國科會「提升私立大學校院研發能量」專案

NSC 91-2745-P-343-002

總計畫名稱：環境問題全球化下的環境政策因應研究

期末執行成果報告書

時　　間：92 年 11 月 30 日

主辦單位：南華大學管理學院

目錄

總 計 畫：環境問題全球化下的環境政策因應研究

子計畫一：民主化機制對政策形成的影響研究

論文名稱：一、Optimizing the capacity of incinerator under a competitive market of household waste treatment

二、環境政策設計與民眾需求差距之研究

子計畫二：生產消費與環保之間的永續發展模式分析

論文名稱：一、More Paper and Less Plastics?

二、The effect of globally environmental trends on environmental strategies

子計畫三：綠色校園教學環境的建置研究

論文名稱：整合式主動推播學習平台模型以課程知識爲基礎

子計畫四：環境問題全球化下環保團體角色扮演之研究

論文名稱：基地台環保抗爭中民間團體角色之扮演與業者因應對策之研究

子計畫五：國際間共同資源的使用及管理模式研究

論文名稱：社會事業與企業公益行爲探討

子計畫六：社區營造永續觀光策略評估模式之研究

論文名稱：玉山國家公園塔塔加至玉山主峰線設置空中纜車之可行性評估

總計畫：

環境問題全球化下的環境政策因應研究

子計畫一：

民主化機制對政策形成的影響研究

論文名稱：

一、Optimizing the capacity of incinerator under a competitive market of household waste treatment

二、環境政策設計與民眾需求差距之研究

Optimizing the capacity of an incinerator under a competitive market of household waste treatment

Chung-Chiang Chen*

Graduate Institute of Environmental Management

Nan Hua University

Abstract

Many authors argue that the modernization of a free market economy for impure public service like solid waste treatment can improve production efficiency in aiming at the sustainable development as a new goal. We assume all facilities were equally dirty and can emit the identical pollution to the neighboring residence and the market of solid waste treatments is perfectly competitive. We present a model that employs the spatial structure (the accessibility to the facility) as a basis to assess the feasibility for constructing notorious facilities and determine the optimal contracting (service) region and the optimal capacity of an incinerator. In a comparative static analysis we compare the effect of economies of density, household income, market price of incineration service, price of recovered energy, unit transportation cost, technology progress, compensation and distance decaying parameter on the decision of optimal contracting region and incineration capacity. The results shows that (1) the demographic factor (formed by economies of density and household income) provide positive effects on the decision variables, (2) the technology progress also yields

* Corresponding author. Corresponding address: 32, Chung Keng Li, Dalin, Chiayi 622, Taiwan, Nan Hua University, Graduate Institute of Environmental Management. Tel. no.: 05-2427116 Fax no.:05-2427117, e-mail: ccchen@mail.nhu.edu.tw

positive effects, (3) the revenue factor (formed by market price of incineration service and price of recovered energy) provides positive effects, (4) the cost factor (formed by unit transportation cost and compensation) provide the negative effects, and (5) the geographical factor (the distance decaying parameter) also provides positive effects.

Keywords: incineration capacity, household wastes, compensation.

1. Introduction

In practical world, the big volume of municipal waste generation due to the rapid industrialization and much slow progress in public administration management has becomes a widespread, environmental problem or even a disaster. The rapid increase in the size of the waste generation has been observed in the developed country. For example, the per capita generation rate of municipal solid waste in America was rising up significantly from 1960 to 1990 (please see Table 1.1).

Table 1.1 US annual MSW generation from 1960 to 1990 by weight

	1960	1970	1980	1990
Total MSW generated by weight (millions of tons)	87.8	121.9	151.4	195.7
Total population (thousands)	180,671.0	203,984.0	227,255.0	249,924.0
Per capita MSW (pounds per day)	2.7	3.3	3.7	4.3

Source: Callan & Thomas (1996), Table 17.1, p. 577.

Similarly, the household waste generation also has lead to high impacts on people's living in developing countries like Taiwan. The daily collection of municipal solid waste incerteased from 13,954 ton in 1986 to a peak of 24,331 ton in 1997 with approximately 6.7% growth rate and in the same period population growth rate reached to 1.58%, and then after 1997, the municipal solid waste generation is gradually decreased to 19,876 ton in 2001. The change rate of refuse collected per day per capita was dramatically decreasing in 2000 (about –9.78%) and in 2001 (-8.4%) (Please see Table 1.2).

Table 1.2 Collection of municipal solid waste in Taiwan

Fiscal year	Population served (1000 persons)	Collection rate (%)	Refuse collected per day (M.T.)	refuse collected per capita per day (kg)	Change rate (%)
1986	18,119	93,64	13,954	0.770	3.61
1987	18,426	94.33	14,475	0.786	2.0
1988	18,733	95.2	16.116	0.860	9.51
1989	19,132	95.6	17,147	0.896	4.18
1990	19,468	96.4	18.753	0.963	7.48
1991	19,823	96.93	19,833	1.001	3.86
1992	20,105	97.38	21,861	1.089	8.68
1993	20,450	98.47	22,513	1.101	3.86
1994	20,754	98.73	23,268	1.121	1.84
1995	20,972	98.04	23,857	1.138	1.47
1996	21,039	98.47	23,870	1.135	-0.26
1997	21,280	98.77	24,331	1.143	0.77
1998	21,441	98.46	24,220	1.135	-0.75
1999	21,684	98.79	23,468	1.082	-4.63
2000	22,039	99.2	21,518	0.976	-9.78
2001	22,220	99.46	19,876	0.895	-8.40

Source: Bureau of Environmental Protection (Taiwan).

In practice, household collection is executed by a municipal arrangement under governmental financial support. Many authors argue that household waste collection can be executed through municipal collection, contract collection, and private

collection and analyze the relative advantages of private collection over municipal collection. According to Kemper and Quigley's (1976)empirical study found that contract collection is from 13 to 30 percent cheaper than municipal collection. Stevens (1978) concludes the similar estimation that the contract or franchise private monopoly arrangement were found to be 26-48% cheaper than the private market arrangement and private monopoly arrangement was 27 to 37 % less costly than a public monopoly. Edwards and Stevens (1978)also reach the similar results and also suggest that the necessity of state intervention with the household waste collection in the form of a competitively bid contract arrangement. However, Cowing and Holtmann (1976) take different views and recommend a preference of a completely private system to collect household waste. Dubin and Navarro, (1988) develop a two stage model for the market organization decision process, in which policymakers choose between laissez-faire and state intervention at first stage, and then, choose in stage two among public ownership, a regulated franchise, or a competitively bid contract arrangement if state intervention is chosen. The collection of household refuse is highly labor-intensive (Young 1972, Dubin and Navarro, 1988) and is seen as an impure public good (Gueron, 1972; Dubin and Navarro, 1988). The privatization of the common service and the comparison of operating efficiency between public and private firms have been focused by many authors (Bos, 1987). Bos (1987) claims that the empirical studies on the comparison of private and public firms and suggests that a higher extent of privatization leads to more efficient production.

Very few literatures focus on the related issue of management strategies on public service that is accompanied with secondary pollution emission. In this paper, we assume that a form of private market for the specified public service (e.g. solid

waste incineration) exists. The entry of a new facility not only considers the price competition, but also cares about the extra costs such as compensation to the neighboring residents due to NIMBY effects. How to set up the optimal capacity of the incinerator and the service fee of solid waste disposal by incineration is important for the new firm.

2. Assumptions and notations

We assume in this paper incineration is the final process for municipal disposal. The installation cost of an incinerator is given and a function of capacity w, i.e. $F = F(w)$ with properties of $F'(w) > 0$ and the unit operation cost α is a function of incinerator capacity, i.e. $\alpha = \alpha(w)$ with properties of $\alpha'(w) < 0$. Therefore, the total cost for waste incineration is $F(w) + \alpha(w)x$, where x denotes the waste processed and treated.

Energy recovery facilities equipped with incineration process can reduce operating costs due to the sale of recovery energy as a by-product of solid waste incineration (Keeler and Renkow, 1994). The efficiency $g(x; T)$ of energy recovery from incineration process depends on current technologies and waste flows, with properties of $g'(x; T) > 0$, and $g''(x; T) > 0$[1]. Thus, the gain of energy recovery accompanied with incineration process is a written as $\mu g(x; T)$, where μ represents price of recovered energy. In practice, the efficiency of energy recovery depends on the nature of municipal solid waste. Higher thermal content of waste bring about better performance of energy recovery. However, the flow rate of solid also plays an important role in affecting the efficiency of energy recovery. High gap between

[1] The super script denotes the partial derivative of $g(\cdot)$ with respect to x and technology progress for energy recovery systems is seen as an exogenous variable in this paper.

solid waste flows and designed incineration capacity will yield inefficiency. A survey with local incineration managements disclose that energy recovery system attached to the incineration execute as a convex function, i.e. $g' > 0$ and $g'' > 0$.

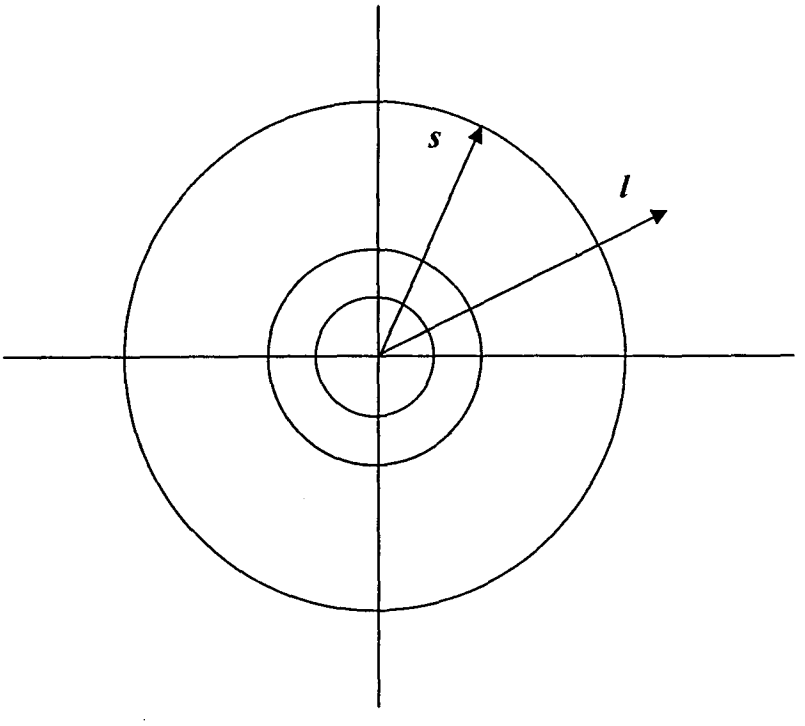


Figure 1. The diagram of contracting region for incineration service

We assume that the solid waste generated per each household h depends on household income[2], i.e. $h = h(I)$, with properties of $h'(I) > 0$. The solid waste collected x over the whole region from the point of the planned incinerator to the most distant household that the firm determines to collect (Please see Figure 1) is expressed as

$$x = \int_0^s eh(I)ldl = \frac{1}{2} eh(I)\, s^2. \qquad (2.1)$$

where e is economies of density[3] and s is the longest distance covering the whole region of solid waste collection..

---

[2] In fact, household generation depends not only on household income, but also on consumption behaviors, product designs, environmental attitudes and other factors. In this paper, household is a representative factor to affect household waste generation.

[3] Economies of density are defined as "the number of housing units per square mile in the relevant

The demand for solid waste treatment service depends on many factors. Most empirical studies use models that emphasize socio-demographic factors and rely explicitly or implicitly on utility theory of the consumer or household production theory to derive a demand function. Hong et al. (1993) assume that the demand for waste disposal is a function of the incremental fee associated with contracting an additional bin for waste disposal. Miranda et al. (1994) examine the household waste production behaviors from 21 cities in USA over 18-month period and find the pricing and recycling programs play important roles in affecting solid waste flows. In this paper, we assume that the price of waste disposal is the only factor to affect households whether to contracting for treatment services. We assume the price solid waste treatment services offered by existing firms is $\bar{p}$. If price of solid waste treatment p determined by this new facility is lower than or equal to $\bar{p}$, the new facility can get the contract for service of solid waste incineration. If the transportation cost is the customer's account, then the customer will buy the service of waste incineration in case of $p + \tau l \leq \bar{p}$, where τ is unit transportation cost of solid waste and assumed to be fixed and given. In other words, only the customers where are located within the distance of

$$s = \frac{\bar{p} - p}{\tau} \tag{2.2}$$

will buy the services (Please see Figure 1). If transportation cost is the seller's account, then the service fee of new facility p is valid for the whole region and should be lower than market price $\bar{p}$, i.e. $p \leq \bar{p}$. When the transportation costs is seller's account, then the firm needs to pay additional transportation costs of $\int_0^s \tau l e l dl = \frac{1}{3} \tau e$

---

community and is designed to measure economies of density" (Dubin and Navarro, 1988, p. 225). In this paper economies of density are seen as exogenous parameters for sensitivity analysis.

$h(I)s^3$. The firm needs to determine the optimal distance s within which the firm will collect and treat the solid waste generated.

In the meantime, the incineration process of solid waste disposal is criticized for the secondary pollution of hazardous gas emission and toxins or heavy metal in residual ash (Keeler and Renkow, 1994). Toxic substance is contained in the solid waste and will result in secondary pollution by incineration especially if the incinerator is not well-designed and supplied with appropriate air pollution control equipment. Thus the public fears their impact on their health, especially from the dioxins. Residents living closer to the incinerator will ask for compensation due to the environmental impacts. In general, the compensation depends on the resident's attitudes and their social status. To simplify our analysis, we suggest the compensation to each household depends on the accessibility of waste collection, i.e. $\frac{\delta}{l^{\beta}}$ where δ is compensation to each household per mile depending on environmental impacts, l is the distance between the location of incinerator and the household, and β is an estimated distance-decay parameter. Thus, the total compensation the firm must pay is $D = \int_0^s \frac{\delta e h(I) l}{l^{\beta}} dl$.

3. The model

The firm has to decide the longest distance covering the whole region for solid waste collection and the incineration capacity of the planned incinerator by maximizing the profit. If the transportation cost is buyer's account, the problem is expressed as:

$$\underset{s,w}{Max} \quad \pi = px + \mu g(x; T) - F(w) - \alpha(w)x - \int_0^s \frac{\delta e h(I) l}{l^{\beta}} dl \qquad \text{(P1)}$$

Substituting (2.1) and (2.2) into (P1) and removing p yields

$$\underset{s,w}{Max}\ \pi = \bar{p}\frac{1}{2}e\,h(I)s^2 - \frac{1}{2}\tau e\,h(I)s^3 + \mu g(x;\ T) - F(w) - \alpha(w)\frac{1}{2}e\,h(I)s^2 - \int_0^s \frac{\delta e h(I) l}{l^\beta} dl \qquad \text{(P1')}$$

If the transportation cost is seller's account, the problem becomes

$$\underset{s,w}{Max}\ \pi = \bar{p}\frac{1}{2}e\,h(I)s^2 + \mu g(x;\ T) - F(w) - \alpha(w)\frac{1}{2}e\,h(I)s^2 - \frac{1}{3}\tau e\,h(I)s^3 - \int_0^s \frac{\delta e h(I) l}{l^\beta} dl \qquad \text{(P2)}$$

It is self-explanatory that the firm will born transportation costs and charge the service fee uniformly over the whole region since profit of (P2) is always more that that of (P1). Thus, the firm will choose to contract with households at the same price for the whole region (the case of problem (P2)). Solving problem (P2) yields the first order conditions:

$$\frac{\partial \pi}{\partial s} = \bar{p}\,e\,h(I)s + \mu g'(x;\ T)\,e\,h(I)s - \alpha(w)e\,h(I)s - \tau e\,h(I)s^2 - \delta e\,h(I)s^{1-\beta} = 0 \qquad (3.1)$$

$$\frac{\partial \pi}{\partial w} = -F'(w) - \alpha'(w)\frac{1}{2}e\,h(I)s^2 = 0 \qquad (3.2)$$

Equation (3.1) reveals that the marginal costs of transportation and compensation should be equal to marginal benefits and (3.2) reflects the marginal costs arisen from incinerator capacity should be equal to marginal benefits. By solving the simultaneous equation of (3.1) and (3.2) we can get the optimal distance and incinerator capacity (s^*, w^*).

In fact, the firm needs to consider the impacts of the environmental parameters including economies of density e, household income I, technology progress T, market

price of incineration service $\bar{p}$, price of recovered energy μ, unit transportation cost τ, compensation δ and distance decaying parameter β on the optimal solutions. Through the sensitivity analysis, we get the results of (1) $\frac{ds^*}{de} > 0$ and $\frac{dw^*}{de} > 0$, (2) $\frac{ds^*}{dI} > 0$ and $\frac{dw^*}{dI} > 0$, (3) $\frac{ds^*}{dT} > 0$ and $\frac{dw^*}{dT} > 0$, (4) $\frac{ds^*}{d\bar{p}} > 0$, and $\frac{dw^*}{d\bar{p}} > 0$, (5) $\frac{ds^*}{d\mu} > 0$ and $\frac{dw^*}{d\mu} > 0$, (6) $\frac{ds^*}{d\tau} < 0$ and $\frac{dw^*}{d\tau} < 0$, (7) $\frac{ds^*}{d\delta} < 0$ and $\frac{dw^*}{d\delta} < 0$, and (8) $\frac{ds^*}{d\beta} > 0$ and $\frac{dw^*}{d\beta}$ are uncertain, depending on the value of β (Please see the proofs in Appendix 1-8). These results show that (1) an increase in economies of density *e* leads to an increase in both distance s^* and incineration capacity w^*, (2) an increase in household income *I* leads to an increase in both distance s^* and incineration capacity w^*, (3) an increase in technology progress *T* leads to an increase in both distance s^* and incineration capacity w^*, (4) an increase in market price of incineration service $\bar{p}$ leads to an increase in both distance s^* and incineration capacity w^*, (5)an increase in price of recovered energy μ leads to an increase in both distance s^* and incineration capacity w^*, (6) an increase in unit transportation costs τ leads to reduction in both distance s^* and incineration capacity w^*, (7) an increase in compensation leads to leads to reduction in both distance s^* and incineration capacity w^*, and (8) if distance decaying parameter $\beta > 1$, an increase in distance decaying parameter β leads to an increase in both distance s^* and incineration capacity w^*. If distance decaying parameter $\beta < 1$, an increase in distance decaying rate β leads to a reduction in both distance s^* and

incineration capacity w^*. If distance decaying rate $\beta = 1$, it does not affect the determination of distance s^* and incineration capacity w^*. The results of the sensitivity analysis are summarized in Table 1.

Table 1. The effects of exogenous parameters on the optimal distance and the optimal incinerator capacity

	e	I	T	$\bar{p}$	μ	τ	δ	β		
								>1	$=1$	<1
s^*	+	+	+	+	+	_	-	+	0	-
w^*	+	+	+	+	+	-	_	+	0	-

"+" represents the positive effects, "-" represents negative effects, and "0" represents no effects.

4. The managerial implications and discussions

We categorize the eight parameters in the previous section into five factors: (1) the demographical factor (formed by economies of density and household income), (2) the technological factor (technology progress), (3) the revenue factor (formed by market price of incineration service and price of recovered energy), (4) the cost factor (formed by unit transportation cost and compensation), and the (5) the geographical factor (the distance decaying parameter). The role of these factors in affecting management decisions are discussed below:

(1) The demographical factor: This paper assumes that the decision of each household's contracting with the firm for incineration services completely based on the net price of waste treatment. To the firm, the total demand for incineration service is affected by the demographical factor including economies of density, household income and household behaviors. The previous sensitivity analysis shows that an increase in demand stemming from household characteristics will leads to an increase in contracting covering area and incineration capacity. These results show that the

demographical characteristic of the residential region around the planned incinerator plays an important factor to affect the firm's decision. Dubin and Navarro (1988) demonstrate the significant effect of economies of density on the waste collection based on their empirical survey and argue that "refuse collection is characterized by economies of density" (p. 218) while previous studies (Kemper and Quigley, 1978; Stevens, 1978; Cowing and Holtmann, 1976) find little relation between economies of density and collection of household. In the previous sensitivity analysis higher economies of intensity and higher income represents higher market demand for incineration services that plays an important facto to encourage investments on the installation of incinerator. In contrast, the investors may lose interest in the region with low economies of density and thus it may be the source of market failure and requires government intervention.

In addition to economies of density and household income, the household behaviors are also critical to the successful attainment of desired environmental outcomes (Baetz et al., 1991; Beaumont et al., 1993) and play an important role in affecting solid waste generation and collection (Read, 1999). Many authors present models to explain the effects of the household behaviors of solid waste behavior (Fullerton and Kinnaman 1995; Dobbs 1991; Morris and Holthausen 1994; Wertz 1976; Huhtala 1997) on environmental managements. Various studies find that if households bear the costs for incineration service they will reduce the solid waste generation (Salkie et al., 2001; Coggins, 2001; Wertz, 1976). Wertz (1976) studies the effect of price of waste collection on welfare and the effects on community response to service and price. Morris and Holthausen (1994) present a model to estimate the household waste production by incorporating some behavioral parameters. In addition, Hirsch (1965) and Quon et al. (1968) find the significant relationship between the

effect of frequency of services and waste collected. The governmental policy to encourage high levels of public's participation to significantly change their behaviors is also important to relate with waste generation (Evison and Read, 2001; Petts, 1997).

(2) technological progress: The analysis shows that technology progress can attract more investments on the service of incineration and results in more competitive markets and the price-up of recovered energy encourages the firm to expand its contracting region and increase its incineration capacity. In fact, technological innovation and progress have improved recovery and re-use of industrial waste (Cosper *et al.*, 1993; Schlauder and Brickner, 1993) and can provide partial solution for the escalation of environmental degradation (Hill et al., 1994). Many authors emphasize the policy can orient the innovation direction and rate of technological progress (Grubb et al., 1995; and Dowlatabadi, 1998) and there are also many authors focus on how existing work practices, processes and technologies contribute to the generation of waste (Formoso et al., 1993; Bossink and Brouwers, 1996; Poon, 1997; Faniran and Caban, 1998).

(3) The revenue factor: The impacts of market price of incineration service $\bar{p}$, recovered energy price μ yields the results of $\frac{ds^*}{d\bar{p}} > 0$, $\frac{dw^*}{d\bar{p}} > 0$, $\frac{ds^*}{d\mu} > 0$ and $\frac{dw^*}{d\mu} > 0$. The increase in revenue will lead to an increased contracting area and incineration capacity. Intuitively these results are acceptable.

(4) The cost factor: When the costs such as unit transportation cost τ and compensation rise up, the firm will shrink its contracting region and reduce its incineration capacity increases; vice versa. Many authors find that "collection cost rises with the frequency of service, noncompacted trash, and the annual level of

precipitation while collection cost falls with the fraction of curbside service and with yards of refuse collected per household" (Dubin and Navarro, 1988, p. 233). In this paper, we assume the collection cost is identical to the unit transportation cost τ that is assumed to be given and fixed. The compensation to each household per mile δ is an additional cost to the firm is assumed to a necessary tool to compromise with the neighboring residents for the construction of the planned incinerator. In fact, Frey et al. (1996) argue that monetary compensation in return for acceptance of a notorious facility may not work well, and may even be of little help to solve the NIMBY effects. However, compensation to reduce opposition to notorious facility is still a more effective way and thus we still use a monetary compensation to the neighboring residents for the acceptance of the construction of a newly incinerator in this paper.

(5) the geographical factor: $\frac{ds^*}{d\beta}$ and $\frac{dw^*}{d\beta}$ are uncertain, depending on the value of β. In practice, the measurement of distance decaying parameter depends on a critical methodology to achieve the accuracy of the locations of point-source hazards (e.g., Scott et al., 1997; Stockwell et al., 1993). In general, the distance decaying parameter is determined by wind direction, frequency, and speed. In general, β is believed to be greater than 1 according to some experimental studies (e.g. Karkazis and Boffey, 1997). Thus, an increase in distance-decaying effects β will lead to an increase in the contracting region and incineration capacity.

The location of the notorious facility is assumed to be given before the determination of the optimal contracting region and incineration capacity. In practice, the siting of notorious facilities has become a serious problem and resulted in high level of social conflicts due to NIMBY effect. Many authors have attempted to solve the problem and propose many mechanisms for the choice of notorious facilities (e.g.

Kunreuther and Kleindorfer 1986; Kunreuther et al, 1987; Mitchell and Carson 1986; Gleeson & Memon, 1994; Petts, 1994; Blowers et al. 1991, Swallow et al., 1992; Gerrard, 1994). Gleeson & Memon (1994) and Petts (1994) focus on the determination of compensation scheme to bridge the gap between the potential victims and the planned value and Blowers et al. (1991) and Swallow et al. (1992) discuss the siting process. In practice, a determination on a newly constructed incinerator involves the interaction of social process and political process in addressing with risk assessment and risk perception.

Theoretically the firm will neglect the resident's opposition and attitude and only consider the viability of the planned incinerator to maintain the viability of the residential service when considering the establishment of the new facility. However, the local opposition to the construction of incinerator may slow down the proceeding of the facilities and become a key factor for successful construction as the notorious facility may emit odors, or accompanied with the groundwater contamination and the aesthetic deterioration of the landscape. The NIMBY concept is generally considered as an important factor to affect the decisions of the issues relating with notorious facilities. It represent a social and political dilemma. In this paper, the resolution of NIMBY effects are assumed to work through the firms' compensation scheme to each household based on the household distance from the point of incinerator.

The objectives of waste treatment service emphasize that the benefit of waste moving away from the communities can rise up environmental quality and awareness of environmentalism. Gottinger (1996) says: " ...waste treatment could be more expensive for the firm than dumping, but is usually cheaper for society." In this paper, the firm does not consider the positive externality effects of waste treatments.

5. Conclusions

This paper assumes that the incineration service of waste treatment is privatized and market structure is perfectly competitive. The results of this paper may provide important insights into the capacity determination of notorious facilities that in most cases are opposed by the local residents and provide valuable information for the policy planner to privatize the public service. Many authors argue that improved management of solid waste can also reduce environmental costs significantly (Graham and Smithers, 1996; McDonald and Smithers, 1998). Thus, the aggregate social welfare may be increased through the privatization of solid waste incineration because the privatized public service may increase efficiency[4]. To assure the applicability, we will find out a practical case by extending the model presented in this paper. Of course, it requires more substantial support about the environmental impacts on the public health due to the notorious faculties as guidance for the policy plant to evaluate.

Quah (1994) argues that the environmentally notorious facility generally impose non-exclusive negative externalities on the neighboring region. Local acceptance of environmentally noxious facilities becomes a prerequisite for the construction that normally requires some form of building or operational license or permit. The social support also play an important factor for the construction and maintenance of a new incinerator. In a democratic society, power is decentralized and therefore all community may attempt to influence others or the politician for a more favorable request. The firm needs to communicate with neighboring residents for the

[4] Bos (1987) claims that the empirical studies on the comparison of private and public firms suggest that a higher extent of privatization leads to more efficient production. Many authors discuss the relative advantages between private ownership and central planning. It seems most researches favor privatization (Kikeri, et al., 1992; Glaeser, & Scheinkman, 1996).

maintenance of the notorious facility even if it is successfully constructed.

This paper also neglects the existence of environmental inequality since most of notorious facility in the practical world located nearby low-income communities who are exposed to more technological hazards than more privileged communities (e.g., Anderton et al., 1994; Oakes et al., 1996). Many studies have found that environmental inequity exists due to unequal distributions of hazardous facilities and toxic emissions in low-income communities (e.g., Adeola, 1995; Boer et al., 1997; Bryant and Mohai, 1992; Burby, 1999; Perlin et al., 1995; Pulido et al., 1996; Ringquist, 1997). The firm needs to evaluate the effects of spatial structure (the proximity to nearby disposal treatments opportunities and the distance of households from the incinerator) and consider the attractiveness of the newly constructed incinerator to households. Thus, a detailed examination on the spatial distributions of notorious facilities in the whole area is needed to support the practical determination of a planned incinerator.

Reference

1. Adeola, F., 1995. Demographic and socioeconomic differentials in residential propinquity to hazardous waste sites and environmental illness. Journal of the Community Development Society 26, 1, 15-40.
2. Anderton, D., Anderson, A., Oakes, J., Fraser, M., 1994. Environmental equity: the demographics of dumping. Demography 31, 2, 229-248.
3. Baetz, B.W., Pas, E.I. and Aarne Vesilland, P., 1991. Waste reduction primer for managers. Journal of Engineering in Management, 7, 33–42.
4. Beaumont, J.R., Pedersen, L.M. and Whitaker, B.D., 1993. Managing the Environment, Butterworth Heinemann, Oxford.
5. Blowers, A., Lowry, D. & Solomon, B. D., 1991. The International Politics of

Nuclear Waste, New York: St Martin' s Press.

6. Boer, J., Pastor, M., Sadd, J., Snyder, L., 1997. Is there environmental racism? The demographics of hazardous waste in Los Angeles County. Social Science Quarterly 78, 4, 793-810.
7. Bos, D., 1987, Privatization of public enterprises, European Economic Review 31, 352-360.
8. Bossink, B. A. G. and Brouwers, H. J. H., 1996. Construction waste: quantification and source evaluation. Journal of Construction Engineering and Management, 122, 1, 55–60.
9. Bryant, B., Mohai, P. (Eds.), 1992. Race and the Incidence of Environmental Hazards: A Time for Discourse. Boulder, Westview.Callan, S.J., and Thomas, J.M., 1996, Environmental Economics and Management: theory, policy, and applications, Chicago: lrwin.
10. Burby, R., 1999. Heavy industry, people, and planners: new insights on an old issue. Journal of Planning Education and Research 19, 1, 15-25.
11. Coggins C. 2001. Waste prevention-an issue of shared responsibility for UK producers and consumers: policy options and measurement. Resource Conservation and Recycling, 32, 3– 4, 181– 90.
12. Cosper, S.D., Hallenbeck, W.H. and Brenniman, G.R., 1993. Construction and Demolition Waste: Generation, Regulation, Practices, Processing and Policies, Office of Solid Waste Management, Chicago: The University of Illinois.
13. Cowing, T.G, and Holtmann, A.G, 1976, The Economics of Local Public Service Consideration, Lexington, Mass: Lexington Books.
14. Dobbs, J. M., 1991, Litter and Waste Management: Disposal Taxes Versus User Charges, Canadian Journal of Economics 24, 221–227.

15. Dowlatabadi, H., 1998, Sensitivity of climate change mitigation estimates to assumptions about technical change, Energy Economics 20, 473-493.

16. Dubin, J.A., & Navarro, P., 1988, How markets for impure pubic goods organize: the case of household refuse collection, Journal of Law, Economics, and Organization, 4, 2, 217-241.

17. Edwards, F.R., and Stevens, B.J., 1978, The provision of municipal sanitation services by private firms, Journal of Industrial Economics 27, 133-147.

18. Evison, T, Read, AD., 2001. Local authority recycling and waste awareness publicity/promotion. Resources, Conservation and Recycling, 32, 275- 92.

19. Faniran, O. O. and Caban, G., 1998. Minimizing waste on construction project sites. Engineering, Construction and Architectural Management, **5**, 2, 182–8.

20. Formoso, C. T., Franchi, C. C. and Soibelman, L., 1993. Developing a method for controlling material waste on building sites. In: Economic Evaluation and the Built Environment, CIB, Lisbon, Portugal, 67–78.

21. Fredriksson, P.G., 2000. The Siting of Hazardous Waste Facilities in Federal Systems, The Political Economy of NIMBY, Environmental and Resource Economics 15, 75–87.

22. Frey, B. S., Oberholzer-Gee, F., and Eichenberger, R., 1996, The Old Lady Visits Your Backyard: A Tale of Morals and Markets, Journal of Political Economy 104, 6, 1297–1313.

23. Fullerton, D. and T. C. Kinnaman, 1995, Garbage, Recycling and Illicit Burning or Dumping, Journal of Environmental Economics and Management 29, 78–91.

24. Gerrard, M. B., 1994, Whose Backyard, Whose Risk: Fear and Fairness in Toxic and Nuclear Waste Siting. Cambridge, MA:MIT Press.

25. Glaeser, E.L. & Scheinkman, J.A., 1996, The transition to free markets: where to

begin privatization, Journal of comparative Economics 22, 23-42.

26. Gleeson, B. J. and Memon, P. A., 1994. The NIMBY syndrome and community care facilities: a research agenda for planning, Planning Practice and Research, 9, 2, 82-89.
27. Gottinger, H.W. 1996. A model of principal-agents control in wastes under technological progress. Environmental and Resource Economics 7: 263-286.
28. Graham, P.M. and Smithers, G., 1996. Construction waste minimization for Australian residential development. Asia Pacific Building and Construction Management Journal, 2, 14–9.
29. Grubb, M., Chapuis, T., and Ha-Duong, M., 1995, The economics of changing course: implications of adaptability and inertia for optimal climate policy, Energy Policy 23, 4, 1-14.
30. Gueron, J. M., 1972, The economics of solid waste handling and government intervention, in Selma Muslin (ed), Public Prices for Public Products, Washington, D.C.: The Urban Institute.
31. Hill, R. C., Bergman, J. G. and Bowen, P. A., 1994. A framework for the attainment of sustainable construction. In: Kier, C. J. (ed.), Sustainable Construction, Center for Construction and Environment, Gainesville, FL, 13–25.
32. Hirsch, W., 1965. Cost functions of an urban government service: refuse collection. Review of Economics Statistics 47, 87-92.
33. Hong, S., Adams R. M., and Love, H. A., 1993, An Economic Analysis of Household Recycling of Solid Wastes: The Case of Portland, Oregon, Journal of Environmental Economics and Management 25, 136–146.
34. Huhtala, A., 1997. A Post-consumer Waste Management Model for Determining Optimal Levels of Recycling and Land filling, Environmental and Resource

Economics 10, 301–314.

35. Karadzic, J., and Boffey, B., 1997. Spatial organization of an industrial area: distribution of the environmental cost and equity policies, European Journal of Operational Research, 101, 430-441.
36. Keeler, A.G., and Renkow, M., 1994, Haul trash or haul ash: energy recovery as a component of local solid waste management, Journal of Environmental Economics and Management, 27, 205-217.
37. Kemper, P., and Quigley, J.M., 1976, The Economics of Refuse Collection, Cambridge, Mass: Ballinger Publishing.
38. Kikeri, S., Nellis, J. and Shirley, M. Privatization: the lessons of experience, Washington: the World Bank, 1992.
39. Kunreuther, H., and Kleindorfer, P.R., 1986, A sealed bid auction mechanism for siting noxious facilities, American Economic Review: Papers and Proceedings 76, 2, 295-299.
40. Kunreuther, H., Kleindorfer, P.R., Knez, P.J., and Yaksick, R., 1987, A compensation mechanism for siting noxious facilities: theory and experimental design, Journal of Environmental Economics and Management 14, 4, 371-383.
41. McDonald, B. and Smithers, M., 1998. Implementing a waste management plan during the construction phase of a project: a case study, Construction Management and Economics, 16, 71- 78.
42. Miranda, M. L., Everett, J. W., Blume, D. and Roy, B. A., 1994. Market-Based Incentives and Residential Municipal Solid Waste, Journal of Policy Analysis and Management 13, 4, 681–698.
43. Mitchell, R.C., and Carson, R.T., 1986. Property rights, protest, and the siting of hazardous waste facilities, American Economic Review: Papers and Proceedings

76, 2, 285-290.

44. Morris, G. E. and D. Holthausen, 1994, The Economics of Household Solid Waste Generation and Disposal, Journal of Environmental Economics and Management, 215–234.

45. Oakes, J., Anderton, D., Anderson, A., 1996. A longitudinal analysis of environmental equity in communities with hazardous waste facilities. Social Science Research 25, 2, 125-148.

46. Perlin, S., Setzer, R., Creason, J., Sexton, K., 1995. Distribution of industrial air emissions by income and race in the United States: an approach using the toxic release inventory. Environmental Science and Technology 29, 69-80.

47. Petts, J., 1994. Effective waste management: understanding and dealing with public concerns, Waste Management and Research, 12, 207-222.

48. Petts J. 1997. The public- expert interface in local waste management decisions: expertise, credibility and process. Public Understanding Sci, 6, 359 - 81.

49. Poon, C. S., 1997. Management and recycling of demolition waste in Hong Kong. Waste Management & Research, 15, 561–72.

50. Pulido, L., Sidawi, S., Vos, R., 1996. An archaeology of environmental racism in Los Angeles. Urban Geography 17, 5, 419-439.

51. Quah, E., 1994, Cost-benefit analysis and the problem of locating environmentally noxious facilities, Journal of International Development 6, 1, 79-92.

52. Read, A.D., 1999. "A weekly doorstep recycling collection, I had no idea we could?": Overcoming the local barriers to participation. Resources, Conservation and Recycling, 26, 217-49.

53. Ringquist, E., 1997. Equity and the distribution of environmental risk: the case of TRI facilities. Social Science Quarterly 78, 4, 811-829.

54. Salkie, F.J., Adamowicz, W.L., Luckert, M.K., 2001. Household response to the loss of publicly provided waste removal: a Saskatchewan case study. Resource, Conservation and Recycling 33, 1, 23 – 36.

55. Schlauder, R.M. and Brickner, R.H., 1993. Setting up for recovery of construction and demolition waste. Solid Waste and Power, 28–34.

56. Scott, M., Cutter, S., Menzel, C., Ji, M., Wagner, D., 1997. Spatial accuracy of the EPA's environmental hazards databases and their use in environmental equity analysis. Applied Geographic Studies 1, 45-61.

57. Stevens, B.J., 1978, Scale, market structure, and the cost of refuse collection, The Review of Economics and Statistics 60, 438-448.

58. Stockwell, J., Sorensen, J., Eckert, J., Carreras, E., 1993. The US EPA geographic information system for mapping environmental releases of toxic release inventory (TRI) chemicals. Risk Analysis 13, 155-164.

59. Swallow, S.K., Opaluch, J.J., and Weaver, T.F., 1992, Siting noxious facilities: an approach that integrates technical, economic, and political considerations, Land Economics 68, 3, 283-301.

