water resources to be used properly and protected the springs not over used. In Central Government, Department of Hydraulic Engineering was proposed counseling for monitoring and recording of hot springs related business running. It is unfortunately that the Taiwanese government has not been involved to develop Szuchungsi hot spring. Our suggestion is that the government provides a special plan combining with agricultural and the hot spring industry development being carefully considered. As the hot spring water pipeline through the land could not be properly designed, if it is not controlled by the government, coordinating or collecting and managing for land would be the most difficult part. It was reported [Chen et al., 2005] that creating a system of reasonably using of hot spring resources has been stepped up to the measurements, legislative regulations and sound management system. Developed legislative regulations by building public pipeline technology, establishing legislative regulations facilities, water supply operation mode

and assessment of operation mode, promote public licensees demonstration, set up hot spring facilities on-site monitoring and audit technology can be done with OT or BOT. Total amount control of water resources, the county government can strictly control the usage of the water, for instance, controlling youth camp room numbers, allocate water charges to reduce the hot spring water resource waste. As the matter of fact, regarding only in accordance with the government management, legislative regulations must also be operated by the public sector because of the problem of pipeline must go through a lot of different units of jurisdiction.

**3-2-2 Opportunities**

First level indicator includes a indicator as opportunities. Under the architecture of the second hierarchy architecture indicators include promotion of using of hot spring for health protection, geothermal energy development and utilization, case example and increasing hot spring resources sustainable use consensus four indicators. Through AHP hierarchy process analysis of the weighting factors, the results are shown in table 5.

**Table 5.** Weighting factors, C.R. and Sequency ordering of the second level indicators under first level indicator opportunites

First Level indicator	Second Level indicators	Weighting Factors	C.R.	Sequency ordering
Opportunities	romotion of using of hot spring for health protection	0.2937	0.0678	1
	geothermal energy development and utilization	0.2601		2
	case example	0.2484		3
	increasing hot spring resources sustainable use consensus	0.1978		4

Hot spring can be used as the natural treatment for the health protection. In Germany and Japan, it will be a hot spring's health protection cost incorporated into the project of national health insurance payment [Guo Wanmu, 2005; Hong Rong Chuan, 2003 & 2002]. Use of hot spring as health care is presented as the future trend for modernized people. It is becoming more and more concerned if can improve the consciousness relative to the conservation of water resources at the same time. Hot springs provide a surprising degree of heat. People have developed many method of application of the geothermal energy [Ministry of Economic Affairs, 2002]. First case is that a centralized management of hot spring improved the ground water level back to 80 meters and increased the water temperature from 56 degree to 62 due to the effective care for the hot springs. A second case is the water management in Taipei city. Centralized management can minimize hot spring industrial development cost and be used hot

spring resources effectively (north of Taipei for hot spring, 2005). It was reported [Zhan, 2005], the hot spring managements in our country have the following problems: lack of the amount of hot spring water providing, for instance, in Peitou, too much hot spring development caused a decline in groundwater level and dried up the hot spring. It leads to public to take care of the conservation of hot water resources.

### 3-2-3 Production factors

First level indicator of production factor with the architecture of the second hierarchy indicators include eight items: increasing of potential tourism, hardware and software quality promotion, water maintenance cost, hot spring water price set, hot spring water recycling, source of the water rights, maintenance cost and hot spring, water temperature controlling, leading right of the water, amount of the water, reuse of the hot spring. Through AHP hierarchy process analysis of the weight, the results are shown in table 6.