60. Wertz, K. L., 1976, Economic Factors Influencing Households' Production of Refuse, Journal of Environmental Economics and Management 2, 263–272.

61. Young, D., 1972, How shall we collect the garbage? Washington, D.C.: Urban Institute.

Appendix 1

Taking total differentiation of Equation (3.1) and (3.2) with respect to economics of density e yields

$$\frac{\partial^2\pi}{\partial s^2}ds + \frac{\partial^2\pi}{\partial s\partial w}dw = -h(I)\,(\bar{p}s + \mu g'(x;\,T)\,s - \alpha(w)s - \tau s^2 - \delta s^{1-\beta})de - \frac{1}{2}\mu$$

$$g''(x;\,T)\,e s^3\;\; h^2(I)\,de$$

$$= -\frac{1}{2}\;\; \mu g''(x;\,T)\,e s^3\;\; h^2(I)\,de \qquad \text{(A1-1)}$$

(By Equation (3.1) we get $h(I)\,(\bar{p}s + \mu g'(x;\,T)\,s - \alpha(w)s - \tau s^2 - \delta s^{1-\beta})e = 0$).

$$\frac{\partial^2\pi}{\partial s\partial w}ds + \frac{\partial^2\pi}{\partial w^2}dw = \;\; \frac{1}{2}\alpha'(w)\,h(I)\;\; s^2\,de \qquad \text{(A1-2)}$$

Solving the simultaneous equations of (A1-1) and (A1-2) yields

$$\frac{ds^*}{de} = \frac{\begin{vmatrix} A_1 & \frac{\partial\pi^2}{\partial s\partial w} \\ B_1 & \frac{\partial\pi^2}{\partial w^2} \end{vmatrix}}{D}, \text{ and } \frac{dw^*}{de} = \frac{\begin{vmatrix} \frac{\partial\pi^2}{\partial s^2} & A_1 \\ \frac{\partial\pi^2}{\partial s\partial w} & B_1 \end{vmatrix}}{D},$$

where D denotes $\begin{vmatrix} \frac{\partial^2\pi}{\partial s^2} & \frac{\partial^2\pi}{\partial s\partial w} \\ \frac{\partial^2\pi}{\partial s\partial w} & \frac{\partial^2\pi}{\partial w^2} \end{vmatrix}$ and $A_1 = \;\; -\frac{1}{2}\;\; \mu g''(x;\,T)\,e s^3\;\; h^2(I) < 0$ as $g''(x;\,T) > 0$ (please see footnote 1). $B_1 = \frac{1}{2}\alpha'(w)\;\; s^2 < 0$ as $\alpha'(w) < 0$ (please see Section 2). To analyze the impacts of the environmental parameters on the decisions we assume the solution exists and thus the secondary conditions satisfy $\frac{\partial^2\pi}{\partial s^2} < 0$, $\frac{\partial^2\pi}{\partial w^2} <$ 0, and $\begin{vmatrix} \frac{\partial^2\pi}{\partial s^2} & \frac{\partial^2\pi}{\partial s\partial w} \\ \frac{\partial^2\pi}{\partial s\partial w} & \frac{\partial^2\pi}{\partial w^2} \end{vmatrix} > 0$. As $\frac{\partial^2\pi}{\partial s\partial w} = \;\; -es\alpha'(w) \;\; > 0$, we conclude $\frac{ds^*}{de} > 0$ and

$\frac{dw^*}{de} > 0.$

Appendix 2

Taking total differentiation of Equation (3.1) and (3.2) with respect to household income I yields

$$\frac{\partial^2 \pi}{\partial s^2} ds + \frac{\partial^2 \pi}{\partial s \partial w} dw = -(\bar{p} s + \mu g'(x; T) s - \alpha(w)s - \tau s^2 - \delta s^{1-\beta}) e h'(I) dI \quad -\frac{1}{2}$$

$$\mu g''(x; T) e s^3 \quad h(I) h'(I) dI$$

$$= -\frac{1}{2} \quad \mu g''(x; T) e s^3 \quad h(I) h'(I) dI \qquad \text{(A2-1)}$$

(By Equation (3.1) we get $h(I)(\bar{p} s + \mu g'(x; T) s - \alpha(w)s - \tau s^2 - \delta s^{1-\beta}) e = 0$).

$$\frac{\partial^2 \pi}{\partial s \partial w} ds + \frac{\partial^2 \pi}{\partial w^2} dw = \frac{1}{2} \alpha'(w) \quad s^2 \quad h'(I) dI \qquad \text{(A2-2)}$$

Solving the simultaneous equations of (A2-1) and (A2-2) yields

$$\frac{ds^*}{dI} = \frac{\begin{vmatrix} A_2 & \frac{\partial \pi^2}{\partial s \partial w} \\ B_2 & \frac{\partial \pi^2}{\partial w^2} \end{vmatrix}}{D} \text{ and } \frac{dw^*}{dI} = \frac{\begin{vmatrix} \frac{\partial \pi^2}{\partial s^2} & A_2 \\ \frac{\partial \pi^2}{\partial s \partial w} & B_2 \end{vmatrix}}{D},$$

where $A_2 = -\frac{1}{2} \quad \mu g''(x; T) e s^3 \quad h(I) h'(I) < 0$ as $g''(x; T) > 0$ (please see footnote 1) and $h'(I) > 0$. $B_2 = \frac{1}{2} \alpha'(w) \quad s^2 \quad h'(I) < 0$ as $\alpha'(w) < 0$ (please see Section 2). Thus, we conclude $\frac{ds^*}{dI} > 0$ and $\frac{dw^*}{dI} > 0$.

Appendix 3

Taking total differentiation of Equation (3.1) and (3.2) with technology T yields

$$\frac{\partial^2 \pi}{\partial s^2} ds + \frac{\partial^2 \pi}{\partial s \partial w} dw = - es\, h(I) \frac{\partial g'(x,T)}{\partial T} dT \qquad \text{(A3-1)}$$

$$\frac{\partial^2 \pi}{\partial s \partial w} ds + \frac{\partial^2 \pi}{\partial w^2} dw = 0 \qquad \text{(A3-2)}$$

Solving the simultaneous equations of (A3-1) and (A3-2) yields

$$\frac{ds^*}{dT} = \frac{\begin{vmatrix} A_3 & \frac{\partial \pi^2}{\partial s \partial w} \\ 0 & \frac{\partial \pi^2}{\partial w^2} \end{vmatrix}}{D} \quad \text{and} \quad \frac{dw^*}{dT} = \frac{\begin{vmatrix} \frac{\partial \pi^2}{\partial s^2} & A_3 \\ \frac{\partial \pi^2}{\partial s \partial w} & 0 \end{vmatrix}}{D},$$

where $A_3 = -es\, h(I) \frac{\partial g'(x,T)}{\partial T}$. We assume that technology progress will leads to an increase in marginal productivity of energy recovery, i.e. $\frac{\partial g'(x,T)}{\partial T} > 0$. Therefore, $A_3 < 0$ and we conclude $\frac{ds^*}{dT} > 0$ and $\frac{dw^*}{dT} > 0$.

Appendix 4

Taking total differentiation of Equation (3.1) and (3.2) with respect to the price of incineration service $\bar{p}$ yields

$$\frac{\partial^2 \pi}{\partial s^2} ds + \frac{\partial^2 \pi}{\partial s \partial w} dw = -e\, h(I) s\, d\bar{p} \qquad \text{(A4-1)}$$

$$\frac{\partial^2 \pi}{\partial s \partial w} ds + \frac{\partial^2 \pi}{\partial w^2} dw = 0 \qquad \text{(A4-2)}$$

Solving the simultaneous equations of (A4- 1) and (A4-2) yields

$$\frac{ds^*}{d\bar{p}} = \frac{\begin{vmatrix} A_4 & \frac{\partial \pi^2}{\partial s \partial w} \\ 0 & \frac{\partial \pi^2}{\partial w^2} \end{vmatrix}}{D}, \text{and} \quad \frac{dw^*}{d\bar{p}} = \frac{\begin{vmatrix} \frac{\partial \pi^2}{\partial s^2} & A_4 \\ \frac{\partial \pi^2}{\partial s \partial w} & 0 \end{vmatrix}}{D},$$

where $A_4 = -e\,h(I)s < 0$. Therefore, we conclude $\frac{ds^*}{d\bar{p}} > 0$ and $\frac{dw^*}{d\bar{p}} > 0$.

Appendix 5

Taking total differentiation of Equation (3.1) and (3.2) with respect to the price of recovered energy μ yields

$$\frac{\partial^2 \pi}{\partial s^2} ds + \frac{\partial^2 \pi}{\partial s \partial w} dw = -g'(x;\, T)\, es\, h(I)\, d\mu \qquad \text{(A5-1)}$$

$$\frac{\partial^2 \pi}{\partial s \partial w} ds + \frac{\partial^2 \pi}{\partial w^2} dw = 0 \qquad \text{(A5-2)}$$

Solving the simultaneous equations of (A5- 1) and (A5-2) yields

$$\frac{ds^*}{d\mu} = \frac{\begin{vmatrix} A_5 & \frac{\partial \pi^2}{\partial s \partial w} \\ 0 & \frac{\partial \pi^2}{\partial w^2} \end{vmatrix}}{D}, \text{ and } \frac{dw^*}{d\mu} = \frac{\begin{vmatrix} \frac{\partial \pi^2}{\partial s^2} & A_5 \\ \frac{\partial \pi^2}{\partial s \partial w} & 0 \end{vmatrix}}{D},$$

where $A_5 = -g'(x;\, T)\, h(I) es < 0$ as $g'(x;\, T) > 0$ (please see Section 2). Therefore, we conclude $\frac{ds^*}{d\mu} > 0$ and $\frac{dw^*}{d\mu} > 0$.

Appendix 6

Taking total differentiation of Equation (3.1) and (3.2) with respect to unit transportation cost τ yields

$$\frac{\partial^2 \pi}{\partial s^2} ds + \frac{\partial^2 \pi}{\partial s \partial w} dw = es^2\, h(I) d\tau \qquad \text{(A6-1)}$$

$$\frac{\partial^2 \pi}{\partial s \partial w} ds + \frac{\partial^2 \pi}{\partial w^2} dw = 0 \qquad \text{(A6-2)}$$

Solving the simultaneous equations of (A6- 1) and (A6-2) yields

$$\frac{ds^*}{d\tau} = \frac{\begin{vmatrix} A_6 & \frac{\partial \pi^2}{\partial s \partial w} \\ 0 & \frac{\partial \pi^2}{\partial w^2} \end{vmatrix}}{D}, \text{ and } \frac{dw^*}{d\tau} = \frac{\begin{vmatrix} \frac{\partial \pi^2}{\partial s^2} & A_6 \\ \frac{\partial \pi^2}{\partial s \partial w} & 0 \end{vmatrix}}{D}$$

where $A_6 = e s^2 \ h(I) > 0$. Therefore, we conclude $\frac{ds^*}{d\tau} < 0$ and $\frac{dw^*}{d\tau} < 0$.

Appendix 7

Taking total differentiation of Equation (3.1) and (3.2) with respect to compensation δ yields

$$\frac{\partial^2 \pi}{\partial s^2} ds + \frac{\partial^2 \pi}{\partial s \partial w} dw = e s^{1-\beta} \ h(I) \, d\delta \qquad \text{(A7-1)}$$

$$\frac{\partial^2 \pi}{\partial s \partial w} ds + \frac{\partial^2 \pi}{\partial w^2} dw = 0 \qquad \text{(A7-2)}$$

Solving the simultaneous equations of (A7-1) and (A7-2) yields

$$\frac{ds^*}{d\delta} = \frac{\begin{vmatrix} A_7 & \frac{\partial \pi^2}{\partial s \partial w} \\ 0 & \frac{\partial \pi^2}{\partial w^2} \end{vmatrix}}{D} \text{ and } \frac{dw^*}{d\delta} = \frac{\begin{vmatrix} \frac{\partial \pi^2}{\partial s^2} & A_7 \\ \frac{\partial \pi^2}{\partial s \partial w} & 0 \end{vmatrix}}{D},$$

where $A_7 = e s^{1-\beta} h(I) > 0$. Therefore, we conclude $\frac{ds^*}{d\delta} < 0$ and $\frac{dw^*}{d\delta} < 0$.

Appendix 8

Taking total differentiation of Equation (3.1) and (3.2) with respect to distance decay parameter β yields

$$\frac{\partial^2 \pi}{\partial s^2} ds + \frac{\partial^2 \pi}{\partial s \partial w} dw = (1-\beta) \delta e s^{-\beta} \ h(I) \, d\beta \qquad \text{(A8-1)}$$

$$\frac{\partial^2 \pi}{\partial s \partial w} ds + \frac{\partial^2 \pi}{\partial w^2} dw = 0 \qquad \text{(A8-2)}$$

Solving the simultaneous equations of (A6-1) and (A6-2) yields

$$\frac{ds^*}{d\beta} = \frac{\begin{vmatrix} A_8 & \frac{\partial \pi^2}{\partial s \partial w} \\ 0 & \frac{\partial \pi^2}{\partial w^2} \end{vmatrix}}{D}, \text{ and } \frac{dw^*}{d\beta} = \frac{\begin{vmatrix} \frac{\partial \pi^2}{\partial s^2} & A_8 \\ \frac{\partial \pi^2}{\partial s \partial w} & 0 \end{vmatrix}}{D},$$

where $A_8 = (1-\beta)\delta e s^{-\beta} h(I)$. If $\beta > 1$, then $A_8 < 0$, we conclude that $\frac{ds^*}{d\beta} > 0$ and $\frac{dw^*}{d\beta} > 0$. If $\beta < 1$, then $A_8 > 0$, we conclude that $\frac{ds^*}{d\beta} < 0$ and $\frac{dw^*}{d\beta} < 0$.

If $\beta = 1$, then $A_8 = 0$, we conclude that $\frac{ds^*}{d\beta} = 0$ and $\frac{dw^*}{d\beta} = 0$.

環境政策設計與民眾需求差距之研究

蘇俞龍*
南華大學環境管理研究所研究生

陳中獎**
南華大學環境管理研究所副教授

摘要

在台灣，有關廢棄物處理設施選址的地方性衝突時有耳聞，而衝突所導致的結果，往往造成巨大的社會損失。本文從政策設計者（中央政府）與社區居民兩種不同立場爲出發點，分析衝突的原因。一般說來，中央政府負責政策設計，主要是以全國性的考量爲主，故對於地方之需求往往無法兼顧。本文嘗試以最適社會福利之模式，去分析政策設計者與地方社區居民對於垃圾處理服務量與污染排放的差異，並藉由敏感分析去探討相關因素。本研究發現，政策設計者所考慮的最適垃圾處理服務量 Q^* 與最適污染濃度 e^*，相較於社區居民所需的最適值 $q^\#$ 與 $e^\#$，政策設計者立場的最適值要比社區居民之最適值爲大，其有可能是衝突產生的原因之一，同時此一結果也可以爲衝突作一註解，並作爲消除政策設計者與社區居民認知歧異的出發點。

關鍵詞：環境政策，社會福利，污染服務，抗爭

---

*南華大學環境管理研究所，嘉義縣大林鎮中坑里中坑 32 號。E-mail：g11144002@mail2.nhu.edu.tw，TEL：(05)2321001 轉 2041

**南華大學環境管理研究所，嘉義縣大林鎮中坑里中坑 32 號。E-mail：ccchen@mail.nhu.edu.tw，TEL：(05)2321001 轉 2041

一、 前言

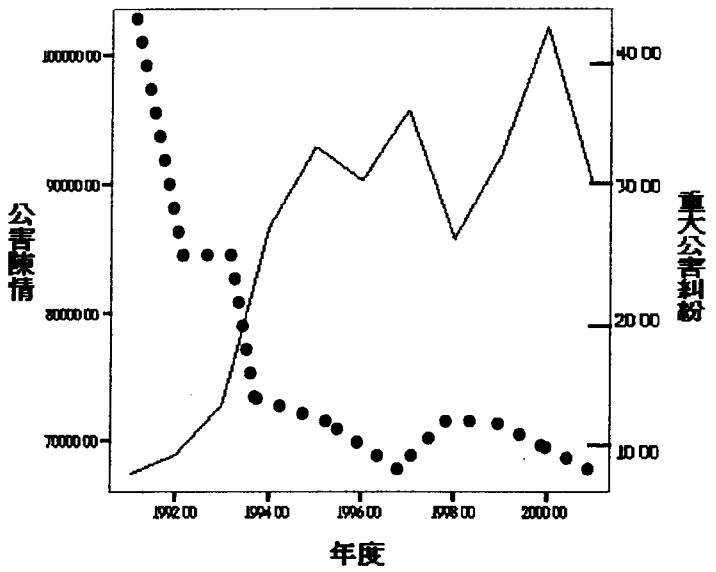
台灣過去幾十年來的政策發展一直都是以經濟成長爲主要目標，而在經濟成長背後所付出的成本，卻是自然資源及生態環境的破壞，誠如 De Steiguer(1995)所認爲的，科技的發展，雖然爲人類帶來了進步與繁榮，但這些便利性卻也是犧牲相對生活環境的結果。而一般大眾在有利可圖的情形下，面對經濟誘因與環保問題，往往是偏向於不損及自身利益的經濟面，相對的也使得社會價值觀變的混淆，同時貧富差距的加大，以及資源分配的不公，也使得『環境不正義』的事件頻傳（王俊秀, 1995）。再加上近年來，國際環保意識聲浪的逐漸高漲，也使得國人在所得提高的同時，對於自身生活品質的要求也相對的提昇（李澤民, 1999; 蔡勳雄, 2000），其中尤以 1987 解嚴爲一重要分水嶺（蕭新煌,1994），『在此一巨幅的轉型過程中，各式各樣的環保抗爭活動也隨同興起』（蕭新煌,1989；李長貴,1992）。[1]

多年來，人們一直感興趣的是環境如何影響人，直到近代才開始思考，人類如何影響環境（Ortolano, 1989），也逼使政府必須在經濟發展與環境保護之間認真思考。然而，就台灣而言，中央與地方所面

[1]由於國人環境意識迅速而普遍提昇，對於環境品質之要求提高，政府乃採取「環境保護與經濟發展兼並重」政策，民國七十六年八月二十二日將行政院衛生署環境保護局升格爲行政院環境保護署。台灣省則於七十七年一月十五日將原環境保護局爲台灣省環境保護處（八十八年七月起改爲環保署中部辦公室，九十一年三月起改爲本署環境督察總隊）。縣市方面於七十七年至八十年間逐設立環境保護局，以加強基層執行能力。

對之傷害程度並不一致，特別是在具污染性的公共設施之廠址所在地上，政策設計者在制訂環境政策時，無法完全符合地方社區之需求。同時由於地方居民是污染的直接受害者，他們對當地資源的維護與污染排除有著最急迫的關懷，因此他們也成爲社會行動中，最可能也最有效的主角（Vivian, 1992）。

民國 90 年公害陳情案件受理資料顯示（環保署統計資料, 2002），總計有九萬零三十二件公害陳情[2]，其中重大公害糾紛[3]案件有八件，而民國八十三年至九十年的統計平均次數爲 9.75，接近 10 次，但公害陳情案件平均數值卻是 91,954.375。



(圖一)歷年公害陳情與重大公害糾紛次數

[2]公害陳情（Nuisance petition）：包括來自機關團體學校、醫院、軍事機關所屬單位、商業、工業、營建工程、交通工具、一般居民等，所製造之空氣污染、惡臭、噪音、水污染、廢棄物、振動、地層下陷等，足以污染環境或影響人體健康者，致使民眾向政府機關提出陳情之案件。

[3]糾紛陳情（Disputes petition）：指涉及損害賠償或重大糾紛案之陳情。

圖一的結果顯示，1996 年之後，重大公害糾紛事件的次數維持在平均每年 10 次左右，而公害陳情案件卻在 92,000 次上下，其原因可能是，廠商的排放量基本上是符合政府的環保規定，但是在公害陳情上，卻沒有減少，這有可能是民眾的環境意識高漲，同時對自身權益與生活品質的重視。而在環保政策的法令執行上，廠商都符合法令規範，然而在一般民眾身上仍然感覺其自身受到環境危害。Lidskog (1997)討論了關於有毒廢棄物設廠選址所引起不同的衝突問題，並企圖利用建構討論平台的模式去尋求衝突的解決。許多學者對於衝突本身已有許多的討論（Gleeson and Memon, 1994; Petts, 1994; Gusman, 1983）。但是實際上關於衝突的問題卻仍待解決，且在決策過程中，不同的角色與利益團體，可能扮演著不同的觀點，這些利益團體包括政治人物、環境團體、產業界、工會以及學者等等(Callan and Thomas, 1996)，再加上當地居民爲直接受害者，因此部分學者將邁向環境永續的希望，寄託在社區以及非政府組織的參與上（Redclift, 1992；Fisher, 1993）。而 Gibbs 及 Jonas(2000)企圖分析環境政策與永續發展的關係，強調區域的部分，也就是環境政策跟當地政府及其他環境團體的交集與互動。

Swyngedouw(1997)認爲，環境政策在目前環境議題的國際化以及貿易問題自由化的情形下，環境議題不再只是本國之事，而是涉及到

多國的協議。但是 Jessop(1995)強調，地方政府的經濟發展與環境規劃，對於地方環境政策的制訂是非常重要的，地方政府的治權會影響到環境政策的分析。而治理理論（regime theory）則提供了相當複雜的研究方法，強調制度結構對環境政策的影響。（Stone, 1989, 1993; Stoker and Mossberger, 1994）。

傳統上，政策的制訂，大多是由上往下（Top Down），當然也有學者建議由下往上（Bottom-up），其優缺點主要在於當地老百姓之民主素養，在美國，則是由於政治的運作，使得許多社區發展及保存計劃（conservation planning）由地方政府負責（Feldman and Jonas, 2000）；同樣的在歐洲，政府則是經由區域發展政策，去延續並校定其永續發展策略(DETR, 1997, 1999)。但是就台灣而言，地方政府與中央政府權限劃分並不清楚，使得許多的政策美意無法下達至地方，因此，針對台灣環境政策由上往下的制訂方式，學者建議採取地方分權式[4]的管理，以社區發展或者是環保團體，共同參與制訂環境政策，但未被政府採用，故實際上，台灣環境政策的制訂是採取由上往下（Top-Down）的方式，因而忽略了地方政府的需求與地方社區民眾的呼聲，因此，中央政府與地方政府在制訂環境政策的同時，顯然的

[4]地方分權制（Decentralization）：乃謂一個國家，將其治權的一部份，賦予地方政府，而中央政府僅立於監督地位的一種制度（趙永茂, 1997）。其施行特點在於地方單位爲地方統治權的行使者，非中央政府之代理人，非依法律，中央政府不得隨意干涉，中央政府僅具監督權，並無指揮權（楊景彬, 1995）。

和地方民眾的考量有所不同，這也是地方性環保衝突產生的原因之一。

Field(2002)認爲環境政策的制訂，主要的考量標準有：（1）效率（efficiency）、（2）公正性（fairness）、(3)可行性（enforceability）、(4)長期改善的獎勵（incentives for long-run improvement）及（5）道德因素（moral consideration），Barr(1992)則是認爲政策的目標應包含效率、公平以及施政可行性，因此，一般在環境政策的制訂規劃上，主要是以民眾受益多寡爲觀點，也就是一般大眾常說的『大多數人的意見』（林水波、張世賢, 1989），而在以環境爲主的問題上，即便只是少數人的意見，在面對環境保護的法規時，其依舊賦予了社區上所有的居民相同的權力，並以此種權力爲原則（Towers, 2000；Bullard, 1996）。而政策制訂的宗旨是爲求得最適社會福利，因此，經濟學者認爲政策評估強調的是社會的公正與對等（Barry and Martha, 2002；Barr, 1992; Milliman and Prince, 1989），例如在選址的問題上，Lake, R.W.（1996）認爲在政策制訂過程中，如何去傾聽少數人的意見，便成爲政策是否符合環境正義（environmental justice）的一項指標，特別是對於會產生環境危害的選址問題上。同時『若無法建立民眾對政府及開發業者的信心，僅依賴公權力之發揮或公害糾紛處理制度、環境影響評估制度與回饋制度之建立，則污染設施的設置是非常困難

的。』（蕭代基, 1996, 頁40）。

環境白皮書（環保署, 2002）指出，政府環境政策制訂的目標在於『維護國民健康，確保生活環境的永續發展、以促進人類福祉爲依歸。』（頁23），但在永續發展成爲政策主流的同時，中央政策制訂與地方民眾需求是否一致? Cocklin and Blunden (1998, p. 66)對於永續發展做了一些評論：『永續發展這個課題，只是社會、經濟和環境議題上的一種連續性的再度審思部分，同時也涉及到空間的創造。實際上，當永續發展成爲現代社會的一個主要議題時，此議題在國家層級上將被視爲主流議題，但是在地方層次上所造成之結果卻是有所爭論的』。目前，我國的環境政策是將永續議題箝入在政策範圍內[5]，大致上在國家層次上都是被接受的且認爲是重要的，同時在國際上也是主流作法，但是在實行時是否有顧及到地方的需求，則是中央與地方的差距所在。

因此，本研究期望藉由社會福利最大之經濟模式的建構，去探討環境政策制訂時，有關中央政府與地方民眾之衝突，並藉著地方分權的方式加以分析，試圖去減少中央環境政策制訂與地方民眾認知差距的影響，藉此降低環保抗爭及社會成本之浪費，並達到雙贏之結局。

[5]行政院在民國八十七年七月二日，二五八五次院會通過的『國家環境保護計劃』，積極的整合各項施政的措施與工具，並擴大民眾參與機制來調整其策略。其主要目標之一便是達成國家的永續發展。

二、 模型假設及符號定義

（一）爲簡化模型之分析，我們做了下列假設：

1. 依據 Butter and Maher(1986)所提出的兩部門模型，本文假設，社會上只有兩種人，也就是政策設計者及地方社區，而環保署有關環保法規制訂過程的說明指出，就台灣而言，環保政策所屬之主管機關，在中央爲行政院環境保護署；在直轄市爲直轄市政府；在縣（市）爲縣（市）政府。因此，中央政府即爲政策設計者，同時，本文所指之地方社區爲污染廠址所在地，且政策設計者之政策目標主要是以追求社會福利最大化[6]爲主，地方社區則爲追求社區福利最大化之團體。

2. 當中央環保政策一旦決定，廠商排放標準也同時被規定或者是強制執行(Ruff, 1981; Spulber, 1989)，必須要透過協商才能取得一些法令上的讓步(Downing, 1983)，因此本文假設廠商完全遵守政策規範，如遵守排放濃度標準等等，也就是政策執行上沒有問題。

3. 政策執行爲單一法規制度，即全國法規一致。以民國九十一年六月十九頒佈施行的空氣污染法爲例，其施行細則上說明了其主管事物包括全國性空氣污染防制政策、方案與計畫之規劃、訂定、

[6]Forest(1980)將社會福利目標值定義爲總消費量和總污染量的函數；Butter and Maher（1986)則將其定義爲污染者生產利益減去受害者的損失。

督導及執行事項。即全台灣之法定標準皆相同，包括污染排放標準以及總量管制等等，因此，中央政策一旦制訂完成，則各縣市及直轄市之主管機關就必須依法行事。也就是在同一治權底下一致。地方主管機關只能在施行後，依法應每兩年提出檢討修正改善，並報承中央主管機關核備之。因此，對於許多鄰避設施政策的紛爭，中央及地方政策設計者與地方社區的認知，往往有很大的落差。而其中對於焚化爐所產生之污染物質，只針對各個污染物質排放濃度加以制訂標準，卻沒有對其排放量做管制等等令人疑竇問題，也是值得去深入探討的。

（二）符號定義與說明

爲了易於瞭解與說明本文所建構之模式，故將本文所採取之符號定義如下：

1. p 表示污染服務價格，Q 表示污染服務量（垃圾量），$f(\ )$ 代表中央政府所決策焚化設施廠址，其所在縣市之全體居民對污染服務的需求反函數；$p=f(Q)$ 表示政策設計者所考慮地方全體居民對產品的需求，正常狀況下，$f_Q(Q)<0$。
2. $g(\ )$ 表示焚化設施廠址所在社區之居民，對污染服務的需求反函數，$p=g(q)$ 表示廠址所在社區對產品之需求，正常狀況下，$g_q(q)<0$。

3. 本文假設，社區需求是地方全體總需求的$\frac{1}{k}$，$k>1$，也就是說$q=g^{-1}(p)=\frac{f^{-1}(p)}{k}$，$kg^{-1}(p)=f^{-1}(p)$，所以，$p=f(kq)=g(q)$。

4. $C(\ )$表示焚化設施污染服務時的生產成本，包括廠商之防污成本；$p=C(Q,e;T)$，e表示污染服務處理後之污染排放濃度，同時，$e<\bar{e}$，$\bar{e}$爲政府所制訂之排放標準，也就是焚化設施必須符合政府相關環保法規，如污染排放標準等等，並設置相關之防污設備。T 表示防污設備之技術，爲其參數。Gottinger(2001)假設廠商產量與防污設備成本之間爲一遞增且凸向原點的函數，但對所產生污染排放與防污設備之間的關係則爲遞減並凸向原點之函數(Farmer, A. et al., 2001; Amacher, G. S., Malik, A. S., 1996, Burtraw, D. et al., 1995) ，本文假設$C_Q(Q,e;T)>0$、$C_e(Q,e;T)<0$、$C_{QQ}(Q,e;T)>0$、$C_{ee}(Q,e;T)>0$、$C_{eT}(Q,e;T)<0$；但是$C_{QT}(Q,e)\neq 0$、$C_{Qe}(Q,e)\neq 0$。

5. $D(\ )$表示社會傷害成本，$p=D(Q,e;N,I,A)$，Page and Ferejohn(1974)認爲環境傷害函數是凸向原點的(Amacher, G. S., Malik, A. S., 1996)，因此，本文假設$D_Q(Q,e;N,I,A)>0$、$D_e(Q,e;N,I,A)>0$、$D_{QQ}(Q,e;N,I,A)>0$、$D_{ee}(Q,e;N,I,A)>0$，本文假設 N 表示人口數目，I 爲居民的水得水準，其皆爲社會傷害成本之參數，Spulber(1989)提到關於污染廠商(傷害者)與消費者(犧牲者)協

商模型時，認爲主要還是依據消費者的所得水準，而Kennedy(1995)認爲人口數的增加會使得污染所產生之傷害成本增加，Antle 與 Heidebrink(1995)探討高所得國家對於本身環境關懷的關係，且所得越高，傷害成本越高。此外，本文假設 A 爲政策設計者對此項產品之環境關懷程度，因此本文假設 $D_{QN}(Q,e;N,I,A)>0$ 、 $D_{eN}(Q,e;N,I,A)>0$ 、 $D_{eI}(Q,e;N,I,A)>0$ 、 $D_{QI}(Q,e;N,I,A)>0$ 、 $D_{QA}(Q,e;N,I,A)>0$ 、 $D_{eA}(Q,e;N,I,A)>0$ 。

三、模型建構

本文首先考慮的是，政策設計者與地方社區兩種不同立場下，其所追求之社會福利，並加以討論。

（一） 政策設計者立場：

根據 Spulber(1985)對社會福利之定義，可以將社會福利定義爲：消費者剩餘減去私人生產成本與外部環境破壞成本，而政策設計者的目標在追求社會福利最大，因此，政策設計者在制訂政策時，所面臨的問題，可以用下列數學式表示：

$$\underset{Q,e}{Max}\, W=\int_0^Q f(x)dx-C(Q,e;T)-D(Q,e;N,I,A) \qquad (P1)$$

爲求其最佳值，因此分別對 Q、e 偏微分並令其爲 0，可得：

$$\frac{\partial W}{\partial Q}=f(Q)-C_Q(Q,e;T)-D_Q(Q,e;N,I,A)=0 \qquad (3\text{-}1)$$

$$\frac{\partial W}{\partial e} = C_e(Q,e;T) + D_e(Q,e;N,I,A) = 0 \qquad (3\text{-}2)$$

由(3-1)、(3-2)式，解聯立方程式可得此一模式之最佳值（Q^*,e*）；(3-1)式的意義表示，焚化設施之污染服務之邊際利益等於邊際社會傷害成本。(3-2)式則表示焚化設施污染服務所排放濃度之邊際成本等於邊際社會利益。Farmer(2001)認爲當政策制訂者在制訂排放濃度的時候，會考慮廠商邊際防污設備成本與社會邊際傷害成本，由（3-2）可得其關係。

當最佳解（Q^*,e*）存在時，爲此模式之極大值，其二階條件必須滿足$\frac{\partial^2 W}{\partial Q^2} < 0$、$\frac{\partial^2 W}{\partial e^2} < 0$、$\frac{\partial^2 W}{\partial Q^2}\frac{\partial^2 W}{\partial e^2} - (\frac{\partial^2 W}{\partial e \partial Q})^2 > 0$，也就是說，此一模式所決定之最適解（$Q^*$,e*），可以爲地方帶來社會福利最大。

（二）地方社區立場：

政策設計者的目標在追求社會福利最大，根據前述 Spulber(1985)之社會福利定義，地方社區在面對焚化設施之污染服務時，其所面臨的問題，可以用下列數學式表示：

$$\underset{q,e}{Max}\, W = \int_0^q g(x)dx - C(q,e;T) - D(q,e;N,I,A) \qquad (\text{P2})$$

爲求其最佳值，故分別對 q、e 偏微分並令其爲 0，可得：

$$\frac{\partial W}{\partial q} = g(q) - C_q(q,e;T) - D_q(q,e;N,I,A) = 0 \qquad (3\text{-}3)$$

$$\frac{\partial W}{\partial e} = C_e(q,e;T) + D_e(q,e;N,I,A) = 0 \qquad (3\text{-}4)$$

由(3-3)、(3-4)式，解聯立方程式可得此一模式之最佳值（$q^{\#}$,$e^{\#}$）；(3-3)式的意義表示，社區居民對於焚化設施之污染服務所產生之邊際利益等於邊際社會傷害成本。(3-4)式則表示焚化設施污染服務所排放濃度之邊際成本等於邊際社會利益。

當最佳解（$q^{\#}$,$e^{\#}$）存在時，爲此模式之極大值，其二階條件必須滿足$\frac{\partial^2 W}{\partial q^2}<0$、$\frac{\partial^2 W}{\partial e^2}<0$、$\frac{\partial^2 W}{\partial q^2}\frac{\partial^2 W}{\partial e^2}-(\frac{\partial^2 W}{\partial e \partial q})^2>0$，如此對地方社區立場而言，此一模式所決定之（$q^{\#}$,$e^{\#}$），是可以帶來地方社會福利最大。

（三）政策設計者與地方居民最適產量與排放量之比較

本文假設社區對污染服務的需求是地方全體總需求的$\frac{1}{k}$，$k>1$，也就是說$Q=kq$，故$q=g^{-1}(p)=\frac{f^{-1}(p)}{k}$，所以得$p=f(kq)=g(q)=g(\frac{Q}{k})$，同時$C_Q(Q,e)=\frac{\partial C(kq,e)}{k\partial q}=\frac{C_q(kq,e)}{k}$、$D_Q(Q,e)=\frac{\partial D(kq,e)}{k\partial q}=\frac{D_q(kq,e)}{k}$，因此（3-1）、（3-2）之聯立方程式可改寫成：

$$g(q)-\frac{C_q(kq,e)}{k}-\frac{D_q(kq,e)}{k}=0 \qquad (3\text{-}5)$$

$$C_e(kq,e)+D_e(kq,e)=0 \qquad (3\text{-}6)$$

對（3-5）、（3-6）做全微分可得：

$$\frac{\partial e}{\partial q}=\frac{kg_q(q)-C_{qq}(kq,e)-D_{qq}(kq,e)}{C_{qe}(kq,e)+D_{qe}(kq,e)}>0 \qquad (3\text{-}7)$$

$$\frac{\partial e}{\partial q}=-\frac{C_{eq}(kq,e)+D_{eq}(kq,e)}{C_{ee}(kq,e)+D_{ee}(kq,e)}>0 \qquad (3\text{-}8)$$

由上可知，政策設計者對於 q、e 座標軸上其斜率皆爲正。再由

社區居民立場之聯立方程式（3-3）、（3-4）全微分可得：

$$\frac{\partial e}{\partial q}=\frac{g_q(q)-C_{qq}(q,e)-D_{qq}(q,e)}{C_{qe}(q,e)+D_{qe}(q,e)}>0 \qquad (3\text{-}9)$$

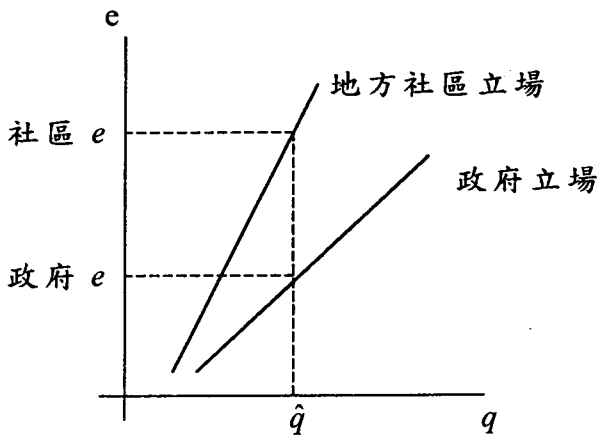
$$\frac{\partial e}{\partial q}=-\frac{C_{eq}(q,e)-D_{eq}(q,e)}{C_{ee}(q,e)+D_{ee}(q,e)}>0 \qquad (3\text{-}10)$$

故可得社區居民立場之聯立方程式其斜率亦爲正，且(3-4)、(3-6)爲相同之方程式，故(3-3)、(3-5)面對的爲同一方程式，同時 $C_Q(Q,e)=\frac{\partial C(kq,e)}{k\partial q}=\frac{C_q(kq,e)}{k}$ 、 $D_Q(Q,e)=\frac{\partial D(kq,e)}{k\partial q}=\frac{D_q(kq,e)}{k}$ ，故(3-5)式可改寫成

$$kg(\frac{Q}{k})-C_q(Q,e)-D_q(Q,e)=0 \qquad (3\text{-}5)^1$$

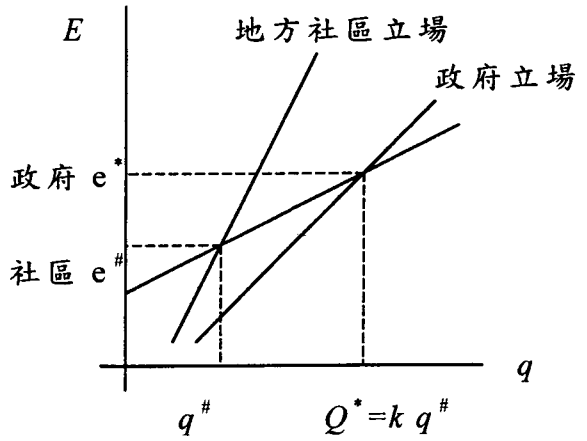
當 $Q=q$ 時，(3-3)與(3-5)[1]的關係如下：

$kg(\frac{q}{k})=C_q(q,e)+D_q(q,e)$ 同時 $g(q)=C_q(q,e)+D_q(q,e)$ ，因此當 $Q=\hat{q}$ 時， $g(\frac{\hat{q}}{k})<g(\hat{q})$ ，也就是當污染服務量固定時，地方社區的污染排放濃度是高於整體社會的濃度，可以下圖表示：



此時由社區立場與政府立場之聯立方程式可得最適解（q^*,e^*）、

（$q^{\#}$,$e^{\#}$），由下圖可知，在各自不同的立場之下，社區居民所面臨的污染服務函數是要比全體需求來的小。



可知，地方對污染服務之需求與地方所能接受之污染排放量($q^{\#}$,$e^{\#}$)，皆低於中央所制訂之標準（Q^{*}, e^{*}），故廠址所在地之居民，面對政策設計者所制訂之污染排放時，社區居民認爲其本身所需要要之污染服務並沒有那麼多，但卻必須承擔全體居民的污染排放量，因此對其而言，中央制訂之環境政策是不公平的，因而會與政府意見產生衝突與抗爭。

然而，就地方社區立場而言，政策設計者所制訂之排放濃度是考慮整全體居民之社會福利亦是整個社會之社會福利，但就地方社區而言，其社會福利是包含在整體社會福利之中，但是其所受到之傷害，卻是占整個社會之傷害成本的大多數。也就是說，政策制訂者在制訂政策時，是從整個社會的角度去出發，而不是從地方社區之立場來看，因此會造成地方社區對環境政策認知之差距，因此鄰避設施幾乎都是選擇在人口較少、對社區以及當地經濟影響較低的區域，同時藉

由回饋機制來緩衝居民可能產生的衝突並降低社會成本的損失。

四、敏感性分析

本文首先考慮，在不同立場之下，政策制訂者與地方社區分別考量各種環境參數，諸如人口數目、環境態度、所得、防污技術水準等，對 Q^*、e^*以及 $q^{\#}$、$e^{\#}$之影響。

（一）政策設計者立場的敏感性分析：

1. 考慮人口數 N 變動時，對 Q^*、e^*之影響，將（3-1）及（3-2）二式，對其變數與人口參數 N 做全微分可得：

$$\left(f'(Q)-C_{QQ}(Q,e)-D_{QQ}(Q,e;N)\right)dQ+\left(-C_{Qe}(Q,e)-D_{Qe}(Q,e;N)\right)de = \left(D_{QN}(Q,e;N)\right)dN \tag{4-1}$$

$$\left(C_{eQ}(Q,e)+D_{eQ}(Q,e;N)\right)dQ+\left(C_{ee}(Q,e)+D_{ee}(Q,e;N)\right)de = -\left(D_{eN}(Q,e;N)\right)dN \tag{4-2}$$

為便於計算，在此處以下列符號代替上述式子：

$$a_1=\left(f'(Q)-C_{QQ}(Q,e)-D_{QQ}(Q,e;N)\right)<0$$

$$b_1=\left(-C_{Qe}(Q,e)-D_{Qe}(Q,e;N)\right)>0$$

$$c_1=D_{QN}(Q,e;N)>0$$

$$a_2=\left(C_{eQ}(Q,e)+D_{eQ}(Q,e;N)\right)<0$$

$$b_2=\left(C_{ee}(Q,e)+D_{ee}(Q,e;N)\right)>0$$

$$c_2 = -D_{eN}(Q,e;N) < 0$$

解（4-1）與（4-2）聯立方程式二式運算，可解出：

$$\frac{dQ^*}{dN} = \frac{b_1c_2 - c_1b_2}{a_1b_2 - b_1a_2} < 0 \qquad (4\text{-}3)$$

$$\frac{de^*}{dN} = \frac{c_1a_2 - a_1c_2}{a_1b_2 - b_1a_2} < 0 \qquad (4\text{-}4)$$

(4-3）表示，政策設計者在考量最適垃圾處理服務量時，當垃圾處理服務範圍的人口數 N 變動時，對於最適垃圾處理服務量 Q^* 的變動會呈現反比的關係；而（4-4）則表示，當人口數 N 越高時，對於最適污染排放濃度 e^* 亦是呈現反比的關係。也就是政策設計者所設定的垃圾處理服務量必須要考慮到人口因素，人口數目越多的地方越不適合設置此一設施，因其所造成之傷害越大。而政策設計者主要考量點在於全體人民的社會福利最大，也就是中央考慮的皆是以全體需求爲主，對其所造成之社會傷害成本部分亦是如此，因而使得廠址所在地居民感覺到不平等，行政院原子能委員會在低放射性廢料處理上，有關陸地最終處置管制規範即規定，政府在核廢料選址問題上認爲必須是位於低人口密度及低開發潛力之地區[7]，而其間的落差，往往便是衝突的來源。

2. 考慮當人民的所得 I 變動時，對 Q^*、e^* 之影響：

由假設可知，$a_1 < 0$、$b_1 > 0$、$c_1 = D_{QI}(Q,e;I) > 0$、$a_2 < 0$、$b_2 > 0$、

[7]行政院原子能委員會之低放射性廢料陸地最終處置管制規範四。

$c_2 = D_{el}(Q,e;I) < 0$，依據前述做法可得：

$$\frac{dQ^*}{dI} = \frac{b_1c_2 - c_1b_2}{a_1b_2 - b_1a_2} < 0 \tag{4-5}$$

$$\frac{de^*}{dI} = \frac{c_1a_2 - a_1c_2}{a_1b_2 - b_1a_2} < 0 \tag{4-6}$$

由上述結果可知，消費者所得的增減對垃圾處理服務的需求與最適污染濃度的影響是呈現反比的關係，也就是不管所得越高，所能趕受到之傷害越大，因此可以解釋政策設計者在垃圾處理廠址的選擇上，會選擇低所得、低開發性的地區來設置的原因。

3. 考慮政策設計者之環境態度 A 變動時，對 Q^*、e^*之影響：

由假設可知，$a_1 < 0$、$b_1 > 0$、$c_1 = D_{QA}(Q,e;A) > 0$、$a_2 < 0$、$b_2 > 0$，$c_2 = -D_{eA}(Q,e;A) < 0$，依據前述做法可得：

$$\frac{dQ^*}{dA} = \frac{b_1c_2 - c_1b_2}{a_1b_2 - b_1a_2} < 0 \tag{4-7}$$

$$\frac{de^*}{dA} = \frac{c_1a_2 - a_1c_2}{a_1b_2 - b_1a_2} < 0 \tag{4-8}$$

由上述結果可知，環境態度與污染服務的需求以及污染排放皆成反比，也就是當政策設計者屬於環境態度較友善者，在政策設計時，會減少污染服務的需求，同時使得污染排放下降。

4. 考慮當廠商防污技術 T 進步時，對 Q^*、e^*之影響:

由假設可知，$a_1 < 0$、$b_1 > 0$、$c_1 = C_{QT}(Q,e;T) < 0$、$a_2 < 0$、$b_2 > 0$、$c_2 = -C_{eT}(Q,e;T) > 0$，依據前述做法可得：

$$\frac{dQ^*}{dT} = \frac{b_1c_2 - c_1b_2}{a_1b_2 - b_1a_2} > 0 \tag{4-9}$$

$$\frac{de^*}{dT}=\frac{c_1a_2-a_1c_2}{a_1b_2-b_1a_2}>0 \tag{4-10}$$

當廠商防污技術水準提升時，處理廠之邊際成本會隨著下降，使得可以處理之污染服務增加，最適污染處理量就隨著積數進步而下降了。同時技術進步也使得處理廠本身污染排放的濃度處理技術上改善，因而可以處理更高濃度的污染排放。

（二）社區居民立場的敏感性分析：

1. 考慮人口數目 N 變動時，對 $q^{\#}$、$e^{\#}$ 之影響，將（3-3）及（3-4）對其做全微分可得：

$$\left(f'(q;A)-C_{qq}(q,e;T)-D_{qq}(q,e;N)\right)dq+\left(-C_{qe}(q,e;T)-D_{qe}(q,e;N)\right)de$$
$$=\left(D_{qn}(q,e;N)\right)dN \tag{4-11}$$

$$\left(C_{eq}(q,e;T)+D_{eq}(q,e;N)\right)dq+\left(C_{ee}(q,e;T)+D_{ee}(q,e;N)\right)de$$
$$=-\left(D_{en}(q,e;N)\right)dN \tag{4-12}$$

爲便於計算，在此處以下列符號代替上述式子：

$$a_1=\left(f'(q;A)-C_{qq}(q,e;T)-D_{qq}(q,e;I,N)\right)<0$$

$$b_1=\left(-A_{qe}(q,e;T)-D_{qe}(q,e;I,N)\right)>0$$

$$c_1=D_{qN}(q,e;I,N)>0$$

$$a_2=\left(A_{eq}(q,e)+D_{eq}(q,e;N)\right)<0$$

$$b_2=\left(A_{ee}(q,e)+D_{ee}(q,e;N)\right)>0$$

$$c_2 = -D_{eN}(q,e;N) < 0$$

對（4-11）與（4-12）二式運算，可解出：

$$\frac{dq^{\#}}{dN} = \frac{b_1c_2 - b_2c_1}{a_1b_2 - b_1a_2} < 0 \qquad (4\text{-}13)$$

$$\frac{de^{\#}}{dN} = \frac{c_1a_2 - c_2a_1}{a_1b_2 - b_1a_2} < 0 \qquad (4\text{-}14)$$

（4-13）、（4-14）表示，就地方社區居民立場而言，隨著地方社區人口 N 的增高，其所需之最適垃圾處理量 $q^{\#}$ 與廠商最適污染排放濃度 $e^{\#}$ 會隨之下降；本文假設地方社區爲垃圾處理廠址所在地，因此社區居民人口數目越高，越希望垃圾處理廠址所帶來的傷害越低，對最適垃圾處理量也會跟著下降。

2. 考慮當人民的所得 I 變動時，對 $q^{\#}$ 、$e^{\#}$ 之影響：

根據假設知 $a_1 < 0$ 、 $b_1 > 0$ 、 $c_1 = D_{ql}(q,e;I,N) > 0$ 、 $a_2 < 0$ 、 $b_2 > 0$ 、 $c_2 = -D_{el}(Q,e;I,N) < 0$，依據前述做法可得：

$$\frac{dq^{\#}}{dI} = \frac{b_1c_2 - c_1b_2}{a_1b_2 - b_1a_2} < 0 \qquad (4\text{-}15)$$

$$\frac{de^{\#}}{dI} = \frac{c_1a_2 - a_1c_2}{a_1b_2 - b_1a_2} < 0 \qquad (4\text{-}16)$$

由上結果可知，所得高低對於地方社區最適污染服務需求與污染排放濃度是成反比的關係，也就是說，所得越高的地區，所期望的最適污染排放越低，也就是大家都不希望危及周遭的生活環境以及生命健康。

3. 考慮地方社區之環境態度 A 變動時，對 $q^{\#}$ 、$e^{\#}$ 之影響：

依據前述做法可得 $a_1<0$、$b_1>0$、$c_1=D_{qA}(q,e;A)>0$、$a_2<0$、$b_2>0$，

$c_2=-D_{qA}(q,e;A)<0$

$$\frac{dq^{\#}}{dA}=\frac{b_1c_2-c_1b_2}{a_1b_2-b_1a_2}<0 \tag{4-17}$$

$$\frac{de^{\#}}{dA}=\frac{c_1a_2-a_1c_2}{a_1b_2-b_1a_2}<0 \tag{4-18}$$

（4-17）、(4-18)的結果顯示，環境態度越高的地區，對最適垃圾處理服務需求與污染排放濃度方面的影響呈現反比的現象。

4. 考慮當污染服務廠商的防污技術 T 進步時，對 $q^{\#}$、$e^{\#}$之影響

依據前述做法可得 $a_1<0$、$b_1>0$、$c_1=C_{qT}(q,e;T)<0$、$a_2<0$、$b_2>0$、

$c_2=-C_{eT}(q,e;T)>0$

$$\frac{dq^{\#}}{dT}=\frac{b_1c_2-c_1b_2}{a_1b_2-b_1a_2}>0 \tag{4-19}$$

$$\frac{de^{\#}}{dT}=\frac{c_1a_2-a_1c_2}{a_1b_2-b_1a_2}>0 \tag{4-20}$$

當廠商防污技術水準提升時，其邊際成本下降，因而得以處理面對更大的污染服務需求；對於污染排放濃度而言，防污技術進步時，對於最適污染排放而言，廠商可以處理更大的排放濃度。

表一爲政策設計者以及地方社區兩種不同立場與不同環境參數敏感性分析所得之結果整理：

表一：不同立場之敏感性分析結果

立場／最適解／環境參數	政策設計者		地方社區	
	Q^*	e^*	$q^{\#}$	$e^{\#}$

人口數目	－	－	－	－
所得水準	－	－	－	－
環境態度	－	－	－	－
防污技術	＋	＋	＋	＋

＋：正比　－：反比

五、結果討論

根據環保署 92 年版環境保護年報資料顯示，2002 年台灣大型焚化場平均每日進廠量約爲 1,546,118.81 公噸，而平均每日垃圾處理服務約爲進廠量的 80.94%，因此，垃圾處理的問題一直是中央政府與地方政府的燙手山芋，本模式之結果發現，對於經環境影響評估等程序所選定的廠址所在地居民而言，其所需之最適污染服務需求以及最適污染排放濃度爲（$q^{\#}$,e$^{\#}$），但社區居民立場所考慮的只有社區自身社會福利最大，而政策設計者所考量的最適污染服務量與排放濃度（Q^{*},e*）必須以全體民眾爲考量，且 $Q^{*}=kq^{\#}$，兩者之間可以發現，整體社會對於污染服務的需求爲地方需求的 k 倍，因此當 k 越大時，地方所分得的服務越少，也就是 $q^{\#}< Q^{*}$，而此時污染服務設施所造成之污染排放，是高於廠址所在地之社區居民所能承受的範圍，也就是說，污染服務所產生之效益是由整體社會分享，而社會傷害成本卻是由人口數目較低的社區居民概括承受。

而在政策設計者與社區居民兩種立場的敏感度分析中，本文發現，在最適污染服務需求與最適污染排放濃度的影響上，所得高低與

環境關懷成反比關係，也就是所得越高與環境關懷程度越高的地區，對於污染服務廠址所提供之服務需求越低，Spulber(1989)認爲消費者所得水準在協商過程中是一項考量因素，原因在於消費者必須購買此一污染服務，但卻又同時必須成爲污染的犧牲者，故就心裡層面而言，所得較高者會認爲其本身價值高於所得較低者，也就是其對社會貢獻相對而言較多，因此對於污染排放所感受之傷害，所得較高者之感受會較深刻。而研究環境關懷的學者認爲，現今人們對於環境保護多是出自內心的感受，是屬於較一般的態度(Weigel, R.H., Weigel, J., 1978； Dunlap, R.E., Van Liere, K.D., 1978)，同時隨著環境教育的宣導，也使得人們對於周遭環境的保護更加重視，其中也涉及到環境問題上有關風險認知的部分，也就是所謂的環境風險[8](Slovic, P., 1987；Gould et al., 1988)。

Clarke 及 Ng(1991, p.73)在關於澳洲環境污染稅制及人口遷移的討論中認爲「假如我們在環境破壞上有好的政策，對澳洲居民而言，人口遷移當然是改善平均經濟社會福利的方式。」Kennedy(1995)則認爲人口遷移以及增加，對於一個國家的環境保護以及自然資源使用上會有所影響，故當政策設計者在考慮鄰避設施廠址時，人口的多寡遂成一重要因素。政策設計者所考慮的污染服務是以社會整體需求爲

[8] 所謂的環境風險即爲具機率概念的災害或危險事件，透過空氣、水體、土壤或食物鏈使的人類健康遭致損傷(Wilson, 1991; Whyie et al., 1980)

考量，因此對於會產生污染的公共設施政策設計者會將在選址時，會將其選擇在人口密度較低，且較不具發展性的地方。

六、結論

大部分的政策制訂，大多是建立在追求社會福利最大基礎之上，但是政策設計者在模型建構或者是實務上，大部分都把政府機構治權之下的經濟體，用一致的標準[9]去衡量，而沒有考慮到各地區不同的需求與環境要求，也就是說，政府只把產品生產所產生之社會福利計算進來，單單只考慮到全國的社會福利，對於所產生之傷害亦是如此，然而，地方社區對於社會福利增加以及大部分的污染所感受到的情形也都是區域性的（除空氣污染以及水污染外），也就是說，對於生產源所產生之社會福利是由全國共享，但是越靠近生產源則其所受到之負面傷害越嚴重，因此，本文考慮上述之情形，制訂出此一模式，得到之結論應該可以做爲環境政策重整（policy reform）的參考之用。

Amacher 及 Mailk(1996)認爲以政府污染排放法規爲基礎時，政府法令的強制性將對污染服務廠商有一定的影響，但經由協商所得的結果，將會成爲社會利益。本文之政策制訂，從區域性經濟出發，隱含著政策設計者必須考量各地區不同區域之特性、當地民眾對產品需求以及污染之反應，另外對於科技之創新對此種落差之影響，未來也

[9] 少數國家，例如美國是依照各洲需求而個別去制訂

許可以考慮技術進步對環保標準制訂之影響，當然，本文對於永續發展並沒有放入模式之中，但基本上此一建議會縮短政府政策與地方需求之差距，相信對政策之實施與抗爭之減少，會有一正面之影響。

而台灣過去從威權統治轉換到民主社會的過程中，民眾對環保議題關注的提高以及環保抗爭所摻生之社會成本，往往被忽略，因此，本文之成果當有助於解決此方面之問題。傳統政策制訂通常爲反應型之方法，在未來政策制訂上，民主參與必定是一重要之趨勢，因此，我們應該考慮更有前瞻性之環境政策設計，如此才會將其所引起之反彈降低。

七、參考文獻

1. 行政院環境保護署：＜國家環境保護計畫＞， 行政院環境保護署策劃，1999。
2. 行政院環境保護署：＜環境白皮書＞，行政院環境保護署綜合計畫處執行編輯，頁 23，2002。
3. 李長貴：激進社會運動，台北：理論與政策雜誌社，1992。
4. 李澤民：＜環境保護與立法＞，環境工程會刊，1999，第十卷第一期，頁 7。
5. 吳濟華、屠世亮譯著：環境規劃與決策（Leonard Ortolano 原著），金名圖書有限公司，1989。

6. 林水波、張世賢：公共政策，五版，台北：五南圖書，1989。

7. 蔡勳雄：＜環保政策與經濟發展＞，中國國民黨中央委員會政策委員會政策月刊，2000，第 44 期，頁 21-23。

8. 蕭代基：＜汙染性設施之設置與民眾信心之建立＞，台灣經濟預測與政策，1996，第 27 卷，第 1 期，頁 39-52。

9. 蕭新煌：七０年代反污染自力救濟的結構與過程分析，行政院環保署委託計劃，1988。

10. 蕭新煌：＜台灣新興社會運動的分析架構＞，台灣新興社會運動，徐正光、宋文理合編，台北：巨流，頁 21-46，1989。

11. 蕭新煌：＜台灣地方環保抗爭運動的性格與轉變：1980-1991＞，1994，環境保護與產業政策研討會論文集，頁 551。

12. Amacher, G. S., Malik, A. S.（1996） Bargaining in Environmental Regulation and the Ideal Regulator. Journal of Environmental Economics and Management, 30, 233-253.

13. Antle J. M., Heidebrink G.（1995）Environment and Development: Theory and International Evidence. Economic Development and Cultural Change 43, 603-625.

14. Barr, N. （1992） Economic theory and the Welfare state: a survey and interpretation. Journal of Economic Literature 30, 741-803.

15.Burtraw, D., Harrington, W., Krupnick, A., and Freeman, A.M. (1995) Optimal "Adders" for Environmental Damage by Public. Journal of Environmental Economics and Management, 29, S1-S19.

16.Bullard, R.D. (1996) Environmental justice : It's more than waste facility siting. Social Science Quarterly, 77,493-499.

17.Butler, Richard V., Mather, Michael D. (1986) The control of externalities: abatement vs. damage prevention. Southern Economic Journal 52 (4), 1088-1102.

18.Clarke, H. R., Ng, Y. K. (1991) Are there valid economic grounds for restricting immigration? Economic paper 10, 71-76.

19.Callan and Thomas, (1996) Environmental Economics and Management Theory, Policy and Applications, Irwin.

20.Cocklin, C., Blunden, G. (1998) Sustainability, water resources and regulation. Geoforum 29 (1),51-68.

21.De Steiguer, J. E. (1995) Three theories from economics about the environment. Bioscience, 45(8), 552-556.

22.Department of the Environment, Transport and the Regions, (1997) Building Partnerships for Prosperity: Sustainable Growth, Competitiveness and Employment in the English Regions. Cm 3814,

London, HMSO.

23.Department of the Environment, Transport and the Regions, (1999) A Better Quality of Life: A Strategy for Sustainable Development for the United Kingdom. CM 4345, DETR, London.

24.Downing, P. B. (1983) Bargaining in pollution control. Policy Stud. J. 11, 557-586.

25.Dunlap, R.E.; Van Liere, K.D. (1978) The "New Environmental Paradigm"A proposed measuring instrument and preliminary results. Journal of Environmental Education, 10-19

26.Farmer, A., Kahn, J. R., McDonald, J. A., O'Neill, R. (2001) Rethinking the optimal level of environmental quality: justifications for strict environmental policy. Ecological Economics 36, 461-473.

27.Field, B. C. (2002) Environmental Economics: An Introduction, 3rd Edition, New York : McGraw-Hill.

28.Feldman, T., Jonas, A.E.G. (2000) Sage scrub revolution? Property rights, political fragmentation and conservation planning in Southern California under the Federal Endangered Species Act. Annals of the Association of American Geographers, forthcoming.

29.Forster, Bruce, A. (1980) Optimal energy use in a polluted

environment. Journal of Environmental Economicsand Management 7, 321-333.

30.Fisher, J. (1993) The Road from Rio: Sustainable Development and the Non-Governmental Movement in the Third World. Westport, CT: Praeger Publishers.

31.Gibbs, D.C., Jonas, A.E.G. (2000) Governance and regulation in local environmental policy: the utility of a regime approach. Geoforum 31,299-313.

32.Gleeson, B.J. and Memon, P.A. (1994) The NIMBY syndrome and community care facilities: a research agenda for planning. Planning Practice and Research,9(2),82-89.

33.Gottinger, H.W. (2001) Incentive compatible environmental regulation. Journal of Environmental Management, 63(2), 163-180.

34.Gould, L.C., Gardner, G.T., DeLuca, D.R., Tiemann, A., Doob, L.W., Stolwijk, J.A.J. (1988) Perceptions of technological risks and benefits, Russell Sage Foundation, New York.

35.Gusman, S. (1983) Slecting participants for a regulatory negotiation. Environmental Impact Assessment Review, 4,195- 202.

36.Jessop, B. (1995) The regulation approach, governance and

post-fordism: alternative perspectives on economic and political change? Economy and Society 24, 307-333.

37.Kennedy, John O. S. (1995) Changes in Optimal Pollution Taxes as Population Increases. Journal of Environmental Economics and Management 28, 19-33.

38.Lidskog Rolf, (1997) From Conflict to Communication ? Public Participation and Critical Communication as Solution to Siting Conflicts in Plinning for Hazardous Waste. Planning Practice & Research, 12(3), 239-249.

39.Milliman, S. R., Prince, R. (1989) Firm Incentives to Promote Technological Change in Pollution Control. Journal of Environmental Economics and Management, 17, 247-265.

40.Robert Lake, (1996) Volunteers, NIMBY, and environmental justice : Dilemmas of democratic practice. Antipode, 28, 160-174.

41.Ruff, L. E. (1981) Federal environmental regulation, in "Case Studies in Regulation: Revolution and Reform". Little Brown, Boston, 235-261.

42.Page, R.T., and Ferejohn, J. (1974) Externalities as commodities: comment. American Economic Review 64(3), 454-459.

43.Petts, J. (1994) Effective waste management: understanding and dealing with public concern. Waste Mangement and Research, 12, 207-222.

44.Slovic, P. (1987) Perception of risk. Science, 280-285.

45.Spulber, D. F. (1985) Effluent regulation and long run optimality. Journal of Environmental Economics and Management 12, 103-116.

46.Spulber, D. F. (1989) Regulation and Markets, MIT Press, Cambridge.

47.Swyngedouw, E. (1997) Neither global nor local:" Glocalization" and the political of scale. In: Cox, K.R. (Ed.), Spaces of Globalization: Reasserting the Power of the Local. New York, Guilford Press, 137-166.

48.Stone, C.N. (1989) Regime Politics: Governing Atlanta 1946-1988. University of Kansas Press, Lawrence, KS.

49.Stone, C.N. (1993) Urban regimes and the capacity to govern: a political economy approach. Journal of Urban Affairs 15, 1-28.

50.Towers, G. (2000) Applying the political geography of scale : Grassroots strategies and environmental justice. Professional Geographer, 52 (1) : 23-36.

51.Weigel, R. H.; Weigel, J. (1978) Environmental concern—the

development of a measure. Environment and Behavior, 3-15.

52. Whyie, A. V., et al. (1980) Environment Risk Assessment. New York. : John Wiley & Sons.

53. Wilson, A. R. (1991) Environment Risk: Identification and Management. Lewis Publishers Inc.

54. Vivian, Jessica M. (1992) Foundamental for Sustainable development: participation, empowerment and local resource management, New York: Routledge, 50-77.

An analysis on the gap between the policy planners's setting and resident's demand

Chunge-Chiang Chen, Yu-Lung Su
Graduate Institute of Environmental Management
Nan Hua University

Abstract

The environmental conflicts among stakeholders on the siting problem of notorious facilities for waste treatments took place very often in the past. As a consequence, it leads to rise-up in social costs. In general, a policy planner (central government) considers all the stakeholder's (regions) interests and determines the social optimality by maximizing the social welfares constituting of all theses regions. In contrast, local residents care about only the interests relating with the local community itself. We present a mathematical model to analyze the policy gap between the policy planner and the local residents. The results of our analysis find that the optimal waste disposal capacity and pollution emission for the policy planner (Q^*, e^*) is greater than local residents demand $(q^\#, e^\#)$. We suggest that the policy gap maybe the cause of environmental conflicts, the model developed in this paper can serve as a guideline for the policy planner to incorporate the stakeholder's perspectives in formulating environmental policies.

Keyword：environment policy, social welfare, waste disposal capacity, conflict

子計畫二：

生產消費與環保之間的永續發展模式分析

論文名稱：

一、More Paper and Less Plastics?

二、The effect of globally environmental trends on environmental strategies

More Paper and Less Plastics?

Miao-Sheng Chen, Chung-Chiang Chen*

Graduate Institute of Environmental Management

Nan Hua University

Abstract

Taiwan's EPA in 2002 implemented a new guideline called the "Plastic Products Restriction Policy", prohibiting some industries to use plastics as packaging materials for the sake of sustainable use of resources. The significant effect resulting from this policy is the substitution of plastic products with paper products. Is this policy beneficial to achieve future sustainability? We attempt to analyze the resource choice between renewable resources and exhaustible resources for production of final products and services in case of exhaustion of natural resources. In this paper we develop a framework to examine the dynamic responsiveness of a socio-economical system in facing a continual depletion of natural resources provided by an environmental system. In this framework the status of an environmental system in terms of carrying capacity is affected by the cumulative impacts caused from human activities, including environmental pollution and resource exploitation. Conversely, it also affects the growth of renewable resources. This framework can serve as a guideline to construct indicators to measure the status of the environmental system and the socio-economical system in order to support a policy planner that formulates

* Corresponding author. Corresponding address: 32, Chung Keng Li, Dalin, Chiayi 622, Taiwan, Nan Hua University, Graduate Institute of Environmental Management. Tel. no.: 05-2427116, Fax no.: 05-2427117, e-mail: ccchen@mail.nhu.edu.tw

an appropriate environmental policy. Based on this framework, we also develop a mathematical model to determine the optimal ratio of resources choice between renewable resources and exhaustible resources.

Keywords: renewable resources, exhaustible resources, carrying capacity, resilience,

1. Introduction

Due to the high increase in human affluence and mass consumption, hazardous waste disposal and solid waste management are perceived as the major resulting problems (Murphy et al., 1995). In Taiwan, municipal solid waste grew from 8,712,600 tons in 1996 to 8,951,400 tons in 1997, a 2.46% growth rate. After 1997, the generation of solid waste declined sharply and fell to 7,600,000 tons by 2002. Among total waste generation, the total consumption of plastics bags was about 105,000 tons and disposable plastic tableware (including styrofoam) was about 43,000 tons in 2001. Taiwan's plastic waste generation per each unit of gross national product is much more than some other countries (please see Table 1).

Table 1. Plastic waste generation per GNP of some countries in 1999
(Unit: gram/USD)

Taiwan	S. Korea	Japan	U.S.A.	England	France	Germany
5.9	5.0	1.2	1.9	1.9	2.1	0.5

(Source: Taiwan EPA, The Purpose of Promotion for the Restricted Use Policy on Plastic Shopping Bags & Disposal Plastic Tableware)

Taiwan's EPA (2003) has claimed that, "currently in Taiwan, 50% of waste treatment is done by incineration. In the process of incineration, a lot of plastic wastes, for instance, PVC and PS, will produce dioxin. Plastic waste materials also

generate very high heat value, which will bring adverse impact upon the operation of many incinerators." The future trend indeed shows that foreign countries' regulation on plastic shopping bags to avoid the gradual exhaustion of natural resources is an on-going plan, encouraging Taiwan's EPA to finally implement its "Plastics Products Restriction Policy" on July 1, 2002. Its target is to achieve the elimination of 16,000 tons of disposable plastic tableware (including styrofoam) equivalent to 37% of current consumption, and 20,000 tons of plastic shopping bags equivalent to 31% of the current consumption of 2002 within one year. Even although many plastic bag manufacturers and related industry were strongly opposed to this policy, it still was "implemented on schedule to safeguard a healthy and safe living environment" (Taiwan EPA, EPM 06-01, January 2003). The implementation of this policy forced food suppliers to use paper lunch cartons to replace plastic cartons and department stores to supply paper bags instead of plastic bags.

Final products made of pure paper may technically yield less environmental impacts due to their easy decomposition. However, final products made of 100% paper are not strong enough, and practically they should be a composite with other materials such as Aluminum or plastics. Unfortunately, the composite material is very difficult to recycle or for treatment and may yield higher environmental impacts. Moreover, the externality of renewable resource consumption has been neglected in practice, and it is generally accepted that the depletion of renewable resources may yield the loss of erosion, biodiversity, and industrial pollution. The overuse of agriculture chemicals to kill insects has led to the reduction of biodiversity and pollutes the environment and results in soil erosion. More paper consumption will result in high deforestation and consequently reduce the power to support extinctive birds, which use forests as habitat.

Even if modern production has advanced with a big shift to non-polluting renewable resources, can this be completely sustainable and beneficial to our future? Is the policy of 'more paper and less plastics" good for the environment? This paper seeks to examine the dynamic responsiveness of a socio-economical system in facing the exhaustion of natural resources and analyzes the resource choice for the production of final products between renewable resources and exhaustible resources.

2. The substitution between renewable resources and exhaustible resources

The scarcity of resources in practice has become a serious problem due to a fixed reserve of exhaustible resources and over-consumption. Many economists see resource scarcity as an economical issue and can be solved automatically by a market mechanism. Ecologists themselves are concerned very much about the irreversibility of resource exhaustions and argue that the price system in an economy cannot solve the problem of absolute scarcity (Daly, 1987).

Simon (1996, p. 26) argues, "So price, together with related measures such as cost of production and share of income, is the appropriate operational test of scarcity at any given moment. What matters to us as consumers is how much we have to pay to obtain goods that give us particular services; from our standpoint, it could not matter less how much iron or oil there "really" is in the natural "stockpile". Therefore, to understand the economics of natural resources, it is crucial to understand that the most appropriate economic measure of scarcity is the price of a natural resource compared to some relevant benchmark." If substitution [1] between

[1] Dasgupta (1993) examines the various factors to affect resource substitutability and finds nine innovative mechanisms to determine the substitution possibilities including: (1) an innovation allowing a given resource to be used for a given purpose, (2) the development of new materials, (3) technological developments which increase the productivity of extraction processes, (4) scientific and technical discovery which makes exploration activities cheaper, (5) technological developments that

renewable resources and exhaustible resources are perfectly possible, then the ratio of resource consumption based on the market system should follow

$$\frac{p_1}{p_2} = \frac{y_1'(z_1)}{y_2'(z_2)}, \tag{2.1}$$

where p_1 and p_2 represent the market price of renewable resources and exhaustible resources, respectively; z_1 and z_2 denote the consumption of the two resources; and y_1' and y_2' represent the marginal productivity of the two resources.

Equation (2.1) neglects the inter-temporal equity that most authors recognize as the rights of future generations to have equal opportunities for use to enjoy the life. If the generational externality is considered in the resource consumption, some authors suggest imposing a resource tax on exhaustible resources for mitigation of the generational externality. Equation (2.1) should be modified as

$$\frac{p_1}{p_2 + \tau_2} = \frac{y_1'(z_1)}{y_2'(z_2)}, \tag{2.2}$$

where τ_2 represents the resource tax for exhaustible resources. After a tax imposition on exhaustible resources, the consumption of exhaustible resources will be reduced.

Ecologists see natural resources as being essential to production and will limit human's sustainability due to the entropic process. The working of an entropic process[2] will degrade natural resources and pollute the environment due to a

---

increase efficiency in the use of resources, (6) development of techniques which enable one to exploit low-grade, but abundantly available deposits, (7) constant developments in recycling techniques which lower costs and thus raises effective resource stocks, (8) substitution of low–grade resource reserves for vanishing high-grade deposits, and (9) substitution of fixed manufacturing capital for vanishing resources. However, the possibility of substitution is confined due to production technology limits.

[2] Georgescu-Roegen (1971, 1979) applies the physical concepts of thermodynamic properties to socio-economical systems and emphasizes the constraints of entropy laws to economics. According to the Second Law, the entropy in a closed system will increase through a working process. Daly (1986, p. 321) argues, "... entropy is a physical law, like gravity, and entropic constraints (depletion and pollution) are objective facts evident in the present, not value judgments, and not speculation about

continuous and irreversible property of order into chaos. When pollution exceeds an uncertain limit due to overconsumption, an environmental catastrophe may occur (Cropper, 1976). The extraction of natural resources tends to obey the irreversible process and may result in a permanent reduction of amenities. In the practical world, over-fishing in many countries has led to the depletion of fishery resources and placed high pressures on inshore fisheries (Zann, 1994).

Many researchers argue that the market price system cannot solve the ecological problems even if prices are good at allocating resources efficiently (Howarth and Norgaard, 1990; Norgaard, 1990; Daly, 1991, 1996; Bishop, 1993). Under such a scenario, the pure market system to determine the resource choice may fail to resolve the resource scarcity problem and lead to a system collapse. The analysis on the distribution of resource consumption without considering the limited carrying capacity is not consistent with the future environment. Moreover, there are several factors to limit the growth and supply of renewable resources. These factors will be discussed in Section 3. As to the determination of the optimal resource choice between renewable resources and exhaustible resources, we will construct a framework as a basis for developing a mathematical model to solve this problem in Section 4.

3. The factor to limit the growth of renewable resources

Many researchers have presented many terms like resilience, carrying capacity, assimilative capacity, threshold capacity, etc. to describe the properties of natural systems. These properties overlap in meaning or are not consistent in a logical structure with traditional economical theories (Lozda, 1995; Mirowski, 1989). In

---

future millennia."

this section, we discuss the properties of resilience and carrying capacity and their impacts on the growth of renewable resources.

Resilience can flip from one state to another if the environment system is disturbed or perturbed. In other words, resilience is defined as the magnitude of disturbance that can be absorbed by the system (Holling, 1973) and can be measured by the effectiveness of the reorganization function of the system to balance the destruction from an abrupt change caused by an external disturbance (Holling, 1986) or the speed of a system to return to equilibrium after system perturbation (Pimm, 1984; Walker, 1995). The loss of resilience implies that the system loses its adaptability to environmental shocks and becomes more fragile and vulnerable to external changes. The major factor causing a reduction in resilience stems from the environmental pollution caused by human activities and ecological collapse that arises from over-exploitation of natural resources. The occurrence of environmental catastrophe will occur when pollution exceeds an uncertain limit.

The concept of resilience can be applied to not only the ecological system, but also ecological-economic systems (Common and Perrings, 1992; Levin et al, 1998). However, some researchers criticize that the lack of a generally-accepted resilience measurement blocks its applicability in guiding environmental policies (Orians, 1996; Risser, 1996). In general, most ecologists agree that the maintenance of system resilience is a major aim of environmental policies since it helps achieve sustainability (Common and Perrings, 1992; Arrow et al., 1995; Folke et al., 1996; Levin et al., 1998).

Carrying capacity is defined as the maximum size of the system that can sustain the growth of natural resources without deteriorating the character and quality of the resource. In detail, it involves socio-economical, biophysical, or environmental

concepts. Seidl and Tisdell (1999, p. 403) write that biophysical carrying capacity is defined as "the maximal population size that could be sustained biophysically under given technological capabilities" and social carrying capacity as "the maximum population size that could be sustained under various social systems."