**Table 6.** Weighting factors, C.R. and Sequence ordering of the second level indicators under first level indicator production factor

First Level indicator	Second Level indicators	Weighting Factors	C.R.	Sequency ordering
Production factor	increasing of potential tourism	0.1501	0.0782	1
	hardware and software quality promotion	0.1443		2
	water maintenance cost	0.1401		3
	hot spring water price set	0.1212		4
	water temperature controlling	0.1201		5
	leading right of the water	0.1110		6
	amount of the water	0.1108		7
	reuse of the the hot spring	0.1024		8

In leisure and recreatuion related industry, due to the increased recreational quality in recent years, the diversified services are necessary for attracting visitors. The hot spring associated bussinesses have to transformed into hotel business associated natural hot spring developed leisure industries (Lung Jun Huangt, Gao Ruyi, Chen Xiuhua, Zhang Wenquan, 2006). Thus, controlling of Szuchungsi spring quantity and temperature as well as effective management and effective water quantity allocations must be improved. Professional promotion for soft and hard ware facilities including improvements of old pipeline for maintenance, change to hot spring water to be more effective in keeping temperature and water quality should be concerned. Who is going to pay for the maintenance? If a small water companyt can bear the cost of maintenance, te hot spring related business will reduce the pressure of the business running. Therefore, associated water company assocites withe hot spring management is necessary. The price of the spring set should be long-term, stable, following with the hot spring act, in taiWan, the current hot spring collection fee is NT\$9 (0.3 US dollar) only. A specific

temperature controlling factory associated with providing-taking company is important for the related business. The right of developing hot spring resources is freezed in Taiwan to protect the environment. The hot spring water yield in the area of Szuchungsi is about 150 hectares. The most amount that can be extracted is limited to 1800 tons. If the water usage is more than the limitation, water shortage will appear. Hot spring water recycling use is the major goal for future development. In Taiwan, people are not still be educated well to understdnd the importance.

### 3-2-4 Demanding factor

In the structure of first indicator of First level indicators Demanding Conditions, the architecture of the second hierarchy indicators include "hot spring water resources total amount control" and "local interested party agreement", "effective integration and execution", "local residents support" and "local government support to the development of natural resources (maintenance)" five items are indicators. Through AHP hierarchy process analysis, the results are shown in table 7.

**Table 7.** Weighting factors, C.R. and Sequence ordering of the second level indicators under first level indicator demanding conditions

First Level indicator	Second Level indicators	Weighting Factors	C.R.	Sequency ordering
Demanding conditions	local government support to the development of natural resources (maintenance)	0.3307	0.0596	1
	local residents support	0.2079		2
	hot spring water resources total amount contro	0.1849		3
	effective integration and execution	0.1764		4
	local interested party agreement	0.1001		5

Statistical Results showed that the support of the local government to develop natural resources (maintenance) on the demand level is extremely important. By nonprofit organizations or local government establish a new career for take-and-supply business must obtain the support of the local administrative authority. It was reported [Chen et al.,2005] that to establish a system for hot spring resources reasonable use, the local government is the key to the regional development. Moreover, the support of the local residents - local residents identity for business is also a key factor for hot spring water resources using in a long time. So that to get people's support is very important. Interview of experts concluded: the hot spring water to extract from the quad stream of hot springs are limited to 1800 tons, how effective is assigned to each hot spring restaurants in each industry concerns. As a result, owners of hot spring water without open especially attaches importance to, officials are concerned about whether water resources have been using. Hot spring water resources total quantity control - along with the development of hot spring, cross hot springs on the

management more and more serious, lack of hot spring area overall development plan, are a large number of extracting lead to hot springs hot springs water yield reduction problem, therefore, should be early to set up a mechanism to curb this phenomenon, vol.115, 2005; Luo Shu circle, 2005; ZhanJinWei, 2005). Place to investigate participant in education - the local hot spring industry, nonprofit organizations, local people consensus, the importance of licensees. Of effective integration and indeed - by pingtung county government to make integration and (for the most effective rate, or in pingtung county hot spring tourism association, the association of the republic of China hot spring tourism guidance of others.

### 3-2-5 enterprise structure and competition strategy

First level indicator of enterprise structure and competition strategy, the architecture of the second hierarchy items include system fairness, improving the quality of the software and hardware and take-and-supply leading authority three times. Through AHP hierarchy process analysis, the calculation result is shown in table 8.

**Table 8.** Weighting factors, C.R. and Sequence ordering of the second level indicators under first level indicator enterprise structure and competition strategy

First Level indicator	Second Level indicators	Weighting Factors	C.R.	Sequency ordering
quality of the software and hardware	quality of the software and hardware	0.4002	0.0663	1
	system fairness	0.3397		2
	Take-and-supply leading authority	0.2601		3

Due to the good competition of the business, the equipments of the impounding reserver and the quality of the professional managers should be improved. However, it was reported [Li et al., 2005] that the budget of the government for hot spring development is not flexible enough. The new construction and the development of hot spring must be specific for the quality promotion.

The contribution of the hot spring resources should be fare and public. Our study shows that the output of the hot spring should be fare is important for the take-and-supply hot spring related business. However, who should lead the tak-and-supply business? It was reported [Lee Sunzone et al., 2005; Geng Huiling e al., 2008] that the government should be the one leading the development of the hot spring



related business so that the management, contribution and the sustainable use of the resources can be efficiently controlled as well as the controlling of the quality of the environment protection. However, the experts for our interviewing survey analysis suggested that the hot spring related small business at Szuchungsi in Taiwan should be released to the local business at Szuchungsi in Taiwan.

### 3-2-6 Relative business supporting

In the first level indicator of relative business supporting, the second level indicators include local human resources, local natural resources, transportation resource, and county governmental supporting four items. Through the AHP analysis, the weighting should be in sequence as listed in the table 9.

**Table 9.** Weighting factors, C.R. And Sequence ordering of the second level indicators under first level indicator of relative business supporting

First Level indicator	Second Level indicators	Weighting Factors	C.R.	Sequence ordering
relative business supporting	transportation resource	0.3329	0.0541	1
	county governmental supporting	0.2911		2
	local natural resources	0.2003		3
	local human resources	0.1757		4

The table 9 has shown that the transportation resource is the most important variable indicator. Due to the accessibility to promote the interest of the visitors to visit Szuchungsi, it was reported that [Chen et al., 2005] the public pipeline system and the water supply model should be formulated. They also argued that creating governmental consultant and assistant system would be better for solving relative problems. Meanwhile, they also suggested that it is necessary to establish the guidance and public regulation for hot spring facilities as well as the onsite monitoring and audit system. Briefly to say, development of hot spring area is based upon the proper choice of the area and the factors that influence the decision and capability for comprehensive developments [Wanf Hua et al., 2004].

## 4. Conclusion

### 4-1 Summery

This study can be referred to develop Szuchungsi hot spring more successfully in Taiwan. The key factors include six first level indicators and thirty second level items. In the first level, the most important indicator is production. The important observation variables in the second level are counseling hot spring industry development of hot spring resources, using hot springs health care consciousness enhancement, increasing of potential tourism, local government support to the development of natural resources, improving the quality of the software and hardware and traffic resources. In recent years, both central and local government establish firmly projects oriented to promote tourism at Szuchungsi hot spring in Taiwan. However, natural environment and diverse cultural resources, unique spring and hot spring hotel, local hot spring industry concerns for water quantity control are all need to be

concerned by the government at Szuchungsi hot spring. For the most important issue at present, only pursuing new idea to change the traditional conservative point of view can help to realize and eliminate the barriers for development of take-and-supply business with the legislated regulation related to hot spring water source protection. For the goal of sustainable use, combined with local non-profit organizations and the hot spring industry, creation of high quality recreational environment to improve economic industry and activate the local economy, promote tourism industry, in long-term development of tourism business are the concerns for the key factor to build successfully take-and-supply business at Szuchungsi hot spring in Taiwan.

### 4-2 Future Research

Understanding of the observation indicators for hot spring industry can come out the affecting factors which would depend on hot spring resources, environmental needs and local culture. Committed to those indicators, a successfully take-and-supply business can be developed. It can also achieve sustainable utilization of water resources, good planning and execution of effective interest management and environmental resource protection.

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