Many researchers conclude that the growth of renewable resources is affected by the current stock of the resources and limited by the carrying capacity of the system in a logistical pattern (Hanley et al., 1997). For example, the growth of forests is function of time in a logistic pattern while the growth of fish stocks is a function of current population. While the stock of renewable resources approaches to the limit of carrying capacity, then overcrowding or congestion may be experienced. The growth of renewable resources is expressed as

$$\frac{dR_1}{dt} = g R_1 (1 - \frac{R_1}{K}), \tag{3.1}$$

where R_1 is the stock of renewable resources, g is the growth coefficient, and K denotes the carrying capacity. Equation (3.1) demonstrates that the growth of renewable resources is significantly affected by the current level of renewable resource stock R_1 and carrying capacity K through the integrity of the ecological processes and services with a human-made production system that consumes a great amount of the natural resource. In the long term the ability of the environmental system to provide renewable resources is limited by carrying capacity K so that the ability to support economic development, based solely on renewable resources, becomes susceptible.

The field experiment studies of Tilman et al. (1996) and Tilman and Downing (1994) find that biodiversity levels play a significant role in affecting plant productivity and resource utilization in a logistic-like curve relationship. Even

though the experiment designs of these studies have been criticized (Huston, 1997; Chapin et al., 1998), the results reveal that the carrying capacity may behave like a logistic function. It implies that the carrying capacity is not fixed and changeable by the external factors. Most research studies presume that the environment is static. Tietenberg (2000, p. 2) argues that, "the environment possesses a unique carrying capacity to support humans. If the capacity is exceeded widespread ecological disruption occurs with disastrous consequences for humanity." However, the environment is dynamically variable and affected by exogenous factors, rather than static ones. "It can thus be concluded that the carrying capacity of a region is neither fixed nor static, but one which changes with time, ..." (Saveriades, 2000).

Carrying capacity is affected by human activities and dependent on management goals, microsystems, and the patterns of human activities (Chen, 2002, Daily and Ehrlich 1992; Shrivastava, 1995; Stankey and Schreyer, 1985). "Carrying capacities in nature are not fixed, static, or simple relations. They are contingent on technology, preferences, and the structures of production and consumption. They are also contingent on the ever-changing state of interactions between the physical and biotic environments. A single number for human carrying capacity would be meaningless because the consequences of human innovation and biological evolution are inherently unknowable" (Arrow et al., 1995, p. 521). Therefore, the carrying capacity K of an environmental system is assumed to increase dynamically depending on technology progress and limited to an upper limit[3] F that will confine the growth of renewable resources and consequently the food availability. The state of carrying

[3] Many theoretical and empirical studies have confirmed the fitness of carrying capacity of an environmental system that will limit the growth and supply of natural resources. Various approaches to determining carrying capacity are analyzed by McLeod (1997) in which he demonstrates the exclusion of complex characteristics and stochastic environmental variables in these models. In the human time scale that is much shorter than the ecological time scale, the ecological changes are much slower and remain stable so that carrying capacity can be determined (Cohen 1995).

capacity behaves as a logistic function and is written as

$$\frac{dK}{dI} = \alpha K(1- \frac{K}{F}), \tag{3.2}$$

where α is a parameter, determined by the effects of human activities I such as pollution and investments, i.e. $\alpha = \alpha(I)$.

Without considering the finite magnitude of carrying capacity and the ecological discontinuity of resilience, the highly exploitation of renewable resources may be beneficial to both future generations and to current ones. Due to the constraints of carrying capacity and resilience in ecological system, unlimited development may result in a permanent destruction of wilderness, the loss of amenity, and our future.

4. A framework for evaluating the impacts of resource consumption

To describe the variability of carrying capacity and resilience and their effects on the growth of renewable resources, we develop a framework as shown in Figure 1. At first, we link the relationship between carrying capacity and resilience. Perrings et al., (1995, p. 8) argue that, "The notions of 'carrying' and 'assimilative' capacity are indirect measures of the level of stress that is consistent with a tolerable level of resilience (what level of resilience is tolerable depends on the severity and frequency of the 'shocks' expected to occur)." It is clear that resilience can affect the adaptive carrying capacity of an environmental system directly. In order to simplify the mathematical model later shown in this section, we assume that resilience is identical to carrying capacity.[4] The environmental system constitutes our life-support system, such as pollination, recycling of biomass, nitrogen fixation, and water purification. An environmental system needs an indicator to measure the current status of carrying

[4] Theoretically, the two terms are distinctively different. Carrying capacity is a continuous variable while resilience is described as a discontinuous variable (sudden change) of a system.

capacity so that it can directly release the related information about the quality of the environment to the public in the socio-economic system. Although the estimates for environmental degradation are very uncertain, the indicator should at least able to reflect the environmental pressure[5] and provide related warning information if the carrying capacity drops suddenly.

Carrying capacity is related to the ability of the environmental system to yield renewable resources to support the maintenance of the environmental system, where the growth of renewable resources is generally modeled as a logistic pattern function with a limit of carrying capacity. Human activities in the socio-economical system mainly focus on production and consumption of final products and services Q, accompanied by waste pollution w_1 and w_2. Thus, the production function is expressed as

$$Q = f(z_1, z_2, w_1, w_2), \tag{4.1}$$

depending on current technologies, where z_1 represents the consumption of renewable resource and z_2 is the consumption of exhaustible resources. Equation (4.1) implies that the pollution will be accompanied inevitably with production. The growth of renewable resource stocks R_1 by modifying (3.1) becomes

$$\frac{dR_1}{dt} = \alpha R_1 (1 - \frac{R_1}{K}) - z_1 \tag{4.2}$$

and the change in the stock of exhaustible resources R_2 is

$$\frac{dR_2}{dt} = - z_2. \tag{4.3}$$

---

[5] Environmental pressure is defined as "pressures exerted by human activities on the environment that have effects on the quality and quantity of natural resources and on the functioning of ecosystems" (Eder and Narodoslawsky, 1999, p. 360).

Through human knowledge and technical skills, both renewable resources and exhaustible resources are seen as essential inputs into a conversion box to produce final products and services[6] to meet humans' demand. In this case, the value of resources is created by humans' ability and needs, not merely by the physical presence of the resources (Rees, 1985, p. 11). An individual's increasing demand for final products and services will lead to an increase in the consumption of materials and energy, and consequently an increase in waste outputs. Production and consumption involving matter conversion may lead to its dissipation and eventually absolute scarcity will increase as human needs increase unlimitedly. Through the production and consumption process in the socio-economical system,[7] environmental pollution w_1 and w_2 arising from the consumption of renewable resource flow z_1 and exhaustible resource flow z_2 respectively occur spontaneously. The change rate of cumulative pollutions is expressed as

$$\frac{dW}{dt} = w_1 + w_2 - \beta W, \tag{4.4}$$

where β is the coefficient of natural decomposition of pollution through the effects of system resilience.

The cumulative effects on the environmental system arise not only from pollution, but also from human activities such as investments in improving environmental quality and the interactions of environmental systems and socio-economical systems in many aspects that yield high effects on the carrying capacity in an additive or synergistic way. In general, these human activities include the progress of knowledge and technology, enhancements of environmental values,

---

[6] Dasgupta and Heal (1979) suggest that natural resources are essential to production. Without the use of natural resources, no goods or services can be produced.

[7] Ayres and Kneese (1969) identify pollution as the residuals from human production activity and consumption process.

etc. Ehrlich et al. (1999) argue that some knowledge[8] does not relate to the quality improvement of the environment and the growth in knowledge does not yield absolutely the positive effect. The appearance of information technology progress speeds up the diffusion of knowledge and makes the knowledge more shared than before. Its impacts on the environmental system may be either positive or negative.

The public's perception of ecological values is another factor to affect environmental impacts through changes on human environmental behaviors. Mueller (1986) defines values as an "enduring belief that a specific mode of conduct or end state of existence is personally or socially preferable to an opposite or converse mode of conduct or end state of existence." Environmental values direct people to express their relationship between humans and the world around us. Hence, environmental values could be either individualistic or collectivist interests (Hofestede and Bond, 1984; Triandis et al., 1990) and play a significant impact on the environmental system. In this case, cumulative effects can be expressed as

$$I = I(W, \textit{knowledge, environmental values, etc.}). \quad (4.5)$$

The cumulative effects, I, yield high impacts on the environmental system's stability and equilibrium, and consequently the carrying capacity and its resilience through the process of Equation (3.2). In this framework, another indicator is equipped with the socio-economical system to measure humans' quality of life while the socio-economical system responds to environmental changes so that human activities like technology progress and humans' environmental attitudes can contribute to the improvements of environmental quality. This indicator reflects the social phenomena in three aspects (economic, environmental, and social trends) and

[8] Ehrlich et al. (1999, p. 268) define knowledge as "accurate information that has been organized and evaluated by a human mind (or minds) and that has shaped actions, beliefs, attitudes, institutions, or mental states (e.g. sense of well being)."

illustrates the links between and among sub-systems. The indicator needs to provide reliable information about the natural, physical, and social world in which we live, and on which our survival and quality of life depend.

Social objectives are practically aimed at improving the quality of life through activities of production and consumption, and the maintenance of the environmental system (Chen and Chen, 1998; Lawn, 1999, 2001) in addition to economic growth (the production and consumption of the socio-economical system Q. Arrow et al., (1995, p. 521) state that "Economic growth is not a panacea for environmental quality; indeed, it is not even the main issue. What matters is the content of growth – the composition of inputs (including environmental resources) and outputs (including waste products)." In this case we assume that the social objective is to seek for the maximization of the current values of consumption and the stocks of all natural resources, i.e. $U = U(Q, R_1, R_2)$. To formulate the mathematical model for solving the problem of resource choice between renewable resources and exhaustible resources, we combine Equations (3.2) and (4.1)-(4.5) to express the problem as

$$
\begin{aligned}
&\underset{z_1, z_2}{Max} \int e^{-rt} U(Q, R_1, R_2)dt \\
&\text{s.t. } Q = f(z_1, z_2, w_1, w_2), \\
&\frac{dR_1}{dt} = g R_1 (1 - \frac{R_1}{K}) - z_1, \quad R_1(0) = \overline{R_1} \\
&\frac{dR_2}{dt} = - z_2, \quad R_2(0) = \overline{R_2} \\
&\frac{dK}{dI} = \alpha(I) K (1 - \frac{K}{F}), \quad K(0) = \overline{K} \\
&\frac{dW}{dt} = w_1 + w_2 - \beta W, \quad W(0) = \overline{W} \\
&I = I(W, \text{knowledge, environmental values, etc.}).
\end{aligned}
\qquad \text{(P1)}
$$

Through the mathematical model of (P1), the optimal ratio between renewable resources and exhaustible resources for the production of final products and services can be determined by numerical approaches if indicators are successfully developed and completed. The mathematical (P1) demonstrates that it is not a linearly relationship between environmental impacts and human activities, neither the growth of renewable resources and carrying capacity of environmental system, nor the quality of life and product consumptions. Solving the problem of (P1) by the mathematical optimization process is a hard job and may fail to obtain the results. We suggest employing a real case study to test the applicability of this model by numerical analysis in the coming future as a further study in which the environmental impacts, the change of carrying capacity, and the quality of life in this case can be illustrated.

5. Applications of this framework

This framework emphasizes the necessity of collaboration between socio-economical systems and environmental systems to solve the problem of resource choice between renewable resources and exhaustible resources for final products and services. Our Common Future (WCED, 1987, p.27) states: "economics and ecology bind us in ever-tightening networks...economics and ecology must be completely integrated in decision-making and lawmaking processes...". This framework of Figure 1 illustrates the distinction among economic, environmental, and social aspects about the current status of the environment, the environmental destruction of resource consumption, and the improvements in the quality of life. The environmental impacts arising from resource degradation or human activities may affect both the current and next generation in economic and environmental activities. The incremental impacts of

development and growth arising from economic development, for either a gradual or sudden change, are mainly dependent on the size of the carrying capacity and resilience of the environmental system. This framework implies that environmental investments on ecological improvement today can provide a better life tomorrow and achieve long-term sustainability. It provides advantages for policy makers to embark upon new policies since the efforts to resolve the ecological problem by separating the environmental system from human activities will fail or result in unsatisfactory conclusions (DeBardeleben, 1985).

Both the environmental system and the socio-economical system in this framework are equipped with each one indicator to state the current status of the two systems. In fact, the effectiveness and validity of the indicators plays an important role in solving environmental problems. A great number of studies in the literature focus on developing sustainable indicators of sustainable development or social welfare (see, for example Castaneda, 1999; Hanley et al., 1999; Pearce and Atkinson, 1993; Moffatt, 1996; Cobb and Cobb, 1994). Moffatt (1996) develops the Environmental Space Methodology (ESM) to measure sustainability by linking up with resource use in any region, which is measured as the relative consumption to the world average use of that resource. The shortcoming of ES is the difficulty in specifying maximum and minimum permissible use rates for resources, carrying capacities, and assimilative capacities (Moffatt, 1996; Hanley, et al., 1999).

Cobb and Cobb (1994) develop the Index of Sustainable Economic Welfare (ISEW) as an indicator of social welfare change in an economy and Aronsson et al. (1997) develop a green NNP to measure sustainable economics welfare. Pearce and Atkinson (1993) propose a concept of weak sustainability based on Hartwick's framework (Hartwick 1990) and develop genuine savings based on flows and stocks

as single indicators of sustainability. Randall and Farmer (1985) and Hanley et al. (1999) present the concept of the minimum necessary conditions needed for sustainable development to be achieved.

This framework provides a theoretical guideline for researchers to construct the indicator to measure the environmental quality or social welfare based on the particular characteristics of the particular region the researcher is focusing on. As the construction of the indicators is based on the integration between the environmental system and socio-economical system covering all peoples' perspectives, the indicator developed will be able to help decision-makers in private or public sectors to assess environmental impacts and economic impacts by linking the economic objectives and environmental objectives in order to assess the progress of sustainability and environmental performance.

6. Conclusions

Hawken (p. 198-199, Guest Essay in Miller, Jr. 1999) argues that, "We have reached a point where the value we do add to our economy is now being outweighed by the value we are removing, not only from future generations in terms of diminished resources, but from ourselves in terms of unlivable cities, deadening jobs, deteriorating health, and rising crime. In biological terms, we have become a parasite and are devouring our host." Considering such a highly distressful environmental condition, the policy on the resource choice between renewable resources and exhaustible resources should be very careful and based on long-term, overall perspectives to obtain the solution. A policy planner must take into account not only the welfare increase arising from a rise in the production level, but also consider society's welfare change due to a change in environmental quality. This

paper contributes to present a mathematical model based on the dynamics and interactions among sub-systems to help the decision-maker decide how much renewable resources should be consumed for final products and services for consumption.

Ecologists suggest that environmental education may be more effective in reducing resources over consumption through an effective scheme of mind reform and social behavior reform (Dierking and Falk, 1985; Orams and Hill, 1998) in order to attain the social objectives when facing resource depletion or to avoid ecological disruption (e.g. Common and Perrings, 1992; Barbier, 1989; Barbier and Markandya, 1990). Environmental education is designed to lead to voluntary cooperation of environmental behaviors and as a seed to reinforce the environmental societal awareness of environmentalism and help the general public to develop their environmental consciousness and manage their daily lives in accordance with the objectives of sustainable development. The connection between environmental education and its effect on the environmental system should be analyzed to support policy making that focuses on the achievement of sustainability. The framework presented in this paper can work as a guide for the future analysis and discussion of the effects of environmental education on sustainability.

Reference

1. Aronsson, T., Johansson, P.O. and Löfgren, K.G., 1997. Welfare Measurement, Sustainability and Green National Accounting. Cheltenham, UK: Edward Elga
2. Arrow, K., Bolin, B., Costanza, R., Dasgupta, P., Folke, C., Holling, C., Jansson, B., Levin, S., Mater, K., Perrings, C., and Pimentel, D., 1995, Economic growth, carrying capacity, and the environment, Science 268, 520-521.

3. Ayres, Robert U., & Kneese, Allen V. 1969, "Production, Consumption and externalities", The American Economic Review, pp. 282-297.
4. Barbier, E.B., 1989. Economics, natural Resources Scarcity and Development: Conventional and Alternative Views. Earthscan, London.
5. Barbier, E.B., and Markandya, A., 1990. The conditions for achieving environmentally sustainable development. European economic Review 34, 659-669.
6. Bishop, R., 1993. Economic efficiency, sustainability, and biodiversity. Ambio 1993, 69–73.
7. Castaneda, B.E., 1999, An index of sustainable economic welfare (ISEW) for Chile, Ecological Economics 28, 231-244.
8. Chapin, F.S., Sala, O., Burke, I., Grime, P., Hooper, D., Lauenroth, W., Lombard, A., Mooney, H., Mosier, A., Naeem, S., Pacala, S., Roy, J., Steffen, W., Tilman, D., 1998. Ecosystem consequences of changing biodiversity. Bioscience 48 (1), 45–52.
9. Chen, C.C., 2002, Can development be truly sustainable? Technology innovation or mental reform. Environment and Ecology 20, 4, 862-872.
10. Chen, M.S. and Chen, C.C., 1998, A theoretical framework linking resource maintenance and environmental protection, Environment and Ecology 16(2), 324-333.
11. Cobb, C., and Cobb, J., 1994, The Green National Product (A proposed index of sustainable economics welfare). University Press of America, New York.
12. Cohen, J.E., 1995a, How many people can the earth support? W.W. Norton & Co., New York.
13. Common, M., and Perrings, C., 1992. Towards an ecological economics of

sustainability, Ecological Economics 6, 7-34.

14. Cropper, M.L., 1976. Regulating activities with catastrophic environmental effects, Journal of Environmental Economics and Management 3, 1–15.
15. Daily, G.C., and Ehrlich, P.R., 1992, Population, sustainability, and Earth's carrying capacity, BioScience 42, 10, 761-771.
16. Daly, H.E., 1986. Thermodynamics and economic concepts as related to resource-use policies: comment, Land Economics 62 (Aug.), 319-322.
17. Daly, H.E., 1987. The economic growth debate. What some economists have learned but many have not. Journal of Environmental economics and Management 14, 4, 323-337.Daly, H., 1991. Steady-State Economics, second ed. Island Press, Washington, DC.
18. Daly, H., 1996. Beyond Growth. Beacon Press, Boston.
19. Dasgupta, P., 1993. natural resources in an age of substitutability. In: Kneese, A.V., and Sweeney, J.L. (eds.), Handbook of Natural Resource and Energy Economics, vol. 3.
20. DeBardeleben, J., 1985. The Environment and Marxism-Leninism: The Soviet and East German Experience. Westview Press, London.
21. Dierking, L.D., and Falk, J.H., 1985, A community based model for environmental innovation, The Third International conference on the nature and teaching of environmental studies in Higher Education, UK: Sunderland Polytechnic.
22. Eder, P. and Narodoslawsky, M., 1999, What environmental pressures are a region's industries responsible for? A method of analysis with descriptive indices and input-output models, Ecological Economics 29, 359-374.
23. Ehrlich, P.R., Wolff, G., Daily, G.C., Hughes, J.B., Daily, S., Dalton, M., and

Goulder, L., 1999, Knowledge and the Environment, Ecological Economics 30, 267-284.

24. Folke, C., Holling, C.S., Perrings, C., 1996. Biological diversity, ecosystems, and the human scale. Ecol. Appl. 6 (4), 1018–1024.
25. Georgescu-Roegen, N., 1971, The entropy law and the economic process, Harvard University Press, Cambridge MA.
26. Georgescu-Roegen, N. 1979, Energy analysis and economic valuation, Southern J. Econom. 45, 1023-1058.
27. Hanley, N., Shogren, J.F., and White, B., 1997. Environmental economics in theory and practice. London: MacMillan Press.
28. Hanley, N., Moffatt, I., Faichney, R., Wilson, M., 1999, Measuring sustainability: a time series of alternative indicators for Scotland, Ecological Economics 28, 55-73.Hartwick, J.M., 1990, Natural resouces, national accounting and economic depreciation, Journal of Public Economics 43, 291-304.
29. Hofstede, G., and Bond, M.H., 1984. Hofstede's culture dimensions: an independent validation using Rokeach's value survey. Journal of Cross-Cultural Psychology 15, 417-433.
30. Holling, C.S., 1973. Resilience and Stability of Ecological Systems. Annual Review of Ecological Systems 4: 1-24.
31. Holling, C.S., 1986. The Resilience of Terrestrial Ecosystems: Local Surprise and Global Change. In W.C. Clark and R.E. Munn, eds. Sustainable Development of the Biosphere. Cambridge, Cambridge University Press.
32. Howarth, R., Norgaard, R., 1990. Intergenerational resource rights, efficiency, and social optimality. Land Econ. 66, 1–11.
33. Huston, M., 1997. Hidden treatment in ecological experiments: re-evaluating the

ecosystem function of biodiversity. Oecologia 110, 449–460.

34. Lawn, P.A., 1999. On Georgescu–Roegen's contribution to ecological economics. Ecological Economics 29, 5–8.

35. Lawn, P.A., 2001. Scale, prices, and biophysical assessments, Ecological Economics 38, 369–382.

36. Levin S.A., Barrett S., Aniyar S., Baumol W., Bliss C., Bolin B., Dasgupta P., Ehrlich P., Folfe C., Gren I.-M., Holling C.S., Jansson A.-M., Jansson B.-O., Martin D., Mäler K.-G., Perrings C. and Sheshinsky E., 1998. Resilience in natural and socioeconomic systems, Environment and Development Economics 3(2):222-234.

37. Lozada, G.A., 1995. Georgescu-Roegen's defense of classical thermodynamics, revisited. Ecological Economics 14, 31-44.

38. McLeod, S.R., 1997, Is the concept of carrying capacity useful in variable environments? OIKOS 79, 592-543.

39. Miller, Jr. G.T., 1999, Environmental Science, 7th edition, Belmont, CA: Wadsworth Publishing.

40. Mirowski, P., 1989. More heat than light: economics as social physics, physics as nature's economics. Cambridge University Press, Cambridge.

41. Moffatt, I., 1996, An evaluation of environmental space as the basis for sustainable Europe, International Journal of Sustainable Development and World ecology (?) 3, 49-69.Mueller, D.J., 1986. Measuring attitudes: a handbook for researchers and practitioners. Teachers College Press, New York.

42. Norgaard, R., 1990. Economic indicators of resource scarcity: a critical essay. J. Environ. Econ. Manage. 19, 19–25.

43. Orams, M. R., and Hill, G.J.E., 1998, Controlling the ecotourist in a wild dolphin

feeding program: is education the answer? The Journal of Environmental Education 29, 3, 33-38.

44. Orians, G., 1996. Economic growth, the environment, and ethics. Ecol. Appl. 6 (1), 26–27.

45. Pearce, D., and Atkinson, G., 1993, Capital theory and the measurement of sustainable development: an indicator of weak sustainability, Ecological Economics, 8, 2, 103-108.

46. Perrings, C.A., Maler, K.G., Folke, C., Holling, C.S., and Jansson, B.O., 1995, Biodiversity conservation: problems and policies, Kluwer Academic Publishers, Dordrecht.

47. Pimm, S., 1984. The complexity and stability of ecosystems. Nature 307, 321–326.Randall, A., Farmer, M.C., 1985, Benefits, costs, and the safe minimum standard of conservation, In: Bromley, D.W., (Ed.), The Handbook of Environmental Economics, Blackwell, Oxford.

48. Rees, J., 1985. Natural resources: allocation, economics and policy. London: Methuen.

49. Risser, P., 1996. Decision-makers must lead in defining some environmental science. Ecol. Appl. 6 (1), 24–26.

50. Saveriades, A., 2000, Establishing the social tourism carrying capacity for the tourist resorts of the east coast of the Republic of Cyprus. Tourism Management 21, 147-156.

51. Seidl, I., Tisdell, C.A., 1999, Carrying capacity reconsidered: from Malthus' population theory to cultural carrying capacity, Ecological Economics 31, 395-408.

52. Simon, J., 1996. The ultimate resources 2, Princeton, NJ: Princeton University

press.

53. Srivastava, P., 1995. The role of corporations in achieving ecological sustainability. Academy of Management Review 20 (4), 936–960.

54. Stankey, G., & Schreyer, R., 1985. Attitudes toward wilderness and factors affecting visitor behaviour: A state of knowledge review. In Proceedings-National Wilderness Research Conference: issues, state-of-knowledge, future directions, 246-293. Ogden: Utah.

55. Tietenberg, T., 2000, Environmental and natural resource economics, Reading MA: Addison-Wesley.

56. Tilman, D., Downing, J.A., 1994. Biodiversity and stability in grasslands. Nature 367, 363–365.

57. Tilman D., Wedin D. and Knops J. 1996. Productivity and sustainability influenced by biodiversity in grassland ecosystems, Nature 379: 718-720.

58. Triandis, H.C., McCusker, C., and Hui, C.H., 1990. Multimethod probes of individualism and collectivism, Journal of Personality and Social Psychology 59, 1006-1020.

59. Walker, B., 1995. Conserving biological diversity through ecosystem resilience. Conserv. Biol. 9 (4), 747–752.

60. WCED (World Commission on Environment and Development), 1987, Our common future, Oxford University Press, Oxford.

61. Zann, L.P., 1994. The status of reefs in South Western Pacific Islands. Marine Pollution Bulletin, 29, 52-61.

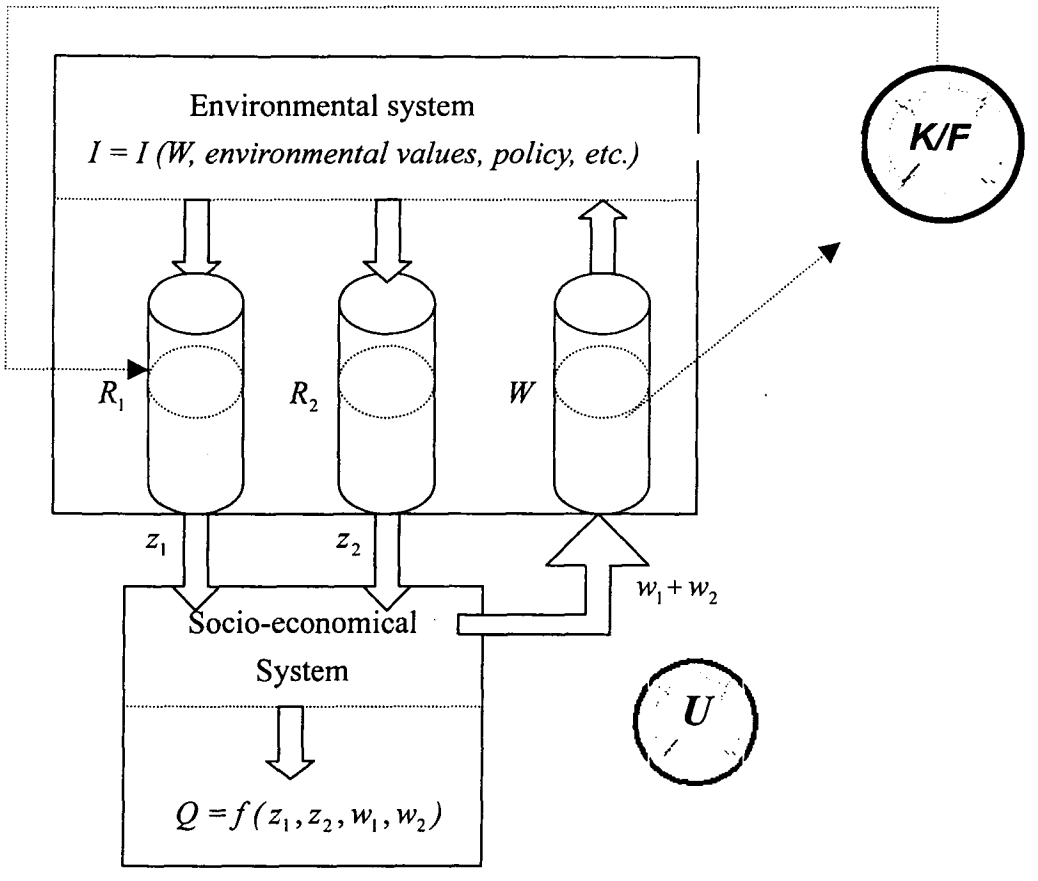


Figure 1. A framework describing the interactions between the exploitation of natural resources, the system's carrying capacity and resilience, and the socio-economical systems, where R_1 represents the stock of renewable resources, R_2 is the stock of exhaustible resources, W denotes the stock of environmental pollution arising from human activities, K is carrying capacity, F is the upper limit of carrying capacity, G is resilience, and U represents the quality of life from the social objectives, the functioning of consumption of final products and services Q, environmental quality (environmental pollution) W, and the stocks of natural resources (R_1 and R_2).

Direct influence

Indirect influence

Material feeding line

The effect of globally environmental trends on environmental strategies

Miao-Sheng Chen, Chung-Chiang Chen*

Graduate Institute of Environmental Management

Nan Hua University

Abstract

Based on a case study by interviewing three industrial firms, this paper attempts to examine the factors to affect the large firm's choices of environmental strategies, to analyze the ingredients of the environmental strategies, to characterize the principal types of environmental strategies, and to assess their strengths and weaknesses of each type of environmental strategies as approaches for achieving sustainability. We suggest that an environmental strategy compromises two elements: social responsibility and environmental performance. Based on the two elements, environmental strategies are categorized into proactive strategies, reactive strategies and escaping strategies. The findings suggest that (1) the external factors such as globally environmental trends play a very important role in affecting the choice of

* Corresponding author. Corresponding address: 32, Chung Keng Li, Dalin, Chiayi 622, Taiwan, Nan Hua University, Graduate Institute of Environmental Management. Tel. no.: 05-2427116 Fax no.:05-2427117, e-mail: ccchen@mail.nhu.edu.tw

environmental strategies for large firms in developing countries, (2) external pressures play as the major role in determining the choice of environmental strategies, and (3) social responsibility is adopted as a major force to form environmental strategies only when the firm can survive.

Keywords: environmental trends, environmental strategies, environmental performance, green purchasing.

1. Introduction

The industrial revolution has changed the relationship between humanity and nature and resulted in an enormous and irreversible environmental deterioration. The rapid growth of production and consumption of food, fiber, biological and industrial products were substantially increasing the use of production resources to increase output and creating undesirable environmental side effects (Jordan, 1995; Miller, Jr. 1999; Chen and Chen, 1998). Many authors argue that the high throughput of ecosystem has lead to destroy the ecosystem and exhaust largely natural resource (Miller, Jr., 1999). Therefore, a great number of environmental problems such as

resources exhaustion, ozone layer depletion, transboundary acid deposition, warming effects and the rapid extinction of plant and animal species[1] have attracted attention (Hoffman, 2000), but we have not developed really effective method to cure it. The environmental problems have awaked the public to concern about the recovery of the ecological system and human's survival (Hoffman, 2000). Many international agreements were signed to prevent the aggravation of environmental deterioration and to pressure the governments to accept and perform. For example, the high gas emission beyond the earth's carrying capacity has altered the global climate. An increase in the average temperature of the earth's surface and the change of worldwide weather patterns would generate a risk to our future life. Kyoto Protocol is the common agreements among countries through a series of negotiation and consideration to resolve the problem of warming effects, but we still cannot expect an optimistic result. Its objective is to prevent the increase in greenhouse gases emissions and reduce greenhouse gas concentrations in the atmosphere at an allowable level that are not dangerous to the climate system.

Researchers suggest using clean technology to develop new processes or

[1] The major environmental trends include (1) global energy consumption has increased 70% since 1971 and is projected to increase at more than 2% annually over the next 15 years, (2) depletion of ozone layer requires another 50 years to return back to normal levels even though the consumption of ozone-depleting substance has been under controlled, (3) Acid rain is on the decline in many developed countries but it is on the rise in many developing countries, (4) almost 20% of tropical forests in the world has been cleared since 1960 and deforestation shows no sign of abating, and (5) some statistics indicates that about 20% of all endangered species are threatened due to reduction in habitats (World Resource Institute, 1998).

re-design new products to substitute the old one as an effective way to solve these problems since it prevents the pollution generation at source. Currently, many international firms have started encouraging, guiding or even forcing their suppliers to form a green supply chain with the adoption of clean production. However, clean production may affect the corporate performance and its competitiveness in the world market. A substantial number of literature focus on the connection between the financial performance and environmental performance (Klassen and McLaughin, 1996; Hart and Ahuja, 1996; Cordiero and Sarkis, 1997; Klassen and Whybark, 1999; Hanna *et al.*, 2000) and recognize the positive relationships by empirical studies (see, for example, Klassen and McLaughlin, 1996; Russo and Fouts, 1997), or study the environmental problem in service operations management (Hasek, 1997; Godfrey, 1998; Sarkis, 1999; Foster et al., 2000), or examine the effects of environmental purchasing on environmental performance (Min and Galle, 1997; Carter and Carter, 1998; Carter and Ellram, 1998; Carter, et al., 1998; Carter, 2000; Carter et al., 2000), or investigate the impact of environmental management on the competitive strategies (e.g. Gupta and Sharma, 1996; Klassen and Angell, 1998). Many researchers believe that the environmental sustainability and ecological performance of a company may depend on financial performance and competitive advantages and suggest that a firm's social responsibility plays an important factor to support

sustainability of an ecological system (Hawken, 1993; Hart, 1995; Shrivastava, 1995b; Stanwick and Stanwick, 1998; Nash, 2000).

In practice, environmental issues have been considered as an important factor to affect a firm's global business strategies as well as environmental strategies that may offer both environmental and manufacturing performance benefits. As a member of the global village, the firms need to conform their environmental strategies to the challenges of global trends to satisfy the need for a modern, competitive, efficient, responsive and socially responsible firm. In Taiwan, some few large firms are serving as members of the international supply chain or keep close contact with global markets while most firms are small-to-medium size and exert their efforts to domestic markets. In this case, the globally environmental trends may become an important focus to affect the large firms' environmental strategies. In this paper, we attempt to find out (1) how environmental strategies are formulated for large firms in development countries, (2) what pressures affect these firms to formulate their environmental strategies, (3)how environmental trends affect the formulation of environmental strategies, and (4) what type of environmental strategies they adopt.

2. Methodology

We select three firms as the target objects for comparison: the first is a shoe

supplier (called F Corp.) in an international supply chain, the second is a public enterprise of wine production (called G Corp.) and the third is a pickled food producer (called A Corp.). The results of the case study are intended to provide a practical example of analysis on environmental strategies under a practical influence of environmental trends. Therefore, there are two criteria for sampling:

(1) Firm size: large firms care more about globally environmental trend and keep close linking with international business.

(2) Headquarters must be in Taiwan so that we can make a face-to-face interview with the interviewee who takes responsibilities for formulations of environmental strategies.

Table 1 describes the history and profile of the three companies for study. F Corp. is licensed to manufacture sports shoes and supervised by world-class firms, mainly contracted with Nike. Through standardization of global products to reduce operation cost, it successfully finds out a survival strategy with these international contractors to make a win-win strategy, and becomes a steadily continuous supplier to these firms. G Corp. is a public enterprise and has been monopolized to produce wines for over 40 years. The monopoly status will be terminated within two years due to privatization policy. We interview one of its factories for production of rice winery. A Corp. is a declining firm and suffering from two sides: (1) the taste changes

on pickled food of new-generation consumers lead to the continuous decline in sales, and (2) the more stringent requirements from the society on environmental regulations and implementations. In order to avoid the cost increase in complying environmental regulations, the most polluted process in pickled food production was moved to Vietnam in 1995.

Table 1 Basic data of the three firms

Firms	F corp.	G Corp.		A Corp.
Headquarter	Taiwan	Taiwan		Taiwan
Ownership	Private	Public		Private
Products	Shoes	Wines		Pickled foods
Number of factory	16	20		3
Local:	2	20		1
Overseas:	14	0		2
Capital (billion NTD)	3.4*	47.0		3.3
Founded in	1971	1945	1987#	1971
Turnover (billion NTD)	17.0	60	3.5#	3.2
Local:	8.4	60		3.2
Overseas	8.6	0		Not available
Employee	1715*	8600	436#	1200

* The indicated amount excludes overseas factories.
# represents the interviewed factory of G Corp.

All of these three firms are to some extent in facing new challenges with the entry of WTO, especially G Corp. and A Corp. who must face the competition of imported winery and pickled food. During interviewing, these firms allowed the researchers to observe their operations on environmental treatment system and also provided appropriate documentation as supporting evidence of environmental strategies. The

purpose of the interviews was to gather data from respondents representing the manufacturers in developing countries in formulating environmental strategies as basis to identify (and compare) how these firms formulated their environmental strategies and the ingredients of the environmental strategies. A series of semi-structured interviews were conducted with representatives of each firm who are responsible for the implementation of environmental management system. The main issues covered during the interviews includes: (1) the implemented environmental management system; (2) the difficulty in implementing environmental management system; (3) the formulation process of environmental strategies; (4) the factors (the source of pressure) to formulate the environmental strategies; (5) benefits and limitations of implementing environmental management systems, and (6) the effects of operation management on environmental strategies.

3. Results and discussions

The formulation process of environmental strategy covers a large set of management decisions, technologies and conflicting resolution among departments in each firm. These firms need to take a trade-off from the consideration of business profit seeking and environmental performance improvements. The in-depth survey finds that the preliminary environmental strategies are presented by the

middle-manager who implements environmental management system and takes responsibilities for environmental performance, and then approved by top-management. In a traditional management system, the top-down approach to formulate strategies among different levels in a firm is adopted (Skinner, 1985; Garvin, 1993). The choice of environmental policies in F Corp. depends on the total interaction across different departments. This implies that the objective to formulate environmental strategies in F Corp. depends not only the environmental concerns but also business survival and this process requires the skills and judgments to review the environmental threats and opportunities. In contrast, the environmental strategies of both G Corp. and A. Corp. are determined by top managements only without detailed discussions.

The statements of corporate objectives and environmental policies claimed in the provided documents are summarized in Table 2. F Corp. attempts to balance the objectives of business profit and ecological sustainability. However, if the two objectives contradict, the basic goal of business must remain economic growth (Schmidheiny, 1992). The other two firms care about the increasing cost of abatements and reduce the overall performance[2]. Thus, they place their environmental

[2] Some literature has investigated the relationship between business performance end environmental performance (Klassen and McLaughin, 1996; Hart and Ahuja, 1996; Cordiero and Sarkis, 1997), but the results are conflicting (Klassen and McLaughin, 1996; Cordiero and Sarkis, 1997).

strategies at the minimum standards to comply with statutory regulations.

Table 2 statements of corporate objectives and environmental policies

Firms	Corporate objectives	Environmental polices
F Corp.	For reasonable profit For comfortable living For everlasting	To minimize environmental impacts by the strategies of reduction, reuse and recycling. Not only to comply with environmental regulations, but also to adopt clean production technology.
G Corp.	To maximize profit and increase customer satisfaction	To comply with environmental regulations To reduce pollution emissions To increase energy efficiency
A. Corp.	To develop and market excellent products To grow	To meet environmental regulations

Environmental strategy is seen as a secondary objective according to our survey with these firms and cannot be considered independently from the other operations objectives. Environmental strategies and operations objectives are mutually dependent and supportive of each other. The integration can build up a means of environmentally and competitively continuing improvements so that it may lead to synergies. The survey finds that social responsibility is employed only when it can improve corporate image and enhance green marketing.

3.1 Source of pressure and environmental strategies

Many factors such as legislation, stakeholder pressure, economic opportunities and ethical motives have led to firms applying environmental strategies (Bansal and

Roth, 2000). Through our in-depth interview, we conclude that the source of pressure to improve environmental management stems from (1) self-regulations (social responsibility), (2) the buyer's products regulations, (3) the customer's requests (the pressures from environmental groups), and (4) international trends and statutory regulations.

(1) F Corp. claims in his statement of corporate objectives and environmental policies that sustainable development is a way to survive and grow. The management believes the investments on improving environment can be returned in a long term. Many authors emphasize the goal of sustainability requires the total participation of all stakeholders with a shared value of environmental responsibility (Schmidheiny, 1992; Klassen, 1993; Shrivastava, 1995b) in which the corporate role in improving environmental degradation is particularly important (Hawken, 1993; Shrivastava, 1995b) since firms can allocate their resources in a efficient way to find ecological solutions for environmental problems (Schmidheiny, 1992). The other two firms face a more stringent challenge than ever before after Taiwan's entry of WTO so that survival is their utmost objective and care about more on financial performance and less on environmental performance.

(2) In the meantime, F Corp. must perform its environmental strategies in conform with the buyer's standard in addition to compliance with statutory regulations. It

needs to discuss and negotiate with international buyers about the generally accepted principles of environmental standards in linking with trade within the world trade systems. Thus, the focus of globally environmental trends becomes a general principle that open domestic markets and open global trading systems. As their loose contact with international markets in the past, the other two firms almost neglect the impacts of environmental trends within the global village.

(3) An environmental institution, in general, plays as a warning system to educate the public, to supervise the producer's production, to lobby the government for a cleaner policy formulation and to force the firms to improve environmental performance (Chen, 2000). In fact, an environmental institution should be actively engaged in partnerships with the neighboring community, interest groups, and other external constituents (Chen, 2000; Dean & Bowen, 1994; Flynn et al., 1994; Hackman & Wageman, 1995; Saraph et al., 1989). Through the continuously environmental education, the consumers commit to exert their efforts to reduce environmental deterioration and enhance natural conservation by giving an effective pressure on the large firms to take the lead in developing clean technology and improving environmental management to reduce the adverse impacts of industrial production. All the three firms acknowledged that they sensitively pay attention to the environmental programs provided by environmental institutions.

(4) When global environmental problems are widely recognized as serious and high risky issues and focused by the public, governmental regulations have become a basis and minimum requirement to resolve these problems and to motivate the producer to alleviate these problems. All the three firms have complied the governmental regulations even though A Corp. claims the complying cost had reduced their competitiveness in the markets.

4. Social responsibility and environmental strategies

Many authors highlights that social responsibilities should be seen as an important corporate duty (e.g. Arlow and Gannon 1982; McGuire et al., 1988) and has become a major factor to affect environmental strategies and emerges as a process of addressing environmental issues. Corporate managers need to take responsibility to all their stakeholders that is defined as those groups that can affect or are affected by organizations (Freeman, 1984; Bowie, 1991; Banerjee, 2001) and to accept sustainability as the top objective and integrate their operations activities with environmental requirements (Schmidheiny, 1992; Porter and van der Linde, 1995). Environmental responsibility is, in general, to be considered as an important criterion to develop a clear environmental strategy. In the previous sections, we have examined the environmental policies adopted by these firms and analyzed the source of pressure

for environmental improvements. In this paper we employ the corporate objectives and written environmental policies, the source of pressures and level of environmental department in implementing environmental strategies as a measure to evaluate corporate social responsibility that is depicted in Fig. 1.

Indicator of social responsibility
1. Corporate objectives and environmental policies 2. Sources of pressures to improve environmental performance 3. Level of environmental department in implementing environmental strategies

Fig. 1 the ingredients of social responsibility

The level of environmental department involving with environmental implementations within the firm is an indicator to show the efforts that the firm adopts social responsibility as a criterion to formulate environmental strategies. Our survey finds that the environmental departments of the three firms are supervised by their presidents and should be responsible for the operations of environmental management, workers safety and health, and environmental sanitization. The survey finds that F Corp. employs 4 engineers (1 master plus 3 bachelors) to be in charge of environmental implementation end working securities. G Corp. employs 3 engineers for engineering improvements and environmental management under supervision of

the factory manager. One staff in A Corp. takes care of everything to support the operations of environmental management, working securities, quality control, and production control. All the three firms attempt to integrate environmental strategies with operation managements to reduce operating costs, to increase employee morale and involvement, to improve company image and customer satisfaction (Guimaraes and Liska, 1995; Shrivastava, 1995a).

5. Environmental performance and environmental strategies

Practically, environmental performance is difficult to measure and understood to minimize the negative impacts on the natural environment that is accompanied from production process or stemmed from consumptive behaviors (Chen and Chen, 1998). Some authors suggest waste generation as a measure to compare the environmental performance among firms (James, 1994), or to employ ecoefficiency, total quality or risk analysis as effective tools to measure improvements of environmental performance (Roome, 1997). The evaluation of environmental performance can link with the daily operation in a firm with the measurement of the impact on the environment as a result of the activities. In this paper, we suggest that environmental performance indicators include implementation of environmental management system, practice of green purchasing, development of clean production technology, corporate

report to the public, waste emissions and treatments, and operations of environmental strategies. The responded data about daily operation activities to judge environmental performance among the three firms are summarized in Table 2.

(1) ISO 14000 is a series of guidelines or process to help the firm to assure the process of environmental management. The certification of ISO 14001 does not assure the fulfillment of environmental obligaiton. However, it is believed to increase assurance regarding compliance with environmental regulations and to enhance competitive advantage in the local and international markets (Casicio et al., 1996; Sayre, 1996; Lamprecht, 1997; Lord, 1997). In general, the certification of ISO 14000 can be seen as a partial indicator of environmental performance. F Corp. and G Corp. have got the certification of ISO 14000 since 2001 while A Corp. still neglected the important trend to exert environmental management systems.

(2) Green purchasing has already attracted the public's attention for mitigating environmental impacts and improving environmental performance, and thus purchasing behaviors are seen as an effective measure for environmental performance (Apaiwongse, 1991, 1994; Drumwright, 1992, 1994; Langrehr et al., 1992). F. Corp. is pressured by its buyers to engage in green purchasing while the other two firms never consider using their power of purchasing policies to influence their suppliers to become greener without the regulatory pressures or customer's pressures. According

to Sarkis (1999), the supply chain system integrating with daily operations enables organizations to move towards waste minimization and improving environmental performance. A firm like F Corp. has complied with the buyer's environmental standards and adjusted itself to meet the environmental trend of more stringent requirements in the future through improving operation managements.

(3) Ehrlich et. al., (1999, p. 270) propose that technology level and human's affluence account for the major environmental impact at a given population size. Montague argues (quoted from Miller, 1999, p. 69) "To deal with these [environmental] problems, industrial societies must abandon their reliance upon waste treatment and disposal and upon the regulatory system of numerical standards created to manage the damage that results from relying on waste disposal instead of waste prevention. We must – relatively quickly – move the industrialized and industrializing countries to new technical approaches accompanied by new industrial goals –namely, "clean production" or zero discharge systems". Clean production can lead to progress in reducing production waste and resource consumption per capita and increasing efficiency, and is seen as a measure of environmental performance. F Corp. and G Corp. integrate their products designs and process improvements with environmental technology improvements. F Corp. joined the team that comprises the buyer and the material suppliers to develop new substitutes with a target time

schedule. The gains are shared by all the partners and serve as a driving force to push the three actors to cooperate closely. Through the appropriate management, a synergy is developed in the supply chain and the so-called win-win-win situation has arisen, where there is an improvement in environmental performance, business performance and the 'family-sense' of the supply chain (Elkington, 1994; Florida, 1996; Maslennikova and Foley, 2000). In fact, the development of environmental improvement activities and programmers can bring about the operations and product quality improvements (Godfrey, 1998; Sarkis, 1995, 1999; Inman, 1999).

In contrast, the factory itself in G Corp. implements the technology development on either products quality or environmental improvements without integrating with its suppliers so that the motivation of clean technology on G Corp is not so strong as F Corp from our survey. The success in clean production development in F Corp. implies that it is an effective way to develop clean technology by integrating with productive operations (Shrivastava, 1995a). In fact, product and process technologies can improve both financial performance and environmental performance. It involves with the environment-related issues and workers' health and safety, ecological risk, materials efficiency, waste generated and disposal treatment (Sarkis, 1995).

Without information about globally environmental trend, A Corp expressed little concerns and interest in improving environmental performance, and thus it did not

attempt to develop newly green substitutes for food packaging without appropriate incentives from governments even green packaging is seen as key to resource sustainability and avoiding using up new resources. (Kassaye, 2001, p. 444).

(4) The environmental reports attempt to make sense of the environmental information release to the public inducing the interest groups about emission, waste and recycling activity. Many international firms have started to issue an environmental report annually to the public in which the major events or investment involving environmental decision are listed. Through our survey, the three firms have not yet presented their environmental report to the public.

(5) Theoretically, waste generation is determined by the process and operations management. Even though many authors emphasize that waste treatment is only a way 'end of pipe' treatment and thus preventive methods should be adopted, the modes of waste treatment is still used as a measure to judge environmental performance. F Corp and G Corp. completely meet the environmental regulations to treat the waste emissions. In contrast, A Corp. re-considers the production process of pickled food and divides the process into 'less polluted' and 'seriously polluted' one. To reduce abatement costs, the production of 'seriously polluted' process was moved to Vietnam. The bottling of pickled food was handled in Taiwan.

Table 2 Results of in-depth survey

	F Corp.	G Corp.	A Corp.
Certification of ISO 14000	F Corp. already got the certification in 2001 under the buyer's request.	G Corp. got the certification in 2001.	No
Green purchasing	Yes. However, the material specifications, material restriction lists and vendor lists were provided by the buyer.	No.	No
Clean production technology	Directed and guided by the buyer, the firm successfully developed newly substitutes for high polluted solvents with chemical and material suppliers.	The engineers in the environmental department have tried to develop new process for energy-saving without support from top management, but outcome is not satisfactory.	No
Corporate report to the public	No.	No.	No
Waste treatments	The scraps are recycled with extra cost. All wastes are handled by its own facilities to meet environmental regulations.	Used PET bottles are recycled due to governmental regulations and all pollution emissions meet environmental regulations.	No recycling. All wastes are treated by contractors.
Operations of environmental strategies	It integrates with working safety and environmental sanitization.	It integrates with engineering design and working safety.	It integrates with working safety, quality control and environmental sanitization.

(6) The role of environmental strategies in linking with manufacturers' operations and the factor to affect the choice of strategies must be analyzed (Vickery *et al.*, 1993). The effects of production technologies on environmental strategies and performance are necessary to reveal the factor of the firm's motives to perform environmental strategies. Operations management is an effective way to accomplish environmental sustainability through the implementation of targeted value of environmental performance. Firms are challenged by the integration of environmental considerations into their production and marketing plans due to international regulations and competitive pressures (Hawken, 1993) and need to revise their traditional strategies in the industrialized countries in response to these pressures (Stigson, 1998). The integration between environmental strategies and operations managements can obtain several benefits associated with the reduction of the firm's impact on the environment.

6. Proactive strategies and Reactive strategies

Strategy is a set of decision-making rules to allocate resources efficiently, "concerned with identifying opportunities for successful and effective activities. These come either from the capabilities and expertise of the organization, from the actuarial and potential market demand, or form a combination of both" (Cramer 2000, p. 39). Environmental strategy must cover the decision making process and the

planning to allocate the scarce resources in order to reach the targets and achieve greater good when it extends its perspective beyond the objective of particular objectives and takes into account the effects of the strategy on the development and future trend of nature. Hart (1995) has identified three environmental strategies including pollution prevention, product stewardship and sustainable development. He points out that the choice of environmental strategic is ordinal and logic. Without pollution prevention, a product stewardship strategy can hardly be adopted. Eventually, sustainable development cannot be achieved without prior proof of product stewardship competence.

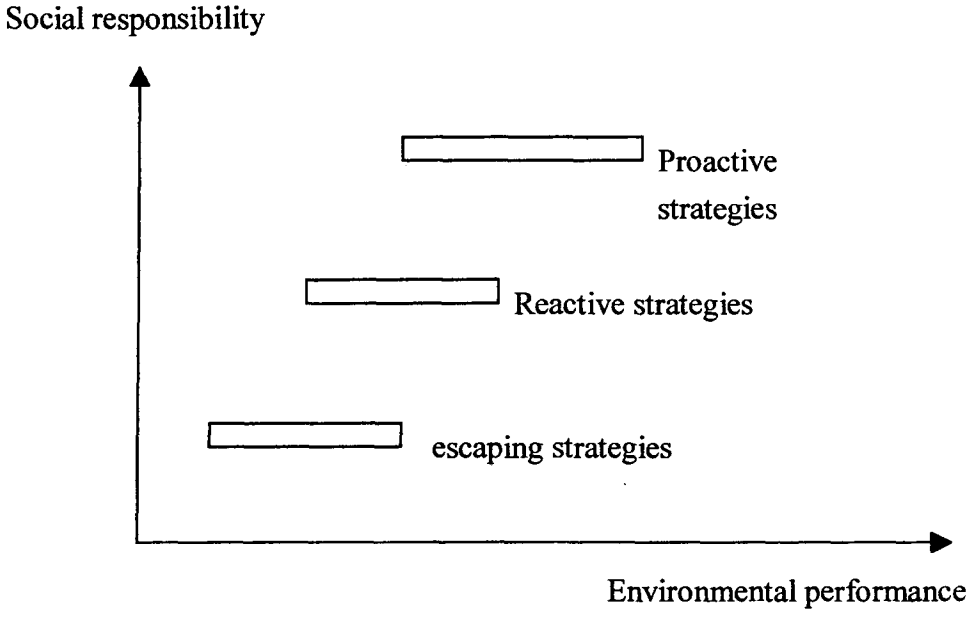


Fig. 2 the classification of environmental strategies based on social responsibilities and environmental performance.

In this article, we propose that the social responsibility and environmental

performance forms a framework to describe the core values of environmental strategies. We classify environmental strategies into three types based on social responsibility and environmental performance and depict it in Fig. 2.

Proactive strategy: Environmental performance is believed to be more important than business performance or at least the same. Social responsibility drives the firms to take the measure of environmental management practice beyond environmental regulations. The top management devotes sufficient resources on environmental management as well as its employee across all levels by providing information to aware their environmental concerns. Top managements commit to invest resources on environmental protection and improve environmental performance through technology innovation to develop new process or new products in an environmentally sound and safe manner to avoid potential accidents. The diversity of business increases so that environmental management strategy becomes more divergent and active. In Fig. 2, environmental performance is not a sufficient condition but a necessary condition to be categorized as proactive strategy.

Reactive strategy: Environmental performance is not so important as business performance. Social responsibility is mentioned only when the firm can survive and be profitable. The firm's policy is to comply with all applicable laws. Compliance with governmental regulation is enough and any investments on environmental

improvements without economic returns will be given up. The firm believes that resources allocated to environmental protection will yield cost increase and harm business performance.

Escaping strategies: Social responsibilities cannot affect the firm's decision on environmental investment and yields no pressures on the improvements of environmental performance. Economic return is the only basis for the firm to choose environmental strategies. Any specific proposal within the firms to improve efficiencies in production or abatement will be decided based on cost-effectiveness analysis to find out a solution in facing environmental challenges. The concept of social responsibility is lay aside and only works for reference.

According to the category developed in this paper, F Corp. is relatively more proactive, while G Corp. chooses reactive strategies and A Corp. employs escaping strategies. As a member of supply chain, F Corp. received up-to-dated information about environmental trends, pressured by the international buyer to comply with buyer's standard and supported to undertake environmental certification, to develop cleaner technology and engage in product design for environment and process innovation. Both G Corp. and A Corp. focused on domestic markets and neglected the importance of the effects of environmental trends on competitiveness in the past. What they can do currently is to be responsive quickly to the changing markets

quickly to survive. Although A Corp. expressed less interest in improvements of environmental performance, it still cannot escape from the liability of providing non-green consumer products in the market. Therefore, A Corp. moves its production facilities with high-polluted units to abroad to reduce environmental costs.

6. Conclusions

In the proposed model in Fig. 1 two core elements of environmental strategies: social responsibility and environmental performance forms the core values of environmental strategies. Through our analysis, keeping contact with globally environmental trends can keep the firm going proactively. The interaction between the firm and global markets is major force to affect the management on the choice of environmental strategies. The impacts of environmental trends serve as a major source to result pressure for corporate change to initiate a number of responses ranging from voluntary action to complying with regulations.

High environmental performance may be an indicator of proactive strategies, but does not assure proactivism. The driving force of environmental implementations is the major criterion to judge the types of environmental strategies. A firm with self-regulation to perform environmental strategies is more environmentally responsible. In Taiwan, most firms still prefer to adopt reactive environmental

strategies by promoting industrial waste minimization with aims of cost-down. Environmental activities involving with proactive strategies in Taiwan are still dimming, and are taking place slowly. In sum, the results of this study indicate that the level of involvement with global environmental trends affects the firms to support the implementation of a proactive environmental strategy. While previous studies in this area have often focused on the influence of external factors on the choice of environmental strategies, this study suggests that the survival is more important than environmental responsibility to affect the firm's decision. In brief, the firms may choose higher-level strategies only when it can survive. The external pressures still plays a very important role in affecting the choice of environmental strategies for large firms in developing countries in developing countries.

Reference

1. Apaiwongse, T.S., 1991. Factors affecting attitudes among buying center members towards adoption of an ecologically related regulatory alternative: a new application of organizational theory to a public policy issue. Journal of Public Policy and Marketing 10, 2, 145-160.
2. Apaiwongse, T.S., 1994. The influence of green policies on a dual marketing center. Journal of Business and industrial Marketing 9, 2, 41-50.

3. Arlow , P., and Gannon , M.J., 1982. Social Responsiveness, Corporate Structure and Economic Performance, Academy of Management Review, 7, 1, 235-241.

4. Banerjee, S.B., 2001. Managerial perceptions of corporate environmentalism: interpretations from industry and strategic implications for organizations, Journal of Management Studies 38, 4, 489-513.

5. Bowie, N., 1991. New directions in corporate social respnsibo97t, Business Horizons 34, 4, 56-65.

6. Carter, C.R., 2000, Ethical issues in international buyer–supplier relationships: a dyadic examination. Journal of Operations Management 18, 191–208.

7. Carter, C.R., and Carter, J.R., 1998. Inter-organizational determinants of environmental purchasing: initial evidence from the consumer products industries, Decision Sciences 29, 3, 659-684.

8. Carter, C., and Ellram, L., 1998. Reverse logistics: a review of the literature and framework for future investigation. Journal of Business Logistics, 19, 1, 85-102.

9. Carter, C.R., Kale, R., and Grimm, C.M., 2000, Environmental purchasing and firm performance: an empirical investigation, Transportation Research Part E 36, 219-228.

10. Carter, C.R., Ellram, L.M., and Ready, K.J., 1998. Environmental purchasing: Benchmarking our German Counterparts, International Journal of Purchasing and

Materials management, 34, 4 , 28-38.

11. Casicio, J., Woodside, G. & Mitchell, P., 1996. ISO 1400 Guide: the new international environmental management standards, New York: McGraw-Hill.

12. Chen, C.C., 2000, Role of Environmental Institution as a warning system in pollution control: awareness of environment, Environment and Ecology, 18, 1, 181-191.

13. Chen, M.S., and Chen, C.C., 1998. A theoretical framework linking resource maintenance and environmental protection, Environment and Ecology 16(2), 324-333.

14. Cordeiro, J. and Sarkis, J., 1997. Environmental proactism and firm performance: evidence from security analyst forecasts, Business Strategy and Environment, 6, 2, 104-14.

15. Cramer, J., 2000. Responsiveness of industry to eco-efficiency improvements in the product chain: the case of Akzo Nobel. Business Strategy and the Environment 9, 36-48.

16. Dean, J. W., Jr., & Bowen, D. E., 1994. Management theory and total quality: Improving research and practice through theory development. Academy of Management Review, 19: 392-418.

17. Drumwright, M.E., 1992. Socially responsible organizational buying. Marketing

Science Institute, Boston, MA.

18. Drumwright, M.E., 1994. Socially responsible organizational buying: environmental concern as a noneconomic buying criterion. Journal of Marketing 58, 3, 1-19.

19. Ehrlich, I. and Lui, F., 1999. Bureaucratic corruption and endogeneous economic growth. Journal of Political Economy 107, 270–293.

20. Elkington, J., 1994. Towards the sustainable corporation: win-win-win business strategies for sustainable development, California Management Review, 36, 2, 90-100.

21. Florida, R. (1996), ``Lean and green: the move to environmentally conscious manufacturing'', California Management Review, Vol. 39 No. 1, pp. 80-105.

22. Flynn, L. 1995. Asphalt rubber recycling? State tests will shed light. Resource Recycling, April, 69–74.

23. Foster, S.T., Sampson, S.E. and Dunn, S.C., 2000, The impact of customer contact on environmental initiatives for service firms, International Journal of Operations and Production Management, 20, 2, 187-203.

24. Freeman, R.E., 1984. Strategic management: a stakeholder approach. Marshfield: Pitman.

25. Garvin, D.A., 1993. Manufacturing strategic planning, California Management

Review, 35, 4, 85-106.

26. Godfrey, R., 1998. Ethical purchasing: developing the supply chain beyond environment, in Russel, T. (Ed.), Greener Purchasing: Opportunities and Innovations, Greanleaf Publishing, Sheffield, 244-51.

27. Guimaraes, T. and Liska, K., 1995, Exploring the business benefits of environmental stewardship, Business Strategy and the Environment, 4, 1, 9-22.

28. Gupta, M.C. and Sharma, K., 1996. Environmental operations management: an opportunity for improvement, Production and Inventory Management Journal, 37, 3, 40-6.

29. Hackman, J. R., & Wageman, R., 1995. Total quality management: Empirical, conceptual, and practical issues. Administrative Science Quarterly, 40; 309-342.

30. Hart, S.L., 1995. A natural-resource-based view of the firm, Academy of Management Review, 20, 4, 986-1014.

31. Hart, S.L. and Ahuja, G., 1996. Does it pay to be green: an empirical examination of the relationship between emission reduction and firm performance, Business Strategy and the Environment, 5, 1, 30-7.

32. Hawken, P., 1993. *The Ecology of Commerce: A Declaration of Sustainability*, Harper Business, New York.

33. Hoffman, A.J., 2000. Competitive Environmental Strategy, Island Press,

Washington, DC.

34. Inman, R.A., 1999. Environmental management: new challenges for production and inventory managers, Production and Inventory Management Journal, 40, 3, 46-9.

35. James, P., 1994. Business environmental performance measurement, Business Strategy and the Environment, 3, 2, 59-67.

36. Jordan, C.F., 1995. Conservation - Replacing Quantity with Quality as a Goal for Global Management. John Wiley & Sons, Inc., New York.

37. Kassaye, W.W., 2001. Green dilemma, Marketing Intelligence & Planning 19/6, 444-455.

38. Klassen, R.D., 1993. The integration of environmental issues into manufacturing: toward an interactive open-system model. Production and Inventory Management Journal 34, 1, 82-88.

39. Klassen, R.D. and Angell, L.C., 1998. An international comparison of environmental management in operations: the impact of manufacturing flexibility in the US and Germany, Journal of Operations Management, 16, 2-3, 177-94.

40. Klassen, R., and McLaughlin, C., 1996. The impact of environmental management on firm performance, Management Science, 42, 8, 1199-1214.

41. Klassen, R.D. and Whybark, D.C., 1999b, The impact of environmental

technologies on manufacturing performance, Academy of Management Journal, 42, 6, 599-615.

42. Lamprecht, J., 1997. ISO 14000 Issues & Implementation Guidelines for Responsible Environmental Management. New York: Amacom.

43. Langrehr, V.B., Langrehr, F.B., and Tatreau, J., 1992. Business users' attitudes toward recycled materials. Industrial Marketing Management 21, 361-367.

44. Lord, C., 1997. ISO 14000, in: Green Productivity: in pursuit of better quality of life (Tokyo, Asian Productivity Organisation).

45. Maslennikova, I. and Foley, D., 2000, Xerox's approach to sustainability, *Interfaces*, 30, 3, 226-33.

46. McGurie, J.B., Sungren, A., and Schneeweis, T., 1988. Corporate social responsibility and firm performance, Academy of Management Journal, 31, 4, 854-872.

47. Miller, Jr. G.T., 1999. Environmental Science, 7th edition, Belmont, CA: Wadsworth Publishing.

48. Min, H., and Galle, W.P., 1997, Green purchasing strategies: trends and implications, International Journal of Purchasing and Materials Management 33, 3, 10-17.

49. Nash, J.L., 2000. Beyond compliance: the sustainability challenge,

Occupational-Hazards, 62, 6, 38-42.

50. Porter, M.E. and van der Linde, C., 1995. Green and competitive: ending the stalemate, Harvard Business Review, 73, 120-134.

51. Roome, N., 1997. ``Corporate environmental responsibility'', in Bansal, P. and Howard, E. (Eds), Business and The Natural Environment, Butterworth-Heineman, Oxford, 41-62.

52. Russo , M.V., and Fouts, P.A., 1997. A resource-based perspective on corporate environmental performance and profitability, Academy of Management Journal, 40, 3, 534-559.

53. Saraph, J. V., Benson, P. G., & Schroeder, R. G., 1989. An instrument for measuring the critical factors of quality management. Decision Sciences, 20, 810-829.

54. Sarkis, J., 1995. Manufacturing strategy and environmental consciousness, Technovation, 15, 2, 79-97.

55. Sarkis, J, 1999. How Green is the Supply Chain? Practice and Research, Graduate School of Management, Clark University, Worcester, MA.

56. Sayre, D., 1996. Inside ISO 14000: the competitive advantage of environmental management. Delray Beach, FL: St Lucie Press.

57. Schmidheiny, S., 1992. Changing Course: A Global Business Perspective on

Development and the Environment, MIT Press, Cambridge.

58. Shrivastava, P., 1995a. Environmental technologies and competitive advantage, Strategic Management Journal, 16 special issue-summer, 77-91.

59. Shrivastava, P., 1995b. The role of corporations in achieving ecological sustainability, Academy of Management Review, 20, 4, 936-60.

60. Skinner, W., 1985. Manufacturing: the formidable competitive weapon, John Wiley and Sons, New York.

61. Stanwick, P.A. and Stanwick, S.D., 1998. The relationship between corporate social performance, and organizational size, financial performance, and environmental performance: an empirical examination, Journal of Business Ethics, 17, 2, 195-204.

62. Stigson, B., 1998. Sustainability in an era of globalization : the business response . In : OECD , Globalization and the Environment: Perspectives from OECD and Dynamic Non-Member Countries . OECD, Paris , 1998, 59-64.

63. Vickery, S.K., Droge, C., Markland, R.R., 1993. Production competence and business strategy: do they affect business performance. Decision Sciences 24, 4 , 435–456.

全球環保趨勢對公司環保策略的影響

陳中獎

南華大學環境管理研究所所長

本文以訪談三家廠商爲個案研究基礎，企圖去瞭解當大型企業在面臨環境衝擊時，何種因素會影響其選擇適當之環境策略；並分析環境策略的組成及其主要型式，同時針對三家廠商不同的環境策略型式，評估這些環境策略對企業本身達成永續發展的貢獻情形。本文假設，環境策略包含兩個要素：社會責任以及環境績效，而基於此二要素，可以將環境策略分成前瞻型策略（proactive strategies）、反應型策略（reactive strategies）以及逃避型的策略（escaping strategies）。本文的研究發現（1）對開發中國家的大廠商而言，像是全球環境趨勢等外部因素，對其環境策略而言，扮演著非常重要的角色與影響，（2）外部壓力對公司環境策略而言，扮演著決定性的角色，（3）只有當廠商可以生存下去時，社會責任才會被採用，並成爲形成環境策略的主要力量。

關鍵字：環境趨勢、環境策略、環境績效、綠色採購

子計畫三：

綠色校園教學環境的建置研究

論文名稱：

整合式主動推播學習平台模型以課程知識爲基礎

整合式主動推播學習平台模型以課程知識爲基礎

王昌斌 吳俊毅 楊惠媚
南華大學資訊管理研究所
大同技術學院企業管理科

An Integrated Push Delivery Model of E-learning Based on Course Knowledge

Chin-Bin Wang Jiun-Yi Wu
Department of Information Management
Nan Hua University
Hui mei yang
Department of business Administration
Tatung Institute of Technology

摘要

隨著資訊技術和網際網路的蓬勃發展，電子化學習已然成爲時代潮流，然而不論同步或非同步學習內部知識傳遞都僅是被動模式，學習者無法根據適性程度和自我需求主動地尋覓知識，因此，此研究將經由知識管理理論、電子化學習，代理人理論及貝氏網路理論，將蘊含於學習平台的知識加以精鍊，輔以推播技術的導入建構一『個人化主動推播模式』，本研究提出一個融合知識管理有效移轉之具體模式架構，以供學習平台主動推播潛在的知識需求給學習者，促使整體學習平台的功能更具多元、實用性。

關鍵字：知識管理理論、電子化學習、模型建置、貝氏網路、推播技術

Abstract

With the prosperous developing of computer technology and World Wild Web, e-learning has already become the world trade. However, not only synchronous but asynchronous inner knowledge delivery learning are just impassive mode; learners are unable to search knowledge automatically by according to their different degrees and needs. Thus, the research of this paper bases on the theories of KM, e-learning, agent & Bayesian network, etc; that is, constructing an integrated personally push delivery model based on course knowledge by condensing the knowledge of learning platform, push technology and Bayesian Network. This research stating a frame of concrete mode for the potential knowledge needs of learners, expecting the whole learning model more functional and practical.

Keyword: knowledge management ; e-learning ; modeling ; Bayesian Network ; push technology

壹、緒論

一、研究背景與動機

網際網路與全球資訊網相關技術蓬勃發展改變了傳統資訊取得模式[8]，再加上電子商務的崛起導致傳統交易模式與消費習慣的變革[17]，由於全球化市場開放促使商場競爭白熱化，企業因此體會到提供完善的個人化的資訊服務，才能在競爭激烈的商場中打敗其他強勁對手並從中脫穎而出。

此外，網際網路上所負載資料量因資訊科技導入而迅速成長[26]，而造成「資訊過載」的冗憂[7][8]，雖然資料資源豐富，但使用者卻必須付出極大心力尋找符合自己需求資料，因此有效地協助使用者在偌大的網路資源中取得所需的資源，儼然成爲網路環境中一個重要課題。[4][5][10]

本研究將經由知識管理理論（knowledge management）、軟體代理人（software agent）、資訊擷取（information retrieval）[6][16][22][23]與相似度衡量（similarity measure）[10][11]等文獻探討，並設計配合貝氏網路理論（Bayesian network），將每一課程群組內含之資訊與知識投影映射到向量空間模型（vector space model）[22]上便於萃取蘊含於學習平台的知識，輔以推播技術（push technology）的導入，建構一以課程知識爲基礎之整合式推播模型，並依學習者之潛在需求，讓學習者在學習歷程或學習活動中，能確實精準地將大量知識紀錄篩選，並適時的傳遞需要的知識，經由此模式引導獲得相關社群的協助，促使整體學習平台的功能更具多元、實用性，最後並對此模型做效能評估。

二、研究目的

電子化學習平台，並非只是一個單純將傳統教學網路化的機制，依靠電腦和網路所架構出的學習環境，僅能提升教學便捷與知識傳播速度，對於線上所有參與者和教學者所產生有關課程知識與技能的大量資源、課程相關知識狀態，如果能妥善加以萃取，適當的管理並過濾出更具附加價值的知識，依參與者和教學者的喜好和需求主動推播相關之知識，讓所有線上的知識個體能成爲一個真正有效率教學互動中心，而不是一個儲存知識的資料庫平台而以。因此，本篇研究將經由知識管理、電子化學習與模型建置等文獻探討，並配合知識萃取（knowledge extraction）與推播技術，來發展學校知識管理之主動推播參考模式，以達下列研究之目的：

1. 建構學校知識管理之主動推播模型

爲協助學習平台所有參與者和教學者，找出合宜的課程知識，所以，建構一模型，希望藉由此模型促使知識得以適時、適宜的，主動推播予線上所有參與者。

2. 設計學校知識管理之主動推播系統

實際分析設計一系統，將模型概念具體化，並評估其整體成果。

貳、相關研究

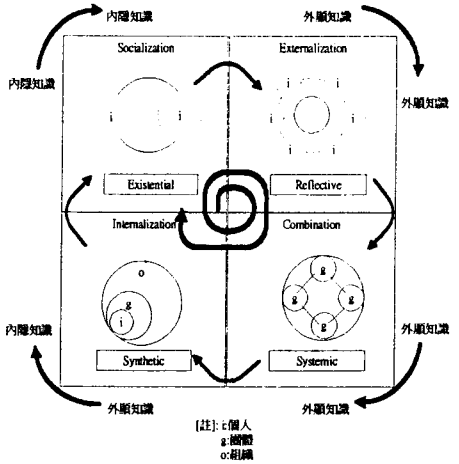
一、知識管理

比爾蓋茲（Bill Gates）在數位神經系統一書中曾指出[15]，「知識管理」就是收集資訊並組織資訊，將資訊傳給需要者，其核心就是管理資訊的流動，讓需要者正確且快速的獲取知識。因此舉凡對知識的取得、學習、評估、整合、創造,並將知識視同資產進行管理，使其有效的增進知識資產價值的活動[1][2][6][13][20]，亦即有系統、有組織的應用知識，進而創造新的知識。

Nonaka 與 Takeuchi(1999) [20]認爲知識是由內隱知識與外顯知識的互動所創造出來的，這種互動稱之爲「知識的轉移」(knowledge conversion)如圖(1)所示，知識轉換是以一種螺旋式的方式運作可分爲四種不同的知識轉換模式：

「共同化」(Socialization):內隱轉換爲內隱。
「外化」(Externalization) :內隱轉換爲外顯。
「整合」(Combination):外顯轉換爲外顯。
「內化」(Internalization) :外顯轉換爲內隱。

因此，學習系統運用「知識管理」之整合與轉化的管理流程爲基礎來設計一整合式模型藉以提升學習者學習興趣與教學績效的目標。



圖(1)：知識的轉移(knowledge conversion)

二、代理人

Wooldridge[25]認爲代理人能自主性地(autonomous)進行運作，它能主動察覺環境的變化並採取相對應的動作，本身並擁有特定的技能來執行使用者所賦予它的任務，而所謂的智慧可以是簡單固定的程序或物件邏輯，也可以複雜到具有推論和學習能力。

Hayes 定義代理人程式需持續地執行三項功能:(1)擁有感知週遭環境中的動態條件之能力;(2)執行動作以影響環境內之條件;(3)根據偵測到之情況進行推論，找出解答並採取適當之行動。

三、資訊擷取技術

本研究以軟體代理人爲基礎元件並融合資訊檢索與貝氏網路應用技術，設計了一套整合式推播系統。其中學習者問題的判別與回函推播相關資訊的選擇方法，即是以資訊分類之概念爲基礎而設計的。

關鍵字擷取爲資訊檢索上基本的技術，一般所稱的關鍵字必須要能充分地代表文章或資訊內容的特徵，它必須能明確地區別出其所代表的文章與其他文章的不同。最常用來決定關鍵字的技術爲 TF*IDF[5][22]。

相似度衡量，最常見的爲藉由計算兩向量間的 cosθ 值,來表現查詢語句與文件間的相似程度。當 cosθ 值愈高，表示兩向量間之角度愈小，相似度即愈高;反之，cosθ 值愈低，表示相似度愈低。其數學運算式如下：[10][11]

$$sim(Qi,Dj) = \frac{\sum_{k=1}^{n} q_{ik} d_{jk}}{\sqrt{\sum_{k=1}^{n} (q_{ik})^2 \sum_{k=1}^{n} (d_{jk})^2}}$$

四、貝氏網路

貝氏網路是結合貝氏機率理論與圖形模式所定義的知識表示方式。

一方面貝氏機率理論是以貝氏定理爲基礎所衍生出來的理論，貝氏定理可以結合事前機率（prior probability）與樣本機率（sample probability）來推算事後機率（posterior probability）；另一方面圖形模式是以有方向性非循環圖形來呈現[12][2][21]。Jensen, Finn V. [17]指出貝氏網路是由一連串的節點與節點間的箭號所構成，爲一有向的非循環圖（Directed Acyclic Graphs，DAG），每個節點代表該領域的一項變數，有向線則代表兩各節點之間的相關程度。

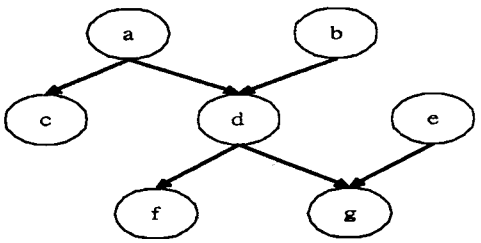
貝氏網路由問題領域內資料與知識所構成，因此若以 B 表示貝氏網路，θ 表示相同機率空間下之有限變數的集合。則其數學表示式如下：[14][18]

$$B(\theta) = (D, P(\theta))$$

其中 D 代表一有方向性的非循環圖（如圖(2)所示）；而 P（θ）爲一有方向性的非循環圖（DAG）中某一變數聯合機率分配，而其表示關係問題資料如下：[14][18][24]

$$P(\theta) = \prod_{i=1}^{n} p(\theta_i | \pi_i)$$

，其中 π_i 爲 θ_i 的父代。



圖(2)：有方向性的非循環圖

叁、模型架構與流程

一、現階段學習平台模式

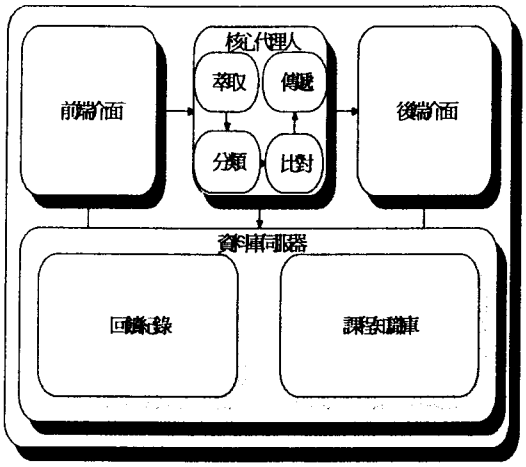
現階段學習平台上所提供的學習活動，因爲資訊科技與網路發展蓬勃，已經突破了時間和空間的藩籬，學習者不必親臨現場即可參與學習與獲取資訊，由於台灣的學生在課堂上不習慣發表意見，再者，教學者僅以單方面的知識傳遞爲主，鮮少做雙方面的互動，導致現階段學習平台雖強化教學型態，但無法有效的發揮其知識傳遞的效能，所以本研究方法以導入推播技術與貝氏推理模組，建構一以課程知識爲基礎之整合式

推播模型以彌補現階段學習平台的不足。

二 模型架構

本系統平台以核心代理人爲中介媒介，將學習平台所蘊藏之課程知識萃取並運用貝氏網路之概念賦予每一課程資料間，具相互關聯之特性，建構出整合三種推播技術之整合式推播系統，並依據每一位學習者的學習狀態機動地調整學習步伐，用以推播潛在需求之課程知識。

從概觀的角度來看，本系統架構可分爲四個主要模組元件分別爲前端介面、後端介面、核心代理人與資料庫伺服器模組元件。(圖(3))



圖(3)系統概觀架構圖[本研究]

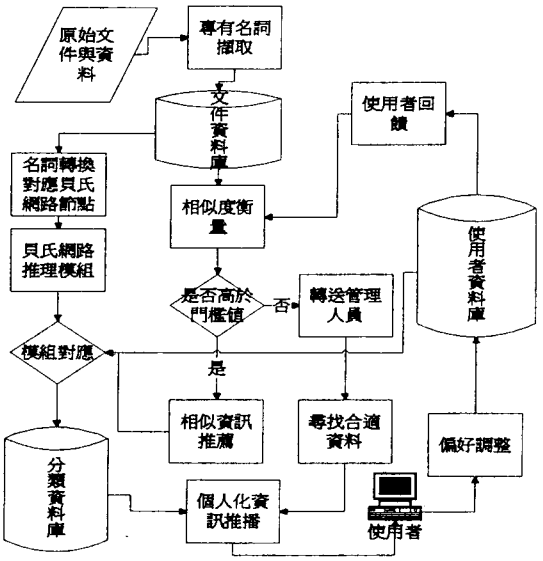
三、模型流程

流程一:

首先將課程原始文件與資料運用關鍵字擷取技術萃取出具代表性之關鍵字，再儲存至文件資料庫中，同時由文件資料庫中將所有名詞皆轉換爲貝氏網路節點，經貝氏網路模組後送至分類資料庫中，接著藉由使用者登錄資料或使用者回饋取得使用者的學習偏好，進而進行相似度衡量比對是否符合，如果符合，即觸發訊息比對(mapping)使用者資料庫內部個人學習資料與貝氏推理模組內部節點關係並分析判斷進而分派相似之分類資料庫的資訊進行個人適性化推播資訊服務。

流程二:

其運作過程類似流程一所述，其不同之處在於相似度衡量比對，如果不符合，系統管理人必須參照使用者登錄資料或人工檢視此一使用者，應分派哪一分類資料庫，進行推播資訊服務。(圖(4))



圖(4)系統流程圖[本研究]

四、貝氏學習網路推理機制模式

本節就流程運作先做一個說明，接著再深入定義貝氏學習網路推理機制模式的細

部開發元件與處理程序。

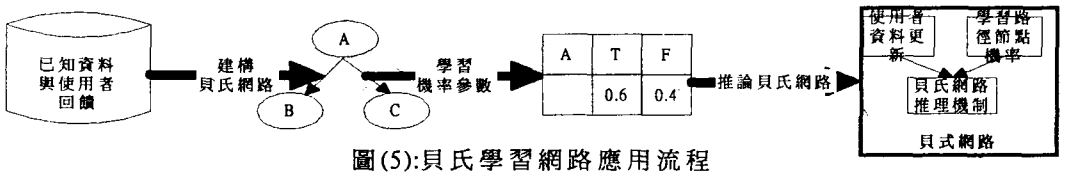
（一）貝氏學習網路應用流程

貝氏學習網路的應用流程爲（圖(5)）：

（1） 建立貝氏網路。

（2） 學習機率參數值。

（3） 推論貝氏網路。



圖(5):貝氏學習網路應用流程

因爲貝氏網路的推理需利用事前機率與構成變數間的相互關係的條件機率，透過貝氏理論所展出來的演算法如 Clustering Algorithm、Polytree Algorithm ...等等，由輸入的證據（evidence）來推導其他節點狀態機率，亦即事後機率，因此貝氏網路允許學習者對因果關係進行學習，當學習歷程所紀錄之學習路徑之資料或知識有不完整的情形時，可經由各節點之事前機率來反推父節點與兄弟節點，並映射出所對應之資料與知識 。

（二）模組細部開發元件與處理程序

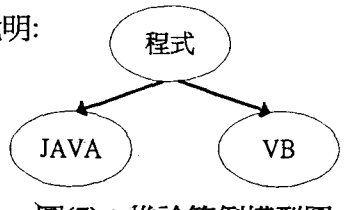
在完成建置貝氏網路前，必須先將原始資料交由本研究之推理機制模組做處理轉換(參照圖(6))。

首先，將課程資料存放到文件資料庫中，接著再從資料庫中取出，做資料整理與彙整等前置處理，然後再將資料切割成分類區段，此時所處理完成的資料爲完整定義的資料。

再利用 MSBNX 軟體根據此完整定義資料建置貝氏網路架構，經此軟體元件處理後便會得到一序列的因果關係，此時便完成了初步貝氏學習網路結構。

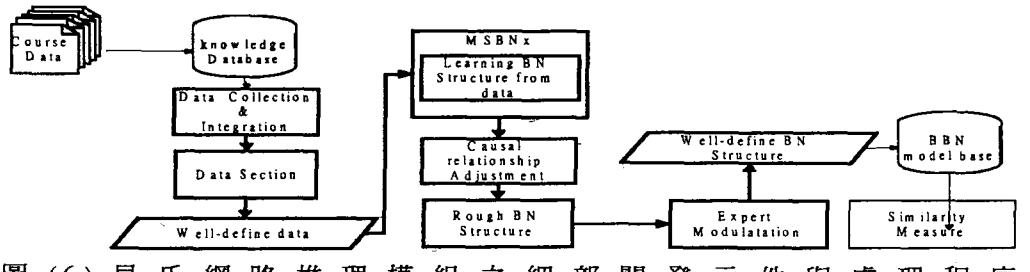
接續，將所得之初步架構交由專家依其經驗作微調處理，完成後可得到完整定義貝氏網路結構，並儲存到貝氏網路學習網路資料庫中，以備比對模組使用。

範例說明:



圖(7)：推論範例模型圖

從文件資料庫中課程文件轉換成貝氏



圖（6）:貝氏網路推理模組之細部開發元件與處理程序[本研究]

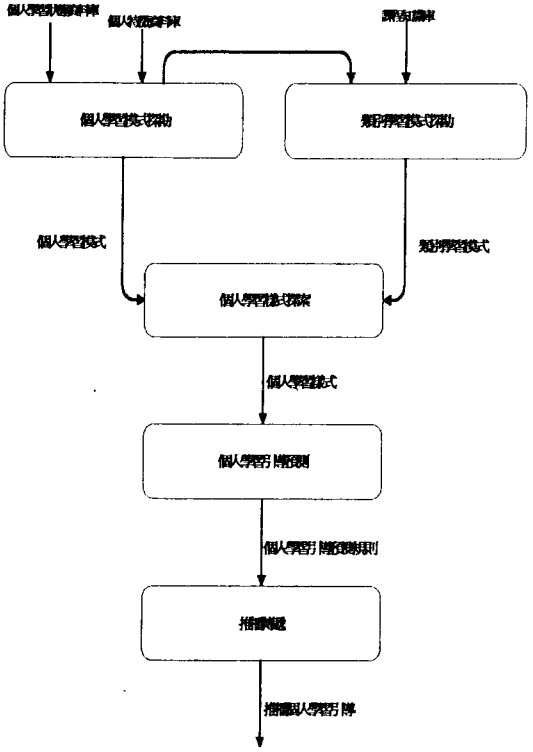
網路節點有向非循環圖(DAG)，如圖(7)，假設文件轉換節點爲一父節點兩個子節點父節點爲程式，子節點爲 VB 和 JAVA；再經由貝氏網路推理模組機制並給定每一節點關聯性機率值，完成一代表某一學習狀態架構圖，此時，如有一使用者在登錄資料或偏好有勾選『程式』，及經由比對後屬於『程式』貝氏網路模組，如兩個機制產出吻合，即根據貝氏推理模組所對應之分類資料庫，根據機率推算判斷是否推薦資訊，假若使用者可能僅點選 JAVA 內容、瀏覽 VB 網頁，但套用此比對機制後，得到 VB 網頁之內容也可能爲使用者所需知識，藉由推播技術將此一建議知識傳遞給使用者，藉以改善一般學習平台之被動『拉』(pull)的資訊傳播，而改爲主動『推』(push)的資訊傳播方式。

肆、研究模型方法

一、方法建構

本研究係根據上述章節之模型架構爲基礎進而介紹整合式主動推播模型(IPDM)之學習引導方法建構，如圖(8)所示，包括個人學習模式探勘 、類別學習模式探勘、個人學習樣式探索、個人學習導引預測、及推播傳遞等五個建構程序。

類別學習模式探勘，主要從課程知識中挖掘出類別學習模式（Class Learning Model)；個人學習模式探勘，係根據個人貝氏網路庫資料中開採出具個人特色之學習模式（Personal Learning Model)；個人學習樣式探索，即是將類別學習模式（Class Learning Model）與個人學習模式（Personal Learning Model）之間的關聯做樣式比對，進而將具個人化之學習樣式（Personal Learning Pattern）探索並整理出來；個人學習導引預測，主要是利用個人化之學習樣式（Personal Learning Pattern）與貝氏推理模組之轉換課程知識網路樣式（Course Knowledge Bayesian Network Pattern）來預測學習者的潛在需求課程知識。



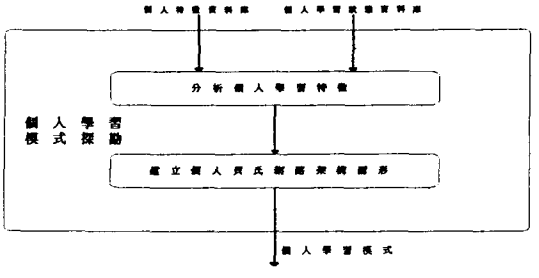
圖(8) IPDM 學習引導方法建構圖[本研究]

挖掘類別學習樣式

主要目的係由龐雜的課程知識庫中依學習者類別層級（Class Level）之學習模式挖掘出來，並依類別層級之學習模式將其分類歸入不同分類資料庫以供個人學習樣式探勘（Personal Learning Patten Explore）模組使用。

挖掘個人化學習樣式

分爲兩個細部處理元件分別爲（1）分析個人學習特徵(2)建構個人貝氏網路。(如圖(9)）首先，分析個人學習特徵，將其學習者特徵（Personal Learning Characteristics），學習者狀況（Personal Learning State）兩個構面所挖掘出之具個人化資料做爲基礎元素，依其個人學習行爲之點選或瀏覽，個人登錄領域、興趣、偏好爲微調變數，使其所建構出之貝氏網路具有其個人化之學習特徵，以便於個人化之學習樣式探索之程序處理。



圖(9)　挖掘個人學習模式之細部處理元件[本研究]

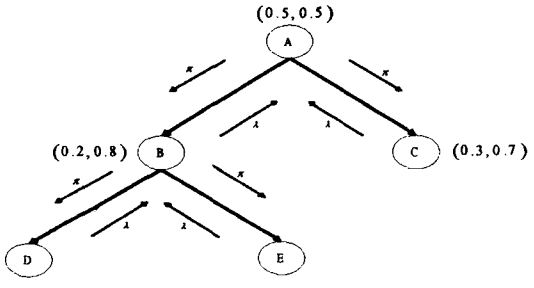
接續，根據分析結果建構出個人貝氏網路，其建構過程必須考量四大元素，依序分別爲：節點、節點關聯、節點參數值與節點機率。(參照圖(10))

(1)節點：代表課程知識領域之中某一特定名詞。

(2)節點關聯：代表某一特定名詞與另一特定名詞之前後關聯。

(3)節點參數值：代表其引發向上傳遞與向下傳遞之λ與π值。

(4)節點機率：代表節點關聯與節點參數所給定或專家給定之特定名詞機率值。



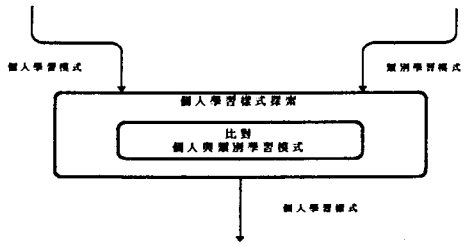
圖(10)　建構出個人貝氏網路[本研究]

根據個人化的學習紀錄，將架構四大元素做微調，隨時依據節點、節點關聯、節點參數值與節點機率的調整而將案例式的領域模式做個人化的修正，經過學習者不斷的學習，則所建構出之貝氏網路將會更符合個人的學習需求。

個人化之學習樣式探索

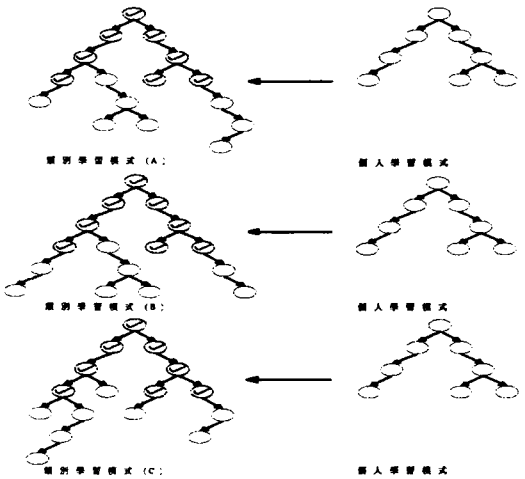
即是將類別學習模式（Class Learning Model）與個人學習模式（Personal Learning Model）之間的關聯做樣式比對（參照圖(11)），而比對所得結果即是個人所有可能

樣式，其比對的方法則是將個人學習模式與類別學習模式做細部節點比對。



圖(11)　個人化之學習樣式探索處理[本研究]

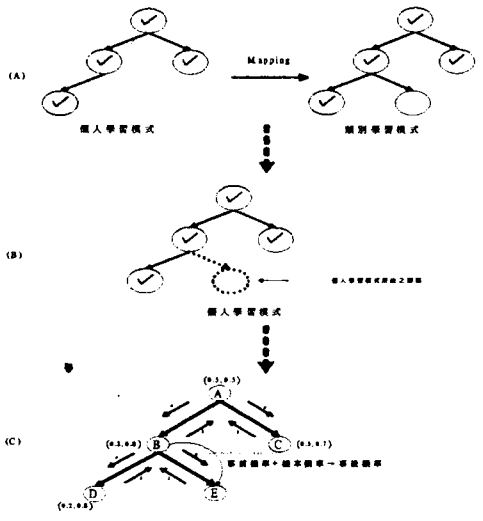
細部節點比對（如圖(12)）將個人學習模式比對所有資料庫中的類別學習模式，得到（A）、（B）與（C）類別學習模式，其樣式符合該個人學習模式，所以將三個可能類別學習模式紀錄在推薦名單中，並交由個人學習導引預測（Personal Learning Guide Predict）之推薦處理。



圖(12)　類別與個人學習模式比對[本研究]

個人化學習導引預測

做預測判斷時，就只要根據所有類別學習模式一一推斷各個貝氏網路架構之模式關聯與因果關係，並依據機率來推論該資訊是否爲學習者潛在所需。其處理程序如圖(13)所示，步驟（A）表示類別學習模式與個人學習模式經對應處理程序後，就可經由比對得出個人學習模式缺少了一個節點，即是步驟（B）所示，此一節點可能是個人學習模式所欠缺的潛在所需的資訊，所以我們可以根據類別學習模式的關聯與因果關係之機率值藉由事前機率（prior probability）與樣本機率（sample probability）來反推事後機率（posterior probability），如步驟（C）圖示。經由機率所推論出之節點我們經由關聯法則來紀錄所有因果關係並將其轉換爲個人學習導引規則（Personal Learning Guide Rule），進而交由推播傳遞之處理。



圖(13)　個人學習導引預測處理步驟圖[本研究]

二、推播技術

技術一：

藉由觀察使用者瀏覽行爲來推測使用者 所 需的目標，再自動代理使用者執行目標搜尋以取得網際網路中相關資訊，對使用者進行資訊推薦或連結建議。

技術二：

由伺服器負責資訊推薦的工作，伺服器可以透過登錄(login)或 proxy 伺服器方式，將使用者學習路徑或回饋紀錄根據 (feedback records)或文件內容進行存取模式辨識，以進行社群過濾取得相似偏好使用叢集，進而推薦同類叢集相關資訊與網頁。

技術三:

採用資料預取(pre-fetch)的觀念建立虛擬伺服器階層式架構。將網頁內容相似的文件資料存放在不同階層的伺服器中，再以整體資源索引(Global Resource Index, GRI)來管理資料所儲存的伺服器位置。當成爲某社群成員時，即可存取此伺服器內其他成員相關資訊。

由於技術一無法取得學習平台其他成員的相關資訊，技術二與技術三所得之相關資訊沒有明確的分類主題，所以此研究融合貝氏網路特性與上述三項技術各項優點，使此推播技術具備整合伺服器與明確分類主題的特性，建置一個整合式的推播技術學習平台，以期學習平台在推播資料技術上更加完備與精確。

三、推播類型

資訊推播系統型態大致可分爲四種，分別是：

（1） 非個人化推薦：此推薦方式沒有一定的推薦規則，如同『夾報廣告』方式將所有資訊不分類別、屬性、或關聯，全部將其推播傳遞給所有人。

（2） 特徵屬性推薦：此推薦方式則是依其要推薦的資訊本身的特徵屬性爲判斷規則，如果該資訊屬性符合該特徵即依此推播給符合該特徵需求使用者。

（3） 關聯屬性推薦：此推薦方式實爲特徵屬性推薦的延伸，其最大不同在於其將所有特徵依造因果關係或關聯規則來作爲資訊推播的準則，當某一資訊推播的同時，即可根據與此一資訊具有某一程度的關聯規則進行資訊推播。

（4） 關聯群組推薦：此推薦方式即是找出特定使用者相似的使者族群，而其推播方式根據該族群之特定關聯，將符合該群組之特定資訊，推播其他群組成員相關資訊給使用者。

而本研究推播類型，即是整合關聯屬性

推薦與關聯群組推薦的優點，一方面將所有課程知識依因果關係或關聯規則做資訊推播的規則，同時另一方面將所有學習者依群組關聯做分類，學習者可以根據同群組其他成員的學習關聯取得更多的推播資訊，所以本研究所建構之推播模型不論廣度或深度的層面都能做有效的推播對於學習者的學習效能將比傳統的推播方式來的更有競爭力。

伍、模型雛型開發

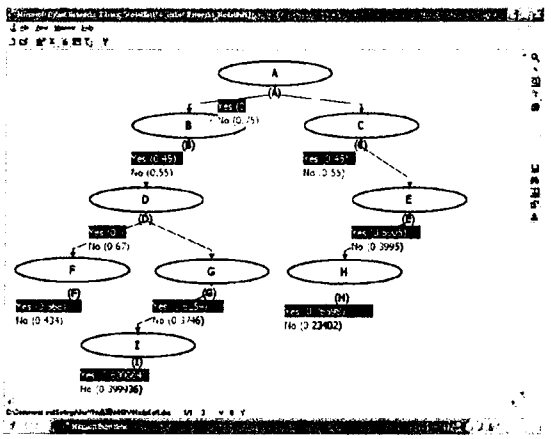
本研究以採用之軟硬體設備如下：

- 中央處理器：Pentium IV 2.53GHz 個人電腦。
- 作業平台：Windows XP Personal Edition 作爲系統開發之環境。
- 程式開發語言：模型採用 ASP.NET 與 Access 2000 兩種程式語言做爲開發工具，貝氏網路架構部分採用做爲 MSBN 做爲資料轉換工具。

本雛型開發主要分爲前端處理與後端處理兩部分

- 後端處理：

首先，本模型必須將課程資料庫中所有課程文件全部轉換爲貝氏網路的架構圖，其貝氏網路架構圖以分群的方式將其相似的課程文件屬性與其因果關聯建構出，完成貝氏網路架構圖後，亦即是簡略貝氏網路架構圖（Rough Bayesian Network），接續，根據累積經驗給定每一個節點一個機率值，因爲每一個節點（Node）各自代表一個課程文件，每一個連線（Arc）代表節點兩兩相關之關聯順序，藉由該後端處理步驟處理過程，我們可以完整得到從根節點到葉節點（from Root Node to Leaf Node)所有承續機率架構圖（如圖(14)所示），稱爲完整貝氏網路架構圖（Well-define Bayesian Network）



圖(14)　完整貝氏網路架構圖

亦即個人化學習樣式探索之類別學習模式與個人學習模式之間的關聯樣式比對，即可挖掘出個人學習模式中缺乏節點的樣式，再根據缺乏節點在完整貝氏網路架構圖所在位置，依其前後因果關聯推斷該節點

之推薦門檻值，是否已達推薦之標準，最後將該節點所代表之課程文件推播給學習者。

- 後端處理：

學習者必須登錄該模型平臺（圖(15)），並依其學習過程勾選學習之課程文件，該模型根據該學習者所設定門檻值，比對符合條件之課程文件並依其因果關聯自動推播給學習者。

整合式主動推播學習模型分爲四個部分（參照圖(16)）：

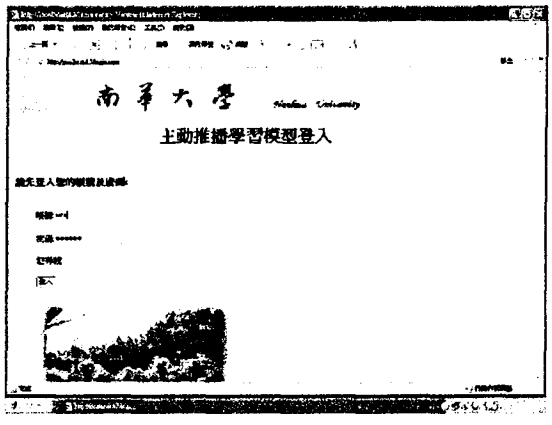
（1） 課程介紹：課程概要簡介與說明。

（2） 課程文件：課程相關資料之電子文件。該部分包括比對結果之處理。（如圖(17)）

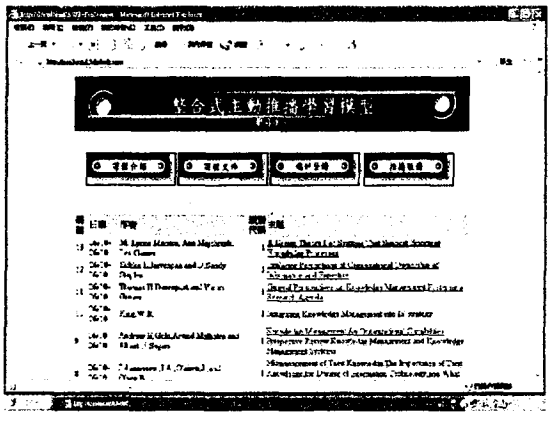
（3） 偏好登錄：提供學習者依其偏好選擇所屬分類資料。（如圖(18)）

（4） 推播服務：根據後端處理評估試算表所匯出之節點機率資料庫，來比對與判別符合推播條件之相對應之課程文件資料。（如圖(19)）

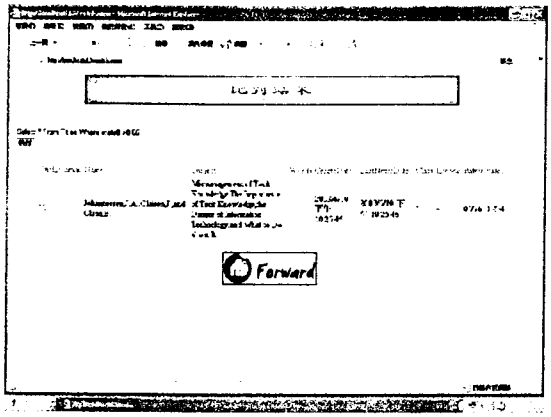
所以本研究所架構之「整合式主動推播學習模型」經由實作驗證後，不論可行性或推論可信度上，都具有相當程度得成效，其模組化之設計可彌補現階段學習平台在互動層面的不足，藉由學習者所提供的學習資訊與學習紀錄，精確的預測推斷學習過程中可能闕漏的知識，進而主動推播學習者有用的知識讓學習者在學習的過程中更有效率。



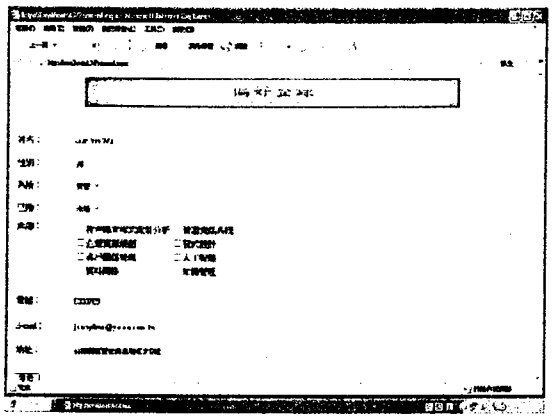
圖(15)登錄畫面[本研究]



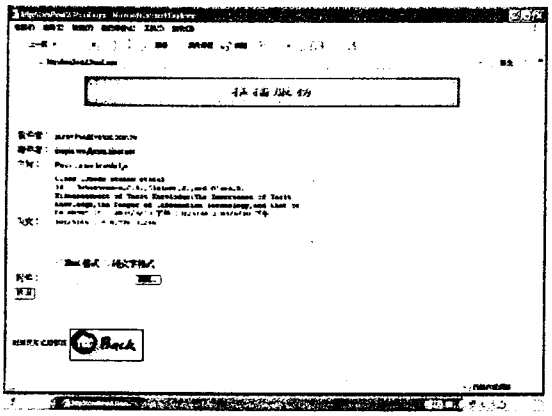
圖(16) 整合式主動推播學習模型畫面[本研究]



圖(17)　比對結果[本研究]



圖(18)　偏好調整[本研究]



圖(19) 推播服務[本研究]

陸、結論與建議

一、結論

本研究即針對現階段電子學習平台之課程知識藉由知識管理理論之知識轉移觀點推導出知識分享的重要性、設計以軟體代理人爲基礎，配合貝氏網路理論，建構一以課程知識爲基礎之整合式推播模型提供一針對符合個人適性化需求，根據使用者的學習狀態適度調整推播潛在之相關學習資訊。綜言之本研究主要特色與貢獻如下:

1. 本研究以個人化資訊推播爲基礎爲新概念，可改善一般資訊推薦代理伺服器缺乏個人化資訊之不足、或資訊過載的問題，並提供使用者學習課程之相關資訊。

2. 本研究融合貝氏網路之觀念，賦予每個課程文件機率值，依其關聯機率較大節點或超過門檻值節點，來斷定使用者可能所需之知識並予以推播，以達到個別化的「顧客關係管理」的目標。

3.本系統能清楚的掌握使用者的滿意程度可一使用者回饋或登錄資料即時修正調整以提供更符合使用者的資訊。

二、後續研究之建議

未來整合式推播系統的發展上仍有以下幾個方向可供後續發展:

1.未來如能結合人工智慧或類神經網路等機器學習功能使其能自我學習建制讓系統更具實用性。

2. 增加智慧型資訊擷取分析模組，以強化整合式推播系統的資訊擷取能力。

參考文獻

1. 尤克強，知識管理與創新，台北，天下遠見出版股份有限公司(2001)。
2. 王如哲，知識管理的理論與應用，台北，五南圖書出版公司(2000)。
3. 林佑安，「資料挖掘技術於個人化輔助教學系統的應用」。大葉大學資訊管理研究所碩士論文, 彰化(2002)。
4. 陳京偉譯， 知識管理的第一本書，勤業管理顧問公司，商業週刊股份有限公司出版，台北(2000)。
5. 陳振東、戴偉勝，「網際網路環境中個人化資訊推薦系統實作之研究」。資訊管理學報，第九卷，第一期，21-38 頁(2001)。
6. 曾元顯，「關鍵詞自動擷取技術與相關詞回饋」。中國圖書館學會會報五十九期(1997)。
7. Bogonikolos N., Fragoudis D. and Likothanassis S., "An Intelligent Agent for adaptive-Personalized Navigation with WEB server System Science", *Proceedings of the 32nd Annual Hawaii International Conference*, pp.1-9 (2000).
8. Bouissou M., Martin F. and Ourghanlian A., "Assessment of a Safety-Critical System Including Software: A Bayesian Belief Network for Evidence", *IEEE Proceedings Annual Reliability and Maintainability Symposium*, pp.142-150(1999).
9. Bowman C. M., Danzig P. B., Manber U. and Schwartz M. F., "Scalable Internet resource discovery research problems & Approaches", *Communications of the ACM*, pp.98-107 (1994).
10. Chen H. C., Chung Y. M. and Yang C. C., "An intelligent personal spider (agent) for dynamic Internet/Intranet Searching", *Decision Support Systems*, pp.41-58 (1998).
11. Chen S. M., "Extensions of the TOPSIS for Group Decision-Making under Fuzzy Environment", *Fuzzy Sets and Systems*(114:1), pp.1-9(2000).
12. Drucker P. H., *Post-Capital Society*, Harper Collins.(1993)
13. Enrique C., Jose M. G. and Ali. S. H., *Expert Systems and Probabilistic Network Models*, Springer-Verlag, New York(1997).
14. Gates B. 數位神經網路，樂爲良譯，*台北:商業週刊*(1999).
15. Griffith A., Luckhurst H. C. and Willet P., "Using Inter-Document Similarity Information in Document Retrieval Systems", *Journal of American Society for Information Science*, vol. 37, pp.3-11 (1986).
16. Heckerman D. and Michael P., "Bayesian Networks", *Communication of the ACM*, March, Vol.38, No3.

(1995).

17. Jensen F. V., *Introduction to Bayesian Networks*, Department of Mathematics and Computer Science, Aalborg University.
18. Laurtzen S., Thiesson S. and Piegelhalter D., "Diagnostic Systems Created by Model Selection Methods", *AI and Statistics IV,* Springer Verlag, New York, pp.143-152(1998).
19. Liang T. P., and Huang J. S., "A Framework for Applying Intelligent Agents to Support Electronic Trading", *Decision Support System* (28:4), pp.305-317(2000).
20. Nonaka and Noboru K., "The Concept of Ba: Building a Foundation for Knowledge Creation, In Cortada, J. W. & Wood, J. A.", *The knowledge management yearbook*, pp.37-51(2000).
21. Norman E. and Martin N., "Software Metrics, failure and new directions", *The Journal of Systems and Software*47, pp.149-157(1999).
22. Salton G. and McGill M .J., *Introduction to Modern Information Retrieval*, McGraw-Hill, NY.(1983).
23. Salton G., *Automatic Text Processing The Transformation, Analysis and Retrieval of Information by Computer Reading,* Addison Wesley, M.A.(1989).
24. Shachter *R.*, "Probabilistic Inference and Inference Diagrams", *Operations Research*, pp. 589-604(1988).
25. Wooldridge M. J., *Reasoning About Rational Agents,* MIT Press, M.A(2000).
26. Yang C. C., Yen J. and Chen H. C., "Intelligent Internet Searching Agent Based on Hybrid Simulated Annealing", *Decision Support System (28:3),* pp.269-277(2000).

子計畫四：

環境問題全球化下環保團體角色扮演之研究

論文名稱

基地台環保抗爭中民間團體角色之扮演與業者因應對策之研究

行政院國家科學委員會提昇私立大學研發能量計畫成果報告

環境問題全球化下的環境政策因應研究

子計畫四：環境問題全球化下環保團體角色扮演之研究

The Study of the role of the environmental group under the global environment problem

計畫類別：☐ 個別型計畫　　☑ 整合型計畫

計畫編號：NSC 89-2745-P-343-002-04

執行期間：89 年 12 月 1 日至 92 年 11 月 30 日

計 畫 主 持 人 ： 陳 券 彪

執 行 單 位 ： 南 華 大 學

中 華 民 國 九十二 年 十 一 月 三十 日

行政院國家科學委員會提昇私立大學研發能量計畫成果報告

基地台環保抗爭中民間團體角色之扮演與業者因應對策之研究

The study on the role of civil groups and the strategy of the relevant enterprises toward the environmental protection against the Base Station

計畫編號：NSC 89-2745-P-343-002-04

執行期間：91 年 12 月 1 日至 92 年 11 月 30 日

主 持 人：陳券彪　南華大學管理所

研究助理：林世賢、陳淑慧　南華大學管理所研究生

一、中英文摘要：

隨著資訊與電子科技的進步，愈來愈多非污染性設施架設的抗爭個案發生，近年來我國行動電話成長迅速，民眾使用行動電話機會日漸提高。為提高通訊的品質，則必須伴隨高密度、高覆蓋率的基地台架設才能夠達成。然而高密度、高覆蓋率的基地台架設往往產生電磁波輻射之隱憂，因而基地台架設所引發之環保抗爭活動日益增多。

本研究擬以 Fernandes 及 Beryl Angela 之衝突管理主要元素（行為、認知、分析及方法）理論為基礎，分析一般民眾及民間團體在基地台環保抗爭中之衝突行為表現，期能提供有價值之資訊給行動電話基地台設置的相關業者在化解對立與衝突之參考。

本研究主要探討的內容包括（1）基地台電磁波輻射環保抗爭活動中，民間團體對基地台電磁波輻射的認知及其所持態度，（2）比較民間團體對基地台設置之環保抗爭訴求與環境污染抗爭訴求之差異，(3）分析電信業者在整個抗爭過程之因應策略。

關鍵詞：行動電話、基地台、衝突管理、環保抗爭

Abstract

Along with the progress of technology in telecommunication and electron, the cases of protest against the installation of unpolluted facilities occurred more and more. In addition, the mobile industries have grown rapidly during the recent years and the opportunities to use the cellular phone are increasing day by day . In order to improve the quality of communication, it results in high density and high coverage in installing the Base Stations. However, the high density and coverage of the Base Stations will cause the concealed worry owing to coming with the radiation of electromagnetic wave. Therefore, there are more and more protest activities of environmental protection caused by the installation of Base Stations.

This study will be based on Fernandez and Beryl Angela's main elements of the conflict management theory, such as behavior, cognition, analysis and method. We will analyze the expression of conflict behavior

among the general populace and civil groups in environmental protection against the Base Stations and expect to offer some valuable information to those relevant industries of Base Stations, which can be the reference to reconcile the confronting position of conflicts.

The main contents of this study will include as follows:(1) the attitude and cognition of civil groups toward the radiation of electromagnetic wave in the protest activities of environmental protection;(2) the comparison of the differences between the protest appeals for the environmental protection against the installation of Base Station and the protest appeals for environmental pollution; (3) the analysis on the strategies of telecommunication industry toward the whole protest.

Key Words: cellular phone, Base Station, Conflict Management, the protest for environmental protection,

二、緣由與目的

在民主政治的環境中，民眾的知識水準提高，民眾參與環保抗爭事件的機會逐漸增多，在環保抗爭的活動中，若雙方未能達成共識以及政治力或環保團體的介入，往往可能導致衝突的發生。近年來我國行動電話成長迅速，國人平均持有行動電話之戶數高達每百人擁有 105.9 戶之水準，充分展現我國行動電話普及化的程度。不過，要有高品質的通訊享受，則必須伴隨高密度、高覆蓋率的基地台架設才能夠達成，而基地台的架設往往產生電磁波輻射之隱憂，在消費者收訊良好需求與電磁波影響身體健康的爭議下，民眾對基地台的恐慌與排斥，並未隨著相關電信業者的宣導而降低。

綜觀過去行動電話基地台架設抗爭案例中，民眾除了電磁波疑慮外，更懂得善用民意代表介入，使得原本單純的行動電話業務，演變的更加複雜及泛政治化(曾松竹，2001)，民眾與電信業者之間的關係也因為各種因素的介入導致衝突不斷。蔡慧姿(2001)指出在都市計劃、環境及都市土地開發層面上，相關業者曾使用衝突管理理論化解衝突事件。然而，有關如何運用衝突管理理論於基地台環保抗爭活動的相關學術研究卻非常少，因此本研究擬探討基地台環保抗爭活動中，民間團體對基地台環保抗爭的認知及其所持態度，並以衝突管理理論為基礎，分析電信業者在整個抗爭過程之因應對策。本研究之研究目的主要有下列四項：(1)瞭解目前民間團體對基地台環保抗爭活動所持的態度；(2)探討衝突管理在環保抗爭事件的應用 (3) 分析基地台環保抗爭活動中，電信業者與民間團體角色之扮演，以及政府相關單位採行之對策；(4)比較民間團體對行動電話基地台設置抗爭訴求與環境污染抗爭訴求之差異。

三、研究結果與討論

為瞭解基地台環保抗爭活動中，民間團體對基地台環保抗爭的認知及其所持態度，本研究透過問卷調查方式蒐集相關之資訊，在研究樣本之選取方面係採立意抽樣方式進行，主要以嘉義、台南及高雄地區的居民為研究對象，每一地區分別抽取 250 個樣本，共計發出問卷 750 份。回收卷數：嘉義 227 份，台南 247 份，高雄 241 份，共計回收 715 份問卷，有效問卷數 697 份(其中嘉義 220 份，台南 242 份，高雄 235 份)，有效問卷率 94.8%，將有效問卷整理後，以 SPSS 統計軟體做進一步分析，獲得下面具

體的成果：

(一) 環境污染抗爭與行動電話基地台抗爭之訴求分析

環境污染抗爭與行動電話基地台設置的相似點在於彼此皆存在(1)鈔票 (2)選票 (3)信任差距 (4)黑白介入等問題，在參與抗爭的團體則以政府相關單位、民間團體、民意代表、產業業者涉入程度最高，當參與團體能夠在實質利益取得平衡，則抗爭規模將變小或消除；若無法處理及在利益上取得共贏，則社會將付出龐大成本。其相異點在於環保抗爭常涉及公權力的介入，例如：焚化爐或電廠設置等議題，而行動電話基地台設置隨著電信政策民營化，逐漸削弱公權力介入的程度，政府相關單位往往是站在溝通協調的立場。另外，科技災難所產生的抗爭，具有模糊性和不確定性的特色，不同於以往污染性設施的架設。

(二) 民眾或民間團體對行動電話基地台架設態度分析

多數民眾不同意在住家附近設置基地台，其主要原因依序為(1) 電磁波對身體健康會造成影響(2) 電信業者無法提供滿意的優惠專案(3) 會影響生活環境及居住品質(4) 無法提供滿意補償金。另依方面認為當住家附近設置基地台時，當地民眾會以理性抗爭(例如:靜坐、要求補償金)的方式與電信業者溝通者居多。

(三) 參與團體應扮演之角色分析

根據調查資料顯示：大多數的受訪者認為民間團體應扮演安全監督者的角色，監督政府相關單位及電信業者確實做好電磁波檢測工作。且認為環保團體介入，對行動電話基地台電磁波環保抗爭，將會有很大幫助。在政府相關單位部分，受訪者所期待的角色為安全監督者，因為政治力介入常使抗爭活動有所助益，主要是其擁有充沛的行政資源以及不可忽視的公權力，若政府相關單位能主動協調溝通，則民眾接受電信業者所提供的條件可能性更高。電信業者部分，其應扮演安全維護者的角色，除了為本身企業獲取最大利益的條件下，若能解除電磁波對身體不會造成影響的疑慮，以及能夠主動宣導輻射波相關訊息，當地抗爭活動或許可減少。

(四) 衝突管理理論在環保抗爭之應用分析

本研究主要是採用 Fernandes 及 Beryl Angela （1987）的衝突管理主要元素（行為、認知、分析及方法）說為理論基礎，分析一般民眾及民間團體在基地台環保抗爭中之衝突行為表現。因此，就衝突事件的行為背景而言，則以民眾對行動電話電磁波輻射疑慮所造成的抗爭為基礎，相關因素包括(1) 電磁波對身體會造成影響(2) 電信業者無法提供滿意的優惠專案(3) 會影響生活環境及居住品質(4) 無法提供滿意補償金。在衝突認知方面，電信業者認為高密度、高覆蓋率的基地台鋪設，才能伴隨高密度的通訊享受；民眾則因電磁波會危害身體健康的考量下，不同意設置基地台，造成彼此認知不同，並經由抗拒、冷漠、語言攻擊、武力攻擊等方式，使衝突明顯化。在分析及方法方面，電信業者可對整個事件有充分的檢視，找出最適的管理方法，依序為(1) 以座談會方式進行溝通協調(2) 免費提供當地社區軟硬體建設(3) 提供補償金，並簽署雙方同意的協議(4) 提供優惠專案，並做好敦親睦鄰(5) 確實做好電磁波檢測，符合法定標準。

由上述討論可知：在基地台環保抗爭中民間團體角色之扮演與業者因應對策之研究中，民眾最大的疑慮是電磁波會對身體造成影響。因此，電信業者應對衝突事件做一

全盤瞭解，先以座談會方式進行溝通，並做好電磁波檢測工作，進而降低衝突抗爭的強度，而政府相關單位或民意代表有責任制定最適之法律規範保障民眾之安全，並以溝通協調的角色，使民眾與業者達到雙贏的理想。

參考文獻

1. 丘昌泰，2003，從「鄰避情結」到「迴臂效應」：台灣環保抗爭的問題與出路，政治科學論叢，第十七期：33-56。
2. 吳秉恩，1986，組織行為學，台北：華泰文化事業股份有限公司。
3. 汪明生、朱斌妤，1999，衝突管理，台北：五南書局，初版。
4. 林偉彥，2002，公害糾紛系統動態模型之研究-以石化產業為例，國立台北大學資源管理研究所碩士論文。
5. 帥韻儀，2003，以問題解決為導向之衝突問題解決模式建立之研究，中原大學企業管理研究所碩士論文。
6. 張利國，1997，從環境衝突觀點探討傳統都市計畫制訂模式之合理性-以台中縣大度山居民抗爭為例，國立台灣大學建築與城鄉研究所碩士論文。
7. 張金鑑，1991，行政學典範，台北：三民書局，第四版。
8. 許秉翔，1993，污染性工業區空間衝突管理之研究-以大社工業區公害糾紛事件為例，淡江大學建築學系碩士論文。
9. 郭晁坤，2001，台電輸變電工程設施衝突事件之探討，國立交通大學經營管理研究所碩士論文。
10. 陳俊潔，1995，都市計畫衝突解決之研究，台灣大學建築與城鄉研究所碩士論文。
11. 陳穎峰，2000，台灣環保政治的結構與策略分析-核四案與拜耳案的比較，國立政治大學政治學系碩士論文。
12. 彭兆良，2000，台中縣海渡發電廠開發衝突之政治經濟分析，逢甲大學建築及都市計畫研究所碩士論文。
13. 曾松竹，2001，行動電話基地台抗爭的迷思，財團法人國家政策研究基金會國政評論。
14. 黃耀正，2003，台北市行動電話基地台都市景觀管制原則之研究，國立台北科技大學建築與都市設計研究所碩士論文。
15. 葉文玉，2000，塔塔加地區土地經營管理衝突之研究，東海大學景觀學系碩士論文。
16. 葉名森，2002，環境正義檢視鄰避設施選址決策之探討-以桃園縣南區焚化廠設置抗爭為例，國立臺灣大學地理環境資源學研究所碩士論文。
17. 趙永茂，1993，台灣地方黑道之形成與選舉之關係，理論與政策，第七卷第二期：19-34。
18. 蔡源德，1997，台北市路外停車場興建衝突管理分析，國立中興大學都市計劃研究所碩士論文。
19. 蔡慧姿，2001，九二一震災農村社區土地重劃衝突及管理模式之研究-以南投縣埔里鎮珠子山農村社區為例，國立台北大學都市計劃研究所碩士論文。
20. 蔡瓊宜，2002，都市交通計畫衝突管理分析，國立成功大學政治經濟研究所碩士論文。
21. 鄭傑仁，1992，台灣地區都市計畫衝突問題之研究-以草嶺風景特定區計畫為例私立逢甲大學建築及都市計畫研究所碩士論文。
22. 謝俊文，1998，環境影響評估之公共參與，高雄市政府環保局。

23. 交通部統計處，http://www.motc.gov.tw /service/index.htm
24. Cohen, Steven and Sheldon Kamieniecki, 1991, Environment Regulation Through Strategic Planning . Boulder: Westview Press.
25. Fernandes, Beryl Angela, 1987, Negotiated Approaches to Planning, Unpub. PHD of Urban Design and Planning University of Washington.
26. Gresch P, Smith B, 1985, Management Spatial Conflict: The Planning System in Swizerland, Progress in Planning,23(3).
27. Hellriegel, D., Slocum, J. W. & Woodman, R.,1986, Organizational Behavior. New York: West Publishing Company.
28. Herbert, T. T.,1976, Dimension of Orga--nizational Behavior. New York:Macmillan Publishing Co:350
29. Jonathan H. Turner, 1986, The Structure of Sociological Theory, The Dorsey press , Chicago.
30. Minnery ,John R.,1986,Conflict Management in Urban Planning, Richaed Clay Ltd, Bungay , Suffolk. England: Gower Publishing Company.
31. Pondy , L. R.,1967, Organizational conflict ：Concepts and models.Administrative Science Quarterly, 12 (2):296-320.
32. Raven, B. H. & Kruglanski, A. W.,1970, Conflict and Power. Academic Press Inc., New York:69-109.
33. Robbins, S. P.,1996, Organizational Behavior. Englewood Cliffs, New Jersey:Prentice Hall International Ltd.
34. Rochford, E. B. Jr. & Blocker ,T. J.,1991, Coping with natural hazards as stress:The predictors of activism in a flood disaster. Environment and a Behavior,23:171-194.
35. Stauart M Schmitdt and Thomas A.Kochan,1972, Conflict: Toward Science Quarterly, 17:363.
36. Susskind, L.and Ozawa,C.,1983, Mediated Negotiation in the Public Sector:Mediator Accountability and the Public Interest Problem, American Behavioral Scientist (Princeton, N.J.), 27(2): 255-279.
37. Towers, G.,2000,Applying the political geography of scale：Grassroots strategies and environmental justice, Professional Geographer, 52(1):23-36.
38. Verderber, R. F. & Verderber, K. S.,1995 ,. Inter-Act: Using Interpersonal Communication Skills. Wadsworth: A Division of International Thomson Publishing Inc.

子計畫五：

國際間共同資源的使用及管理模式研究

論文名稱

社會事業與企業公益行為探討

社會事業與企業公益行爲探討

傅篤誠 [1]

黃瑞杉 [2]

壹、前言

非營利組織面臨了具大的改變，而這樣的改變影響著我們日常生活中的每一年事情(Burton A. Wesbroadl，1998)，在國內這樣的狀況不僅是醞釀發生而已，而是已經出現，同時不只是國內就連國外也都是遭受到同樣的狀況-非營利組織受到外在環境環境的影響改變，必須面對資源匱乏的衝擊，而必須去開發營利的管理，而延續組織的生命。非營利組織商業化或企業化的現象，主要的因素來自己非營利組織財務的來源，非營利組織主要收入的來源爲社會、企業與政府；來自社會大多爲個人捐贈或會費、而當政府推動社會福利民營化的政策之下，增加了非營利組織來自於政府公辦民營的方案，契約外包是目前主要的方式之一；而最後企業的捐贈或贊助是另外的一項作法。當外在環境改變的現今，政府財政減少、個人捐贈收入不如已往及企業捐贈或贊助的金額縮水的現今，非營利組織力圖尋求解決財務問題，這是一個嚴肅的問題攸關組織延續或永續經營。九〇年代資訊科技出現革命的進展，網路科技的進步造成了人類在地球的各地的時間與空間出現了壓縮的現況。企業經營者面對著全球化，從區域性的競爭帶往全球性競爭，出現在過去企業高利潤不再，取而代之的是微利時代的來臨，企業面對這波全球化與微利時代，必須能夠讓企業能夠支撐下來，而產生了許多因應之道例如，價值鍊、策略聯盟…等，而其中一條是走入非營利組織領土，而這一塊處女地是過去營利性企業較少去碰觸，甚至過出營利性組織認爲非營利組織或第三部們是無利可圖，亦或是微利而不願花費精神去開闊這塊市場。然而企業面

---

[1] 南華大學 非營利事業管理研究所 副教授

[2] 南華大學 非營利事業管理研究所 碩士研究生

對於全球化的變局，微利或是不確定利潤的市場，尚且必須面對而努力從中榨取微薄的利潤；然非營利組織這塊處女地，雖是微利透過良善的經營未必比投入全球競爭市場來的不好。非營利組織與營利企業組織都因爲受到外在環境的影響，面臨收入來源不穩定而影響組織生存或永續，這樣的問題如同開始所述，對於我們生活事物影響愈來愈大。本文章乃針對於非營利組織轉往企業；企業投入非營利組織進行探討，試圖透過對於過去文獻的整理與分析，了解目前非營利組織與企業之間的互動關係、社會企業的可行性與企業如何進入非營利組織。

貳、社會事業

社會事業(Social Enterprise)興起背景英國與美國的非營利組織回應政府補助款的逐年下降與民間捐款的有美的情況，開始從事福利提供的營利性活動。對於非營利組織而言，尋求營利性活動收益爲對主要的價值而，對於非營利組織而言的附加價值在於營利活動的收益，可以促使組織財源的穩定性，而得以發展新型服務，提供更多元性的服務。江幸子(2003)指出根據 Dees 指出，社會事業(Social Enterprise)乃結合了社會使命的熱情與商業的革新想法(Dees,1988)，將創新、冒險等企業精神運用在追求非營利組織的使命與宗旨上。陳金貴(2002)指出美國著名的羅伯咨基金會(The Roberts Foundation)提出「新社會企業」(New Social Enterpriese)的觀念，透過社會工作、社區發展或擁有企業才能背景的在來當非營利組織的管理員，讓他們透過對於社會目的(Social purpose)創造尋求經濟活力化的願景，提供發展的機會。該基金會也進一步提出非營利企業(Non-Profit Enterprise)的定義，認爲非營利企業是一種產生收入的機制，其成立是爲了非營低收入的人們，創造出工作或訓練機會。對於社會事業的類型學者也提出看法，其中 Prabhu(1999 轉引江幸子，2003)認爲社會事業可以以各種合法的型態存在，如協會、俱樂部、合作社或代理組織…等等。而就類型而言，江幸子(2003)指出 Prabhu 將其分爲三類：

(1) 慈善類型：以提供急難救助等服務，通常跟宗教有關，成員具有熱情、強烈道德感與犧牲奉獻。贊助的人希望透過非政治或非暴力手段達成社會改革。

(2) 社會行動類型：主動尋求政治上的或社會正義的議題，有時候透過政治手段來達成社會改革。

(3) 發展類型：希望透過科技或組織的知識改善弱勢族群的經濟狀況，通常不具有社會改革的意圖

在英國 Social Enterprise London(2002)提出社會企業的三種特性：包括了

(1) 企業導向(Enterprise oriented)：直接參與市場中的產品生產或服務提供，從事實際交易，並從中獲去利益。

(2) 社會目的(Social aim)：具有明確的社會目的，包括創造工作機會、訓練及提供地方性服務；其倫理價值在於地方性發展能力的建立，責無旁貸爲其成員與廣大社會擔負起社會、環境和經濟的影響力。

(3) 社會所有(Social ownership)：是一個獨立自主的組織，以利害關係人使用者、案主和地區性社會團體或是信託人的參與爲基礎，行使治理權和所有權，利潤分配給利害關係人或做爲社區福利。(江幸子，2003；金玉琦，2003)

而英國 Social Enterprise London(2002)將英國社會企業類型分成：

(1) 爲員工所有的企業(Employee-owned business)：由工作的員工擁有股份和掌控的企業，沒有特定的結構型態，會因參與人員、公司大小以及免稅項目不同而有所不同。

(2) 儲蓄互助會(Credit union)：一種財務合作組織，成立目的在於提供存款和貸款。會員將錢存在共同基金之中，每年可獲得最高 8%紅利，同時也可有低利貸的權益。

(3) 合作組織(cooperative)：由會員組織起來支持一個可共同分享福利的機構。可以運作於各種領域，傳統的領域包括零售業、銀行業、保險業、

旅行業與儐葬業。而新型的行業在英國還包括了房屋業、照護業與業農。

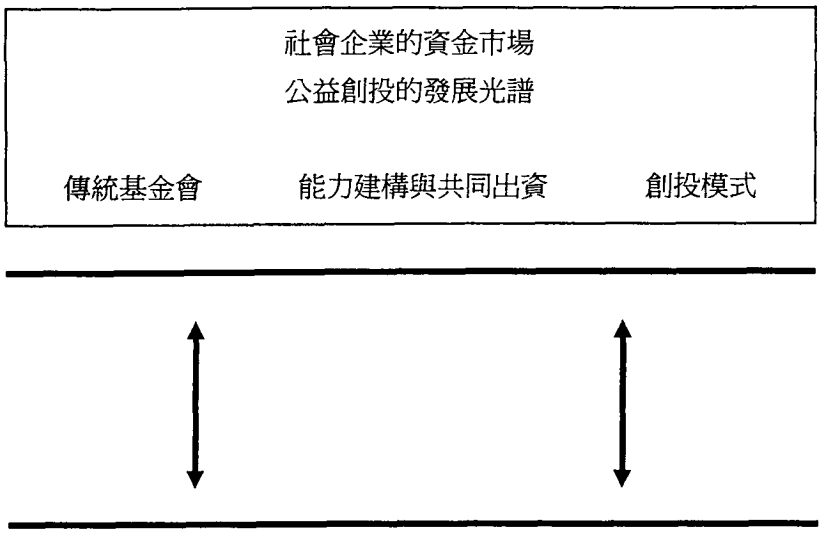
(4) 聯合發展組織(development trusts)：運作方式類似療護組織，由地方社區代表、地方企業家和社區組織代表組成董事會，舉辦各種社區再生活動。

(5) 社區事業(Community business)：是一種貿易組織，由當地社區設立、擁有與掌控。主要重點爲地方發展，最終目的是爲了當地民眾，創造自我維生的工作。

(6) 社會工廠(Social firm)：社會工廠的建立，是以市場導向追求社會使命，提供身體殘障或有其他缺陷者就業和訓練的機會，使他們自力更生。

(7) 勞工市場仲介方案(Intermediate labor market projects)：對長期失業者提供工作訓練和增加工作經驗，有時是一個獨立的公司組織有時是一個與其他組織合作的方案。

(8) 公益組織的附屬企業(Trading arm of charities)：公益商店與志工推銷聖誕卡行不通時，公益慈善組織以創新的事業投資去追求它們的目標；這些產業包括了博物館的書店 餐聽、街頭商店與志工部門也可利用政府契約增加服務工作。



社會企業的發展光譜

資料來源：Collens 1998(轉引鄭怡世，2000)

傅篤誠(2002)曾經舉出台灣地區非營利組織進入公益創投的兩個案例，一個是嘉義縣阿里山鄉的固魚季與高雄縣三民鄉楠梓仙溪高山固魚，其中位於嘉義縣阿里山鄉鄒族原住民文化，特別是在固魚季時再加上鄒族的歌舞表演吸引遊客；而後者高雄縣楠梓仙溪開放時，販賣釣魚證讓遊客到溪中垂釣。這兩個案例中前者嘉義縣阿里山鄉爲縣政府資源贊助與有關人員推動；而後者僅完完全全由當地原住民在生態保護議題中找到平衡點：「不能絕澤而漁」希望留一些魚獲給後代子孫，而讓世世代代都能享有上天提供給他們的資源。

當生態環境與觀光、休閒甚至文化保護可以結合多項功能而發展成爲某些事業經營的形態，最爲需求的是資金與經營管理的才能，而這又對企業經營模式不同，非營利組織所強調當地的特色，而這又特別發生在草根性的非營利組織身上，當企業強調組織的合併經營規模愈來愈的同時，在地社區或像阿

里山鄉固魚季則是以呈現區域獨特的風貌而吸引眾人的注意。非營利組織在經營事業或要營造一項獨別活動，必須呈現出當地地區不論是自然境觀、風俗文化、人群特質等不同的多樣性，而加入創意點子，透過在地的多樣性與獨特性加入創意的創造出的點子，使之其它地方不無仿冒(Copy)而使其能夠生存保有其生命生。

所以傅篤誠(2002)也提到不論非營利組織在公益創投或產業化的同時，它的著力點必須是在：資源與企業才能；表現在具體方式：透過自主性的方式由當地住民或需要協助的個體自己來做(Empowerment)。然而資源與經營能力藉由外來的協助，但是一旦將資源交至他們手中，訓練經營能力，逐步地由住民或受協助者接手經營，到一定程度之後資源與能力的提供便可以「收手」，再將資源轉移到其它需要的地方。

參、企業公益行爲

企業永續經濟再於企業是否能夠善盡社會責任。過去 1880 年工業革命當時尚沒有所謂的企業，而是以工頭爲主要工作的負責人；慢慢的生產者爲了能夠降低生產成本，開始將生產地點設直在水陸要衝爲能夠降低固定成本，而對於員工開始實行各種科學的生產方式，爲得是取得最大的生產利益。演變至今，企業不僅要能要取得最大股東的利益；爲了永續的經營，善盡社會責任也是現今重要的一個課題，因爲企業社會責任對影響著消費者對於購買企業產品產生影響。另外當企業步入微利時代，無不處處爭取利益，然而當市場上大多數產品的品質、售後服務大多是相同的時候，消費者會選擇具有經濟附加價值的產品，而社會的經濟附加會讓消費者產生投入社會公益的心理，而願意對其產品購買，或是企業營造出良好的企業形象塑造出陽光、朝氣的代名詞，根值於消費者心理產生長期的顧客忠誠。鄭怡世(2000)提出由於過去政府對於社會福利制度在於謀求人民的最大福祉包括了了預防或解決社會問題、實現社會正義、協助人民享有完全與美滿的生活；八〇年代政

府由「福利國利」對於福利的最大干預的思考，逐漸爲向「福利社會」或「福利社區」的趨勢，開始強調政府、非營利組織與企業參與社會福利服務，也稱之爲「混合市場經濟」，企業對於福利服務方面已逐漸開始產生提供者與供給者的角色。政府也透過立法的程序，鼓勵民間企業投入社會福利服務的工作。這上述企業面對競爭與永續的壓力、政府面對財政無法負荷及民間非營利組織發展尚未成熟的情況，針對社會福利相關產生密切連結。政府開始釋出一些興新產業以減少政府財政與人力的不足；企業紛紛開始投入過去沒有的新興的市場；而非營利組織當中扮演服務輸送，但是這三塊區域有其原先就存在的地位，而開始相互靠攏之後會出現重疊(overlap)的部分，政府、企業與非營利組織相互重疊所產生的新名詞稱之爲社會經濟「social economy」，

企業公益贊助的演進，呂怡慧(2003)六十年代，社會大眾要求企業要善盡社會責任的壓力之下，大部份美國企業會設立自有基金會，多捐助約稅前津利的百分之五爲公益基金，且成爲產業中展現對社會關注的做法，發展之今日，企業公益下範正在形成，越來越多的企業支援社會改革運動的過程中，也試圖去協助企業目標的達成。轉引郭玉禎(1999)對於美國企業公益演進作一比較：

年代	法規或社會壓力 與社會趨勢	企業公益作法
17 世紀	設立美制性條款與不成文規定，防止企業干涉社會事務。	企業領導者是美國最主要捐款人，但只是突出企業家之個人捐款而非企業捐獻，且未用來滿足企業目的之用。
19 世紀 50 年代	最高法院解除限制性條款之法規障礙，不限制企業涉入社會事務	多從事個人捐獻
19 世紀 60 年代	1.企業面臨善盡社會責任之壓力 2.企業稅前盈餘最多 5%可捐款得以免稅	企業自行成立基金會，多數積極企業如 Dayton Huson, Levi Strauss 等捐獻大量稅前盈餘，已成爲產業界展示其社會契約，盡社會責任之手段。
19 世紀 70 年代至 80 年代中期	延續 60 年代之法令放寬，而持續進行關心社會事務之企業公益	1.企業捐獻選擇對象爲跟企業所屬業別最無關係。 2.因景氣變差或盈餘減少影響，而捐獻減少。 3. 營利企業已和非營利組織有所互動。
19 世紀 80 年代至中後期至今	理念行銷新趨勢，且企業公益新典範形成	1. 企業主動舉辦贊助活動增進與消費者之溝通與公共關係，即贊助對象跟營業有緊密關係

		2. 500 大企業增加海外捐助金額。 3. 企業公益作法更爲多元化。

呂怡慧(2003)對於美國現今因經濟或某些市場擴展因素而對於止業進行減肥或裁員的同時，企業仍持續進行企業捐贈，只是其中不再漫無目的，而對於企業公益作法、將企業公益與慈善捐助作策略性考量與運用。例如運用企業社會責任與市場策略結合考量而成的-理念行銷(cause-related marketing)或有其它學者專長稱之爲善因行銷、因果關係行銷及與目的相關的行銷。相較於美國不同的作法，莊秀美(1999)日本企業對於公益贊助的熱衷程度是比個人從事公益贊助活動來的多，而日本企業在公益活動上的角色，主要是在提供藝術文化、學術研究、社會福利、國際合作等各種民間公益活動的財源、人才及經營管理。

領域別	捐贈支出	獨立的公益活動支出
學術研究	14.0	5.4
教育	9.8	5.2
藝術/文化	7.4	21.6
社會福利	6.2	10.5
休閒活動	5.1	9.3
健康/醫學	5.0	3.3
社區活動	11.7	17.9
環境保護活動	3.9	10.0

領域別	捐贈支出	獨立的公益活動支出
史跡/傳統文化	1.7	0.9
國際交流/合作	7.4	7.1
災害救助	19.9	3.2
其他	7.6	5.4

資料來源：轉引自莊秀美編譯，1999

一、企業贊助類型

鄭怡世(2000)認爲「企業的公益贊助」乃是企業組織爲實踐其社會責任，增進人類福祉與公共利益，而提供有形的財務或無形的勞務給予特定的非營利組織，以協助其完成各項與公共利益有關的活動或服務。然而各種企業贊助的方式各有不同，「企業公益贊助的架構光譜圖」(Burlingame&Frishkoff，1996；轉引鄭怡世，2000)，企業公益贊助的理念及類型中，位居光譜最左邊的是「利它主義」(altruism)，最右邊則是「善盡管家職責」(stewardship)，這是企業公益贊助的架構中左右的兩個極端，在這兩個極端的連性譜中有「分享利益」(shared benefits)、「長期的自利行爲」(enlightened self-interest)，以及「慈善投資」(charitable investment)。其意義及具體作法如圖(鄭怡世，2000)。

「企業公益贊助」位置的連續性				
利他主義	分享利益	長期的自利	慈善投資	善盡管家責任
無私地優先考慮他人的利益，亦即企業在進行公益贊助的行動時，並不會想到會從中獲得什麼好處，純粹只是想要原助他人	捐助前會先考量所捐贈的對象或其所提供的服務或活動是否爲社區所關注的問題、對受贈者是否有實質的助益，並不會期待從捐贈中能獲得什麼樣的回報。這樣的觀念通常是來自企業的負責人，其意識到協助社區解決問題、滿足需求是企業的責任，同時也樂意和社區分享其利益。	捐助的目的是期待獲得企業短期的金錢利益，並考量從捐贈中可獲得何種程度的品饋。慈善投資是期待將企業的公益贊助與企業的使命、目標與產品結合，以使公益贊助成爲企業獲利的一部分	捐助的目的是期待獲得企業短期的金錢利益，並考量從捐贈中可獲得何種程度的品饋。慈善投資是期待將企業的公益贊助與企業的使命、目標與產品結合，以使公益贊助成爲企業獲利的一部分	認爲企業最大的責任便是爲投資者謀求最大的福利，亦即企業所有的作爲，都是以提高企業獲利淨額爲優先考量，並讓投資者獲得最多的品餽
捐助方式				
匿名捐贈、合資捐贈、捐出財產	擔任志工、提供技術、提供設備、實物捐贈	與目的相關的行銷、企業資助的公益廣告、長期目標額的捐助	短期目標額的捐贈、策略的公益贊助、社會投資	以捐贈來獲得稅賦上的減免

1984 年美國「半島社區基金會」(the Peninsula Community Foundation)首創了「公益創投」一名詞，將企業創投的作爲轉化到公益領域。而這於上述「企業公益贊助」連續譜中「利益分享」有極相似之處，例如提供技術、提供設備或實物捐贈等方式；另外也有不同的地方。Christine W. Letts 等(1997 轉引金玉琦，2003)提出贊助型基金會，在涉入非營利組織活動時，除了資金的贈與之外透過對於創投概念的模式，提供技術的支援或參與管理運作。而金玉琦(2003)指出 NESsT 所提出的公益創投定義爲，公益創投是一種具有雙重底美的公益投資，即以非營利組織社會公益使命與本質，結合商業創投基金模式的長期投資，其基本策略爲將資金投入非營利組織或社會企業，並協助內部管理能力建構或技術支援。目前公益創投在台灣正在開始發展，而企業所投入模式尚未能如同上述定義，真正屬於公益創投模式，而偏向屬於「企業公益贊助」形態爲最多，本文中乃針對於「企業贊助公益」行爲做探討，而略過對於「社會公益創投」(Social Venture Philanthropy)的論述。

鄭怡世(2000)五〇年代早期美國的企業組織對於企業公益贊助仍落在「善盡管家職責」的思考脈絡，也就是圖(　)所指企業組織普遍認爲管理者的責任是爲股東及投資者的報酬求取最大的利益。企業逐漸(原因)轉爲「長期的自利」及「利益分享」的層面；然全球化競爭與微利時代，對於純粹表現在利他主義及利益分享的公益贊助方式的思考方式，而不顧及企業股東與利潤的考量所產生的衝突，逼漸企業也開始對於企業公益贊助產生新的策略來因應解決上述問題。謀求企業與公益讚助兩者的平衡乃對於企業開始思索贊助的策略，而不是漫無目的地將所有資源投入於不熟悉的公益組織或活動。企業公益贊助逐漸形成對於捐助採取具有策略性性質的投入，企業能夠對公益贊助以有限的資源集中在促使企業能夠獲得最大的利益，這裏的利益不僅限於企業利潤、銷售成長…等，更加包括了企業形象、社會責任等；透過策略性捐贈或贊助來展現對於社會關懷與增加企業活力的機會，而這時候的企業公益贊助所浮現的是如何進行贊助策略(鄭怡世，1999)。

二、企業贊助公益活動的動機

企業對於贊助公益活動項目有很多，然而對於企業本身贊助公益本身有涉及到的動機是什麼呢？爲什麼企業會選擇贊助公益活動。呂怡慧(2003)整理對於企業組織贊助公益活動之動機，相關學者專家的意見，透過檢視對於過去學者專者對於企業贊助公益活動的探討，得到未來非營利組織能夠從企業組織獲得資源協助：

(一)、Glaskiewiez(1985 轉引葉淑貞，1998)認爲企業贊助公益的動機爲

(1) 對於銷售的動機：企業贊助公益活動最典型的短期目標，無非是爲了增加消費者對產品或企業的好感，以促進產品銷售。但是另一方面公益活動如何過於富於商業色彩的話，反而會遭至非議。

(2) 競爭的動機：市場上同業間如何愈來愈普遍的從事公益贊助活動，而會形成同業之間的壓力，造成企業體本身因爲外在壓力而被動式地投入公益活動，買加消費者對於比較同業之間對於社會公益的落差。

(3) 減稅的動機：政府爲了鼓勵企業能夠從事公益活動，乃會針對部分稅制採取減稅或優惠的措施，對於企業而言，能夠從事公益活動之餘，進而減少稅金的支出也不外是一件益事。

(二)、Siegfroed & McElroy(1980 轉甲王學孔 1986)：

Siegfroed & McElroy 這兩位學者曾經對美國企業做過調查，而調查結果顯示在受訪企業的心目中，歸納出企業認爲贊助公益活動最重要的前十項原因：由表顯示出 Siegfroed 與 McElroy 的調查企業責任所占比例較高。

排名	企業認爲重要的原因	該項目企業認爲重要的比例(%)
1	企業責任	83.3
2	建立健康、福利好的環境	56.2
3	改善文化環境	47.6
4	藉由教育改善員工素質	45.4
5	維持非營利組織的活力	35.8
6	改善企業形象	27.5
7	鼓勵其他人或機構贊助	26.2
8	改善公益活動的效率	21.4
9	提昇員山的士氣	16.0
10	支持獨立的研究	9.2

根

三、Marx(1998 轉引郭玉禛，2000)對於美國 226 個企業組織的管理階層進行企業從事公益行爲之目標價值的動機要素郵寄問卷調查，調查結果顯示：

企業目標價值	個數	所占百分比%
協助社會與提高生活品質	187	96.4
獲得企業形象	186	95.9
社區服務	182	93.8
種族和諧	162	83.5
獲取正面的媒體曝光	155	79.9
員工忠誠度	154	79.4
員工福利	142	73.2
吸引並保有高素質員工	127	65.5

企業目標價值	個數	所占百分比%
擴充現存市場	98	50.5
進入新市場	93	47.9
產品或服務的銷售	75	38.7
減少政府管制	67	34.5
稅賦減免	52	26.8
降低法律成本	39	20.1

資料來源：Marx(1998 轉引郭玉禎，2001)

Marx 調查結果所得到的企業贊助公益的目標價值，管理階層人員的認知是以協助社會提高生活品質、獲得企業形象與提供社區服務爲最多。

四、對於台灣本土方案的研究，劉念寧(1990)也針對於天下雜誌所公佈之「1989年天下 1000 大企業排行榜」中的企業組織進行問卷調查，對於企業贊助公益活動的機構最主要的是以社會責任、企業形象、單純的爲善與提昇員工整體生活品質爲主要動機。

彙整以上個學者所看法整理出企業贊助公益行爲動機，可以分爲長期自利的考量、短其自利的考量與其它考量：

(一)、長期自利考量

(1) 提昇企業形象：

所謂企業形象是指企業體在確定長期經營理念下，結合其系統化發展而成的一種形象。在消費者心目中，企業形象會直接、間接的影響到銷售成績，而擁有良好的企業形象在對未來產品之銷售推展將更加順暢。

(2) 善盡企業社會責任：

企業爲社會的一份子，而企業的利潤取之於社會，則回饋社會、用之於社會是企業的責任。當企業透過各種公益行爲改善社會環境，並提高人們的

生活水準，進而提高購買與消費的能力，整體的商業環境提昇，企業的獲利也能提高。

(3) 降低企業的負面形象：

企業以營利、獲利爲目的，容易以起社會大眾的負面印象。而採行贊助公益可以獲得正面形象，還可以具有平緩來自消費者團體或顧客的聯合抵制或抗議行動的功能；只企業贊助公益時應特別注意對於明顯在塑造企業商品的行爲也可能遭到批評的負面效應。

(4) 提昇品牌知名度：

從事公益活動時可以得到媒體的關注，提昇企業的知名度，許多企業都將公益活動視爲廣告的一部份，甚至將公益活動上媒體的時間、篇幅等作爲活動績效指標。

(5) 創造顧客忠誠度：

當企業在採行善因行銷之後，顧客在消費選擇上就有了與其他產品不同的思考，特別是長期關注或支持這個企業所選定主題的消費者，會成爲這個品牌的忠實客戶，而企業的產品也與競爭者有了市場區隔。

(二)、短期自利考量

(1) 作爲行銷策略工具

促進顧客初次購買與再次購買的意願、數量，創造不斷增加的銷售額。

(2) 進入新市場

藉由公益的形象打響知名度，作爲攻佔新市場的利基。

(3) 提高企業的品牌價值

提昇品牌知名度與顧客的認同，並且與其競爭者形成市場區隔

(三)、其他附加效果

(1) 增加員工的認同感

採行善因行銷的企業可以使員工增加對企業的認同感，若企業有鼓勵志工的方案，則員工更可能得到工作以外的滿足和成就感。

(2) 視爲減稅的策略

國內外的稅法對於捐款給爲公益而設立的組織上的賦稅優惠，都有明文規定，因此賦稅上的考量往往也是企業從事善因行銷的考量。在這方面日本是一個特殊的例子，在日本企業比個人從事更多的公益贊助活動，包括現金捐贈或組成志願工作服務隊，因爲日本對企業與個人的課稅制度是不一樣的，個人所得稅的課稅率最高可達 65% (國稅 50%，地方稅 15%)，反之對企業的稅率最高僅達 50% (國稅 37.5%)，因此企業的捐贈多於個人的捐贈，其架構爲個人放棄些許所得，再由企業進行捐贈(莊秀美編譯，1999)。

肆、總結

上述我們探討的議題中，其中的一部分是非營利組織面對了外部環境的改變，而這個改變也許是來自於政府與企業的補助或捐贈減少了；也可能來自於內部捐款者的改變。總而言之乃造成了非營利組織對於持續經營產生危機，或許多人會提到非營利組織是可以進入冬眠期或呈現休息的狀況，等待時期再重新出發等觀點，但是對於非營利組織存在的意義乃是爲了提供社會福祉，或是針對政府未能關心，爲非主流的社會團體所存提供資源轉介與聯結，所以這些非營利組織所爲了能夠生存必須花費更多的時間撰寫政府方案或是尋求個人捐贈或是企業的贊助，另一種可能是設法自立自強賺取商業利益，當中有許多方法例如，販賣商品、勞務、代工…等能夠獲取利益的收入的活動，這是上述社會事業所提到的重點。本文的另外一個重點是企業再全球化與微利時代，產業間競爭壓力之下，不斷地壓縮利潤以求得企業的利益。而企業也關注到企業不僅要具有對於產品品質的保證或具研發研究的趨勢之外，社會責任(Social Responsibility)也必須能夠所有體認。上述對於企業贊助公益的動機多位學者的調查研究中，企業贊助公益當然包括了對於產品販售增加爲其重視的目標之一，然而更多是重視企業贊助公益所能夠帶來的是對於長期企業社會責任的交代、企業形象的建立、企業員工之間的認同與顧客對於產品所帶來的附加價值。

伍、參考書目

王學孔(1986) 企業形象對消費決策影響之研究，台北：國立政治大學企業管理研究所碩士論文。

李艾佳(2003) 「第三部門發展新趨勢：非營利組織產業化」，新世紀智庫論壇，22：81-90。

別蓮蒂、游舒惠(2002) 「公業贊助公益活動之動機、決策與影響因素」，廣告學研究，18：53-95。

金玉琦(2003) 非營利組織資源開發新途徑-公益創投與社會企業之可行性研究，嘉義：南華大學非營利事業管理研究所碩士論文。

江幸子(2003) 照顧服務產業之本土性案例-非營利組織觀點的分析，嘉義：國立中正大學社會福利研究所碩士論文。

莊秀美編譯(1999) 「日本企業的公益贊助」，社區發展季刊，85：251-262。

呂怡慧(2003) 台灣百貨事業贊助公益活動現況研究，嘉義：南華大學非營利事業管理研究所碩士論文。

陳金貴(2002)「非營利組織社會企業化經營探討」，新世紀智庫論壇，19：39-51。

傅篤誠(2003) 非營利事業行銷管理，嘉義：中華非營利組織管理學會。

傅篤誠(2002) 非營利事業管理-議題導向與管理策略，台北：新文京文化公司。

鄭怡世(2000)「淺論企業的公益贊助-社會福利的另類資源」，社區發展季刊，89：201-214。

郭玉禎(2000) 台灣企業基金會現象與經營管理之研究-以大型企業基金會爲例，高雄：國立中山大學企業管理研究所碩士論文。

葉淑貞(1998) 非營利組織的經營管理-以企業文教基金會爲例，彰化：大葉大學事業經營研究所碩士論文。

劉念寧(1990) 大型企業贊助公益活動之研究，台北：國立台灣大學商學研究所碩士論文。

Burton A. Weisbroad (1998) To Profit or Not to Profit, United States: Cambridge University Press.

Dee, J. Gregory (1998) "Enterprising nonprofit", Harvard Business Review, 76(1):55-67.

Social Enterprise London (2001) "Social Enterprise: Organizational Development Issues", http://www.sel.org.uk/publication.html

子計畫六：

社區營造永續觀光策略評估模式之研究

論文名稱：

玉山國家公園塔塔加至玉山主峰線設置空中纜車之可行性評估

玉山國家公園塔塔加至玉山主峰線設置空中纜車之可行性評估

沈 進 成*
旅遊事業管理研究所副教授

Yushan Nation Park :the possidility of an air cable car from TATAKA area to Yushan main teak

摘要

為因應政府「觀光客倍增計畫」政策的推動，加強玉山國家公園觀光資源的利用，避免因步道過度開發而破壞環境平衡等之因素考量下，本研究擬研議出空中纜車，運送遊客於塔塔加至玉山作深度之生態旅遊，並希望藉著纜車的運送，除能均衡提供各類遊客的遊憩需求，經由親身視覺的觀感，能體會國家公園對生態保育的努力及其重要性外，更能結合當地附近遊憩資源，重振觀光產業。根據回收問卷統計，在纜車運輸市場規模上，多數遊客均有強烈搭乘搭乘纜車去欣賞玉山、鳥瞰生態風光及重遊的意願，多數遊客並希望未來纜車能藉由民間經營、政府監督的模式下，界定合理的票價及提供完善的旅遊資訊服務。由專家學者填寫之問卷，在考量技術、法令、環境影響、景觀及財務等因素下，藉由層級分析法(AHP 法)評選出以同時可載送一般遊客鳥瞰風光及登山客攀爬玉山之對開式纜車系統，由塔塔加遊客中心為起點，經由玉山西峰為中間站，到達玉山北風為中點之方案最為專家學者所接受。本研究除發現纜車設置因多數遊客強烈搭乘意願而有廣大市場外，專家學者所評出纜車營運路線亦能同時滿足一般遊客及登山客的遊憩需求，此結果應可為政府在符合國家公園保育理念下，考量當前觀光政策、遊客需求及未來發展政策之參考。

【關鍵詞】空中纜車、生態旅遊、層級分析法

*南華大學旅遊事業管理研究所，嘉義縣大林鎮中坑里中坑32號。E-mail:sccheng@mail.nhu.edu.tw
TEL：(05)2321001 轉 2061

Abstract

According to promote the governmental bill-'Plan for Double-Increase Tourist' and emphasize to utilize Yushan National Park tourist attractions, we concluded the Aerial Cable Car, transporting tourists from Tanaka to Yushan deep natural environment tour. By using Aerial Cable Car, we could responseagainst tourist's several desires and their visual experience to understand and realize National Park has been made a continuous efforts to the ecological preservation and it's importance and furthermore it will be connected with the local tourist attractions and it promote the tourist industry.

According the analysis of the market research and the scale of the Cable Car market, a large majority of tourist wish strongly to go to I'san and see the ecology of nature by the bird's eye view repeatedly by Cable Car. Also a majority of tourist hope the management operation of Cable Car will be entrusted to the private in the future under the government's control such as reasonable fair and offer a perfect tour information.

In the research to the Expert, AHP system is accepted by considering the elements of the technique, the laws, the environment influence, the landscape and the finance etc., which will be transported the tourist and the a mountain climber at the same time using a shuttle system at the starting place-Tanaka tourist center through Yushan west peak and reach to the North peak as a route.

By our closer research, the installation of Cable Car is not only well accepted by the majority tourist expanding the market but Expert commented the operating route will give a satisfaction to the tourist and climber's needs. Under the circumstances, Government could be considered a present touring policy to response the tourist's hope considering an idea of what National Park of n ature preservation ought to be.

【Keywords】 Air Cable Car 、Eco-tourism 、 Analytic Hieraechy Process

一、前言

1.1 研究動機

「永續發展」依地球高峰會議時聯合國秘書長蓋里於開幕致詞中所做的定義為：「發展係滿足現階段之需求、且不損及未來世代之福祉。將永續發展定義為：「既能滿足當代的需要，同時又不損及後代人滿足其本身需要的發展能力」。永續發展的目的在於滿足現在及未來人類的需要，並使世界上資源能重新分配給所有的使用者，確保世代間及各群體間的公平性。

隨著社會經濟的繁榮，所得逐漸提高，工作時間的縮短，人們的生活習慣和休閒態度隨之改變，國人從事觀光遊憩活動日益頻繁。由於旅遊休憩活動的人數增加、旅遊時間的延長及旅遊資源使用的密集等因素，而使遊憩環境遭受嚴重破壞。遊憩衝擊的正面效應包括：1.心理上的利益：遊樂者在經過心理上和經驗上的滿足後，則能提高其身心的平衡發展或穩定性。2.行為上的利益：能改變個人和團體的行為，而善導到較高層次的舉止。3.教化社會的效果：能建立社會倫理、道德與秩序。4.帶動地方性或區域性之經濟繁榮：促進無煙囪工業發展與增加就業及收入。5.群體之和諧：個人與社會間之交互作用能更臻祥和樂利。而遊憩的負面效應包括 1.生態環境之衝擊：遊憩活動造成資源與環境的破壞。2.景觀心理之衝擊：遊憩區的開發、使用，所造成的景觀破壞，以及因擁擠造成的滿意度降低。3.經濟與社會之衝擊:因為發展遊憩而對當地之經濟及社會狀況的急速改變。4.政治與法律之衝擊：如森林保育與礦業開發之間的衝突性及不相容性，即會引發政治與法律層面的影響。在遊憩發展的過程中，如何在遊憩發展、資源保育與環境永續利用間取得平衡發展，創造及發展一個具有本土化、生態化、多元化價值均衡系統的優質的環境系統，以增進社會大眾的福祉，益顯其重重性。

玉山國家公園由於具備地理及地形上獨特性，自然景觀及動、植物生態體系保存的完整性，以及歷史遺跡可研究的價值性，在保育、育樂、研究之目標經營下 ，一直是國人進行戶外旅遊所嚮往的去處。尤其以塔塔加至玉山主峰線，沿途步道系統完整，遊憩設施完備，可及性高，除有原始自然之動植物生態景觀外，並有豐富之地形、地質及水文景觀，一直是遊客及登山界進行生態旅遊的最愛，每遇假日登山客更是絡繹不絕。塔塔加遊憩區從八十年開放入園管制後，遊客量均在每年一百萬人次，呈穩定成長。即使因八十七年間九二一大地震造成新中橫公路嚴重損毀，遊客量因而驟減。因經地震災損的修復，塔塔加遊憩區風景的宜人，全年遊客量亦回升到六十餘萬人次，其人數有逐年上升之趨勢。基於對玉山自然環境的喜好，平均每年均有 50 萬人申請入山，為避免過高的遊憩活動導致生態環境及景觀資源永久性破壞，使資源無法做最有效的利用與再生，在「承載量管制」的消極手法下，實際核可登山的人數僅為 6 萬人，也因此造成多數嚮往玉山的遊客無法同少數經核可的遊客同樣享有共同生態遊憩體驗，使遊憩資源無法做最有效的運用，此舉除是玉山國家公園經營管理一大衝突點外，亦是多數遊客

每至塔塔加旅遊的一大憾事。

由於近年來國內交通運輸的便捷，經濟穩定的成長，以及社會風氣的導向，使國人從事休閒活動的行為加劇，加上政府推動觀光發展政策、遊客倍增計畫方案之執行，國家公園在經營管理上應隨潮流所趨，去構思如何在不違背既有的保育政策，發展國家公園整體觀光計畫，構建適當遊憩模式，提昇塔塔加遊憩區遊憩品質，並結合鄰近的日月潭及阿里山兩大遊憩資源，使之形成一塊完整生態旅遊帶，以吸引多數遊客，重振嘉義及南投觀光產業。隨著近百年來纜車系統技術發展的快速，加上其對惡劣環境的克服性高，國內外設置纜車據點數眾多，尤以法國、奧地利、瑞士、加拿大、美國、日本及中國大陸等知名遊憩區裝設最多。上述諸多先進國家之國家公園、風景區及景觀據點使用纜車多年後，由於纜車具有安靜、便捷、快速、成本低廉及其設施對環境衝擊少之特性，對當地觀光資源之整合頗有助益，普遍獲得民眾良好之評價。玉山國家公園考量當前觀光發展政策、遊客需求及未來發展政策等因素，在符合國家公園對環境保護之理念下，研擬塔塔加－玉山主峰線設置空中纜車以運送遊客。有鑑於此，本研究案乃從當地環境資源、生態保育、經濟影響、市場需求、可行技術等構面，來進行玉山國家公園設置纜車之可行性評估，以作為政府相關單位施政之參考。

1.2 研究目的

本研究欲達成的目的包括如下：

1.探討現行塔塔加遊憩區登山及旅遊型態，了解遊客遊憩動機及體驗感覺，作為遊憩開發之參考。

2.探討各項資源運用(建設經費、遊憩資源) 情形，以及對環境影響狀況，評估其合理性及永續性。

3.分析遊客對於塔塔加－玉山主峰線提供空中纜車之接受度，作為設置可行性分析之參考。

4.分析設置塔塔加－玉山主峰線空中纜車對玉山國家公園於市場面、技術面、法令面、環評面、景觀面及財務面之影響，進而對塔塔加－玉山主峰線空中纜車型態及路線之可行性做評估。

1.3 研究範圍

塔塔加遊憩區為玉山國家公園中部地區一處重要遊憩據點。向東可眺望玉山主峰、連峰之高山景觀，往西隔神木溪與祝山、塔山山脈相望，清晨、傍晚在山壑間常有雲海、山嵐形成；在入冬之際，附近山區台灣紅榨槭變紅時，楓紅景色在翠綠森林中，更顯得驕艷美麗；在春分清晨季節，山間林中盛開的森氏杜鵑白裡帶紅的花朵為大地添粧了彩衣，塔塔加(TATAKA)曹族原住民語言，意為寬闊、平台草原的地方。海拔 2610 公尺塔塔加，是新中橫公路最高點，也是嘉義－玉山段台 18 線與水里－玉山段台 21 線公路之交界點，往嘉義阿里山方向為台 18 線，往南投信義方向為台 21 線公路，因為環境優美及交通便利，每年平均吸引遊客一

百萬人次左右。玉山國家公園為提供國人賞景及健行等遊憩活動，在塔塔加地區規劃一處遊憩區，開闢步道系統，設置遊客服務中心，並配合解說員、各項牌示、多媒體等解說設施，讓遊客享受一趟有意義的國家公園生態之旅。

1.4 研究架構

本研究架構概如圖 1 所示。第一階段為探討使用者對現有制度的看法，第二階段了解塔塔加遊憩區資源特色、觀光政策及國家公園發展計畫、現有旅遊形態及預期未來發展模式，第三階段則依市場面、技術面、法令面、環評面、景觀面及財務面等六個構，透過問卷調查方式評析出纜車運輸之需求性，第四階段由專家學者篩選最佳纜車型式及營運路線，第五階段為整理與分析資料，並撰寫結論與建議。

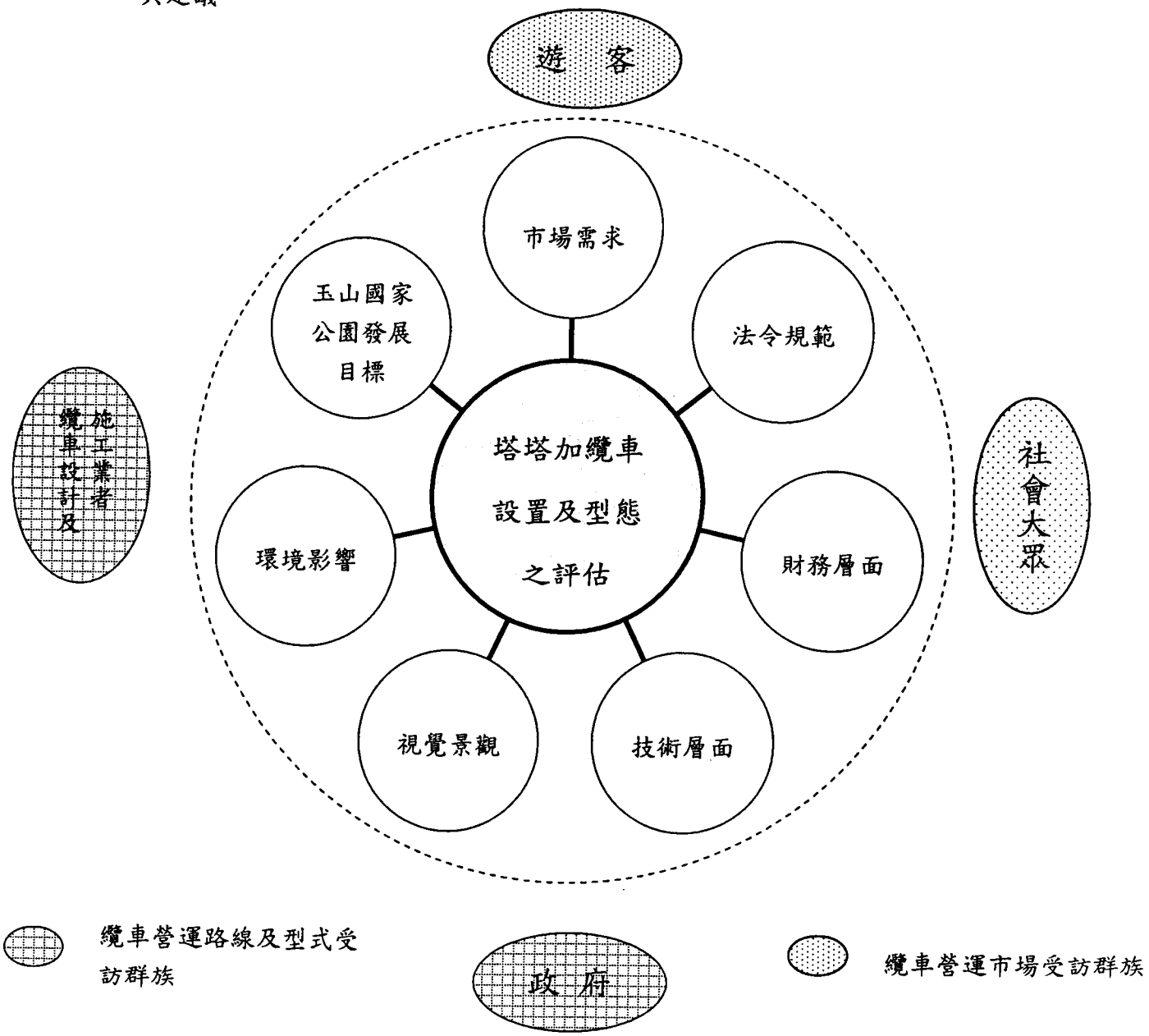


圖 1 研究架構圖

貳、文獻回顧

2.1 塔塔加遊憩區設置空中纜車適法性分析

依據國家公園法第十四條規定：一般管制區或遊憩區內，經國家公園管理處之許可，得為左列行為：1.公私建物或道路、橋樑之建設或拆除。2.水面、水道之填塞、改道或擴展。3.礦物或土石之勘採。4.土地之開墾或變更使用。5.垂釣魚類或放牧牲畜。6.纜車等機械化運輸設備之興建。7.溫泉水源之利用。8 廣告、招牌或其他類似物之設置。9.原有工廠之設備需要擴充或增加或變更使用者。10 其他須經主管機關許可事項。前項各款之許可，其屬範圍廣大或性質特別重要者，國家公園管理處應報請內政部核准，並經內政部會同各該事業主管機關審議辦理之。發展觀光條例第七條第 2 款：國內重要觀光地區，應是需要建立交通運輸設施，其運輸工具、路面工程及場站設備，均應符合觀光旅行之需要。

2.2 永續發展

當全球環境與發展議題的形成，資源環境問題的惡化及其對人類生存的威脅，乃引起世人對社經發展結構上的反省，永續發展則是針對此危機所提出的解決方案與構想。在永續發展理念的探討上，按照世界環境發展委員會(The World Commission on Environment and Developmen)的闡述，以下面兩種理念模型最能掌握資源與環境問題在人類未來發展中時間上及程度上的威脅性：1.世代正義模型－永續發展乃是滿足當前需要的發展，而不去危害未來世代滿足其需要的能力。2.自然承載能力模型－永續發展中的社經發展必須保持在自然承載能力的範圍之內，使其不對自然環境造成無法挽回的危害（Richardson, 1994）。Hetzer(1965)對永續發展最直接的定義：是 1.最小的環境衝擊；2.對當地文化最小衝擊；3.對地主有最大經濟效益；4.遊客有最大遊憩滿意度。1991 年「國際自然和自然資源保護聯盟」(Union for Conservation of Nature and Natural Resources, IUCN)、「聯合國環境規劃署」(United Nations Environment Programme，UNEP)及「世界野生動物基金會」(World Wild Fund for Nature, WWF)三個國際保育組織在「關心地球(Caring for the Earth)」報告中強調永續發展定義是：「生存在不超出維生生態系統容受力(carrying capacity)的情況下，改善人類的生活品質」。Hunt(1992)認為永續發展是種"新觀光(neo-tourism)"活動，生態/自然觀光是長期觀光的結果，如果發展適當可以保護與保育獨特的自然文化環境，生態觀光提倡者相信者是"仁慈與溫和的觀光"不需要大量與深度的發展或簡化環境社會活動。永續發展的理念與意義源自於國際上對於全球環境與發展問題的省思與共識，其實踐則需仰靠各國在地方的層面上推廣，以形成一股全球性的改革運動。永續所表達的一個重要意義在於，當非再生資源的物理量減少時，必須提供取代性資源以供使用；而這些資源被使用後對環境產生的影響必須保持在地球可吸納此影響的承載能力範圍之內（Pearce, 1993）。1972 年，世界知名科學家及經濟學家所組成的「羅馬俱樂部」發表「成

長之極限（The Limits to Growth）」報告書指出：由於人口急遽增加、追求經濟發展造成地球資源及能源（包括礦產、化石燃料、森林及生物資源等）逐漸減少，再加上公害污染致使環境生態不斷的遭受破壞，因此，人類的成長將於數十年內將到達極限。聯合國於同（1972）年召開「人類環境會議」，發表「人類環境宣言」，呼籲全球合力保護地球資源，並將之傳至後世子孫。1992 年超過一百位國家元首出席由聯合國主辦的「地球高峰會議（Earth Summit）」，一致支持永續發展（Sustainable Development）的理念，並通過「聯合國廿一世紀議程（Agenda 21）」做為全球推動永續發展的行動方案;此外亦發表共同聲明「里約宣言」，強調全民共同參與、發揮「夥伴關係（Partnership）」是追求永續發展的重要性關鍵。

2.3 遊憩纜車系統

纜車系統近百年來的技術發展快速，且大部分裝設在惡劣嚴苛的環境下，譬如冰天雪地的滑雪勝地、終年潮溼的大瀑布邊、鹽害威脅的(香港與新加坡)海上纜車、雲霧繚繞的(黃山)纜車或乾燥沙漠邊緣的(長城)纜車，日本箱根纜車也須經歷溫泉與冰雪環境的嚴苛考驗，迄今都能安全運轉。現國外已裝設的纜車據點則已超過一萬多處，以法國、奧地利、瑞士、加拿大、美國、日本、紐澳等旅遊風景區或滑雪勝地裝設最多，中國大陸也在黃山、長城等許多風景據點裝設纜車系統。國人出國觀光可能較熟悉的為香港海洋樂園、新加坡聖淘沙、日本箱根...等，均可搭到纜車，感受絕佳的景觀遊憩體驗。而目前台灣地區則共有烏來雲仙樂園、日月潭九族文化村及花蓮海洋公園裝設有纜車系統，烏來雲仙樂園裝設的是對開式纜車系統，跨越距離大，跨過峽谷與瀑布，造價較高，運輸量也較低；九族文化村及海洋公園則是採用單線自動循環式的纜車系統，單向運輸能量較高，私密性亦較佳，目前係作為園區內之遊憩系統使用。空中纜車系統已在歐、美、日等先進國家之國家公園、風景區、觀光遊憩據點使用多年，對當地之觀光資源之整合獲得良好的評價。

三、問卷設計

3.1 市場特性

本研究在問卷內容結構上共分五部分：1.旅遊特性：旅遊訊息得知、搭乘的交通工具、旅遊伴侶、旅遊天數、旅遊次數、旅遊目的、重遊意願。2.旅遊動機：攝影、聯誼、公務、森林浴、欣賞風景、靜坐沉思、登山健行、賞鳥賞蝶、打發時間、繪畫寫生、學術研究、滿足好奇心。3.行前期望與實際感覺：遊憩活動及心理體驗。4.塔塔加至玉山線纜車運輸選擇特性：玉山國家公園內纜車設置之贊同性、搭乘纜車意願度、合理票價之認同、搭乘纜車之主要理由、纜車玉山端設置位置、纜車站應提供之服務項目、纜車開發及經營管理方式、重遊意願。5.遊客基本資料：遊客性別、年齡、教育程度、職業、平均月收入、婚姻狀況及居住地。

3.2 塔塔加遊憩區纜車路線及型式評估分析

採用 Saaty（1971）所提出之層級分析法(Analytic Hierarchy Process，AHP)來進行模式之評估。AHP 法主要應用在不確定情況下極具有多數評估準則的決策問題上。其目的是將複雜的問題系統化，透過不同的層級分解，透過量化的綜合評估，以提供決策者選擇適當方案的資訊，降低決策錯誤的風險。本研究評估層面分為「整體發展」、「市場需求面」「法令」、「環境保育」、「工程技術」、「財務」等六個層面，整合各評估項目之績效值後，再圈選出整體最適合之方案。相關評估準則非常多，而 AHP 法能透過層級分解將複雜的問題系統化，可求取各準則之權重以顯示各準則之重要性，同時能進行量化的綜合評估，以提供決策者選擇適當方案的資訊。

四、實證分析

4.1 樣本結構分析

本研究總計發出問卷 430 份，問卷回收 416 份，其中無效問卷 20 份，共得有效問卷 396 份，有效問卷回收率為 92.09 %。經由回收有效之遊客問卷就其基本資料採敘述性統計分析，針對受訪者之性別、年齡、教育程度、職業、平均月收入、婚姻狀況、居住地點等項進行以下分析與描述，如表 1 所示。1.就性別而言，以男性稍居多，佔 54.5%，女性佔 45.5%。2.年齡分佈分別以 31-40 歲者最多佔 36.2%，其次為 41-50 歲佔 23.3%及 21-30 歲佔 21.5%，最少者為 61 歲以上者佔 3.2%，由此可知，年齡層分佈大多是屬於青年及中年。3.在教育程度方面，以專科佔 31.4%最多，其次為大學佔 29.8%及高中職佔 21.5%，再其次為研究所及以上佔 9.8%，國中佔 5.6%，小學或以下最少，佔 1.9%；可見本遊憩區頗受高教育程度遊客的青睞。4.在職業方面，以公教人員佔 30.1%最高，其次為商業佔 26.8%及工業佔 14.8%，學生及無業（退休、家管、求職中）亦分別佔 10.1%及 11.6%，最少為軍警業及農林漁牧業各佔 2.8%及 1.0%，其現象或與目前政府推動周休二日有相當關係。5.對於平均月收入方面，其中以 4-5 萬元佔 22.4%為最高，其次為 5-6 萬元者佔 18%，最少者為 9-10 萬元以上佔 0.8%。6.在婚姻狀況，已婚（有小孩）佔 60.1%最高，其次為未婚佔 28.0%，而已婚（無小孩）佔 11.9%最低，可推測來此風景區旅遊者大部分應有攜眷。7.遊客居住地點以中部（苗栗、台中、彰化、雲林、嘉義、南投）地區最多，佔 63.2%，其次為北部（基隆、宜蘭、台北、桃園、新竹）地區佔 20.2%及南部（台南、高雄、屏東）地區佔 14.3%，最少為東部（台東、花蓮）地區最少，佔 2.3%，可見遊客多來自中部地區，與塔塔加遊憩區位於台灣中部有其地緣性關係。

4.2 遊客市場特性分析

表 1 遊客基本資料分析表

項目		人數	百分比%	項目		人數	百分比%
性別	男	218	54.5	平均月收入	10000 元以下	41	10.4
	女	178	45.5		10001~20000 元	15	3.8
年齡	20 歲以下	25	6.3		20001~30000 元	68	17.1
	21~30 歲	85	21.5		30001~40000 元	58	14.7
	31~40 歲	143	36.2		40001~50000 元	89	22.4
	41~50 歲	92	23.3		50001~60000 元	71	18.0
	51~60 歲	38	9.5		60001~70000 元	26	6.5
	61 歲以上	13	3.2		70001~80000 元	12	3.0
教育程度	小學或以下	7	1.9		80001~90000 元	5	1.3
	國中	22	5.6		90001~100000 元	3	0.8
	高中職	85	21.5		100000 元以上	8	2.0
	專科	124	31.4	職業	農林漁牧業	4	1.0
	大學	118	29.8		工	56	14.3
	研究所及以上	39	9.8		商	106	26.8
婚姻狀況	未婚	111	28.0		軍警	11	2.8
	已婚-無小孩	47	11.9		公教	19	30.1
	已婚-小孩	238	60.1		學生	40	10.1
居住地	基隆、宜蘭、台北、桃園、新竹	80	20.2		無	13	3.3
	苗栗、台中、彰化、雲林、嘉義、南投	250	63.2		其他	45	11.6
	台南、高雄、屏東	57	14.3				
	台東、花蓮	9	2.3				

遊客的旅遊特性包括旅遊訊息得知、搭乘的交通工具、旅遊伴侶、旅遊天數、旅遊次數、旅遊目的、重遊意願等七項進行分析，結果如表 2 所示。1.遊客如何獲得塔塔加遊憩區旅遊資訊，其中透過旅遊雜誌佔 49.0%最多，其次為電腦網路佔 38.1%及親朋好友的 35.6%次之，最少者為觀光宣傳摺頁佔 21.1%；顯示遊客外出至塔塔加遊憩區旅遊時，專業報導的旅遊雜誌、電腦網路及親朋好友事前的介紹是決定成行的重要因素。2.對於遊客前來所使用的交通工具，以自用車佔 82.1%最多，其次為遊覽車佔 12.9%，最少為機車佔 2.0%；可知在公眾運輸尚未發達的塔塔加遊憩區仍以便利的自用車及團體使用的遊覽車較為大家所接受。3.旅遊同伴方面，主要為家人親戚佔 64.1%，其次為朋友同事佔 24.7%，單獨前來佔 5.6%，最少為同學師長佔 2.3%；可知家庭式的旅遊是此次調查的主流，而機關團體及散客

則比較少，是未來可加強推廣的對象之一。4.對前來次數問項中，則以第一次前來佔 34.1%為最多，第二次前來佔 28.3%及第五次以上佔 18.9%次之，第四次前來佔 4.3%為最少；可知本遊憩區對遊客再度參訪的誘因非常強烈。5.停留時間方面，以一天佔 44.7%為最多，其次為二天佔 38.9%，再其次為三天佔 13.6%，最少者為四天以上佔 1.0%；顯見本遊憩區無論是漫遊性質或停留過夜皆宜，惟對遊客停留過夜之設施(如住宿、餐飲)仍待加強。6.至本遊憩區旅遊的目的，則以欣賞風景佔 81.3%為最多，其次為森林浴佔 50.6%、登山健行佔 43.4%、賞鳥賞蝶佔 32.1%及攝影佔 23.2%次之，最少者為學術研究佔 3.0%為最少；可見本遊憩區因天然環境所致，遊客前來主要以接近大自然、放鬆自我為目的。7.對重遊意願方面，回答願意佔 56.1%最多，非常願意佔 26.0%次之，普通佔 14.6%，回答不願意佔 0.5%最少；可顯示本遊憩區應有其發展潛力。

表 2 遊客旅遊特性分析

項目		人數	百分比%	項目		人數	百分比%
旅遊資訊	電腦網路	151	38.1	停留時間	一天	177	44.7
	旅遊雜誌	194	49.0		二天	154	38.9
	報紙	119	30.1		三天	54	13.6
	電視或廣播	121	30.6		四天	7	1.8
	親朋好友	141	35.6		四天以上	4	1.0
	觀光宣傳摺頁	84	21.1	旅遊目的	欣賞風景	322	81.3
	其他	18	4.5		靜坐沉思	85	21.5
交通工具	機車	8	2.0		登山健行	172	43.4
	自用車	325	82.1		攝影	92	23.2
	遊覽車	51	12.9		聯誼	60	15.2
	其他	12	3.0		森林浴	200	50.6
旅遊同伴	單獨前來	22	5.6		賞鳥賞蝶	127	32.1
	家人親戚	254	64.1		打發時間	38	9.6
	朋友同事	98	24.7		滿足好奇心	68	17.2
	同學師長	9	2.3		學術研究	12	3.0
	其他	13	3.3		繪畫寫生	18	4.5
前來次數	第一次	135	34.1		公務	28	7.1
	第二次	112	28.3		其他	5	1.3
	第三次	57	14.4	重遊意願	非常不願意	11	2.8
	第四次	17	4.3		不願意	2	0.5
	第五次以上	75	18.9		普通	58	14.6
					願意	222	56.1
					非常願意	103	26.0

4.3 纜車運輸選擇特性分析

纜車運輸選擇特性包括是否贊成於玉山國家公園設置纜車、是否願意搭乘纜車、認定合理票價、搭乘纜車主要理由、玉山端纜車塔站設置位置、纜車站附近應提供服務項目、纜車開發經營模式及重遊搭乘意願等八項進行分析，結果如表 3

所示。1.對於是否贊成於玉山國家公園設置纜車，以回答願意佔 64.5%最多，其次為不願意佔 19.1%，最少為視票價而定佔 16.4%。2.對於是否願意搭乘纜車，則以回答願意佔 67.7%最多，其次為是票價而定佔 20.2%，最少為不願意佔 12.1%；可見如能以合理價位於玉山國家公園設置纜車提供遊客另一種親近大自然、增廣視野的旅遊模式，還是能為多數遊客所接受。3.對於合理票價的認定，以 100~300 元佔 57.8%最多，301~600 元佔 22.5%及 601~1000 元佔 14.9%為其次，1000 元以上佔 4.8%為最少。4.至於搭乘纜車主要理由，則以欣賞玉山鳥瞰生態風光佔 81.8%為最多，其次為好奇嘗新佔 30.6%，最少為體力考量佔 16.4%、攝影佔 15.1%及培訓膽量佔 14.4%。5.對玉山端纜車塔站設置位置，以玉山主峰下約 10 分鐘路程平台佔 29.8%最多，其次為玉山主峰下約 30 分鐘路程平台佔 24.0%及排雲山莊附近佔 22.5%，最少為玉山主峰上佔 15.7%及其他佔 8.1%。6.纜車站附近應提供服務項目，則以遊客資訊服務 63.4%為最多，餐飲服務佔 56.3%，觀光度假旅館佔 47.5%及停車空間佔 44.2%為其次，最少為購物商店街佔 21.0%。7.對於纜車開發經營模式，以回答民間開發及經營管理，政府監督佔 43.4%為最多，回答公辦公營佔 28.8%及公辦民營佔 23.7%為其次，回答其他佔 4.1%最少。8.至於重遊搭乘意願之問項，則以回答會佔 84.6%最多，回答不會佔 15.4%最少。

表 3 纜車運輸選擇特性表

項目		人數	百分比%	項目		人數	百分比%
纜車設置態度	願意	256	64.5	玉山端纜車塔站設置位置	玉山主峰上	62	15.7
	視票價而定	65	16.4		玉山主峰下約 10 分鐘路程平台	118	29.8
	不願意	75	19.1		玉山主峰下約 30 分鐘路程平台	95	24.0
纜車搭乘意願	願意	268	67.7		排雲山莊附近	89	22.5
	視票價而定	80	20.2		其他	32	8.1
	不願意	48	12.1	纜車站附近應提供服務項目	觀光度假旅館	188	47.5
合理票價	100~300 元	229	58.7		餐飲服務	223	56.3
	301~600 元	89	22.5		遊客資訊服務	251	63.4
	601~1000 元	59	14.9		購物商店街	83	21.0
	1000 元以上	19	4.8		停車空間	175	44.2
搭乘纜車主要理由	欣賞玉山鳥瞰生態風光	231	18.1		其他	13	3.3
	好奇嘗新	121	30.6	開發模式	公辦公營	114	28.8
	培訓膽量	57	14.4		公辦民營	94	23.7
	攝影	60	15.1		民間開發及經營管理，政府監督	172	43.4
	體力考量	65	16.4		其他	16	4.1
				重遊意願	會	335	84.6
					不會	61	15.4

4.4 旅遊動機及滿意度分析

在遊客旅遊動機方面，對各個變項分析求得平均數、標準差並給予排序，如表 4 所示。由表 4 得知遊客旅遊動機最強為欣賞風景，其次為登山健行及森林浴，最弱為繪畫寫生及公務。

表 4 遊客旅遊動機分析表

變　項	平均數	標準差	排序	變　項	平均數	標準差	排序
欣賞風景	5.64	3.78	1	攝影	4.39	1.33	7
登山健行	5.18	1.83	2	聯誼	4.12	1.46	8
森林浴	5.16	1.21	3	打發時間	4.06	1.55	9
賞鳥賞蝶	4.91	1.23	4	學術研究	3.90	1.71	10
靜坐沉思	4.71	1.32	5	繪畫寫生	3.77	1.70	11
滿足好奇心	4.51	1.51	6	公務	3.68	1.85	12

在遊客行前期望與實際體驗滿意度分析，結果如表 5 所示。由表 5 得知遊客行前期望最高為鬆弛身心，其次為體驗大自然，低者為尋求孤獨體驗及整體體驗。遊客實際體驗滿意度最高為體驗大自然，其次為鬆弛身心，低者為心理綜合體驗及尋求孤獨體驗。綜合上述遊客行前期望與實際體驗滿意度來看，兩者平均值之差值均呈現正值，呈現出低行前期望與高實際體驗滿意度之情形，惟實際體驗滿意度僅達「高」之範疇內，實有待管理單位檢討改善。

表 5　遊客行前期望與實際體驗滿意度分析表

變　項	行前期望值			實際體驗滿意度			差值
	平均數(I)	標準差	排序	平均數(S)	標準差	排序	(S-I)
鬆弛身心	5.26	1.16	1	5.44	1.07	2	0.18
體驗大自然	5.24	1.28	2	5.49	1.10	1	0.25
逃避壓力	4.61	1.30	3	5.11	1.21	3	0.5
增進人際關係	4.57	1.38	6	5.09	1.25	4	0.52
知識的增加	4.75	1.20	4	5.01	1.18	5	0.26
尋求孤獨體驗	4.15	1.43	7	4.49	1.40	7	0.34
心理綜合體驗	4.58	1.25	5	4.94	1.22	6	0.39
整體體驗	4.15	1.28	7	5.11	1.36	3	0.96

4.5 塔塔加遊憩區纜車路線及型式評估分析

1.纜車系統終點站及路線之擬定

在終點站部分，由於玉山主峰為台灣乃至於東北亞之第一高山，無論就地理、歷史及文化層面，均有其特殊之象徵意義，因此本研究案評估纜車場站以「靠近而不直接設置於其上」為原則，保留適當距離，亦留與喜好登山人士攻頂趣味，而無法負荷登山體力之愛山人士，亦能以最近的距離觀賞玉山的美，因此擬研議以玉山北峰及排雲山莊作為終點站之可能替選場址。而在路線方案研擬部分則應從下述幾個方向進行考量：(1)配合纜車系統作業時之基本要求。(2)路線土地取得難易的考量。(3)地質、風力以及其他工程相關因素。(4)避免破壞纜車沿線之當地景觀。(5)優先考慮沿線景觀優美的路線，提高纜車路線觀光價值。因此本研究研

經由玉山國家公園及相關纜車設計、施作專業人員共同現場會勘後擬以塔塔加遊客中心或麟芷鞍部為起點，並分別以玉山北峰或排雲山莊等二地點作為初步評估之纜車場站設置區域，進一步研擬各路線初步方案如表 6 所示。

表 6 玉山纜車系統路線方案初擬概況

		路線方案一	路線方案二	路線方案三	路線方案四
纜車型式		對開式	循環式	對開式	循環式
起點站	起點站位置	塔塔加遊客中心	塔塔加遊客中心	麟芷山鞍部	麟芷山鞍部
	地面高程	2,659 m	2,659 m	2,805 m	2,805 m
中間站	中間站	玉山西峰	玉山西峰	山峰稜線	山峰稜線
	地面高程	3,528m	3,528m	-	-
迄點站	迄點站位置	玉山北峰	玉山北峰	排雲山莊	排雲山莊
	地面高程	3,858m	3,858m	3,402m	3,402m
起迄高程差		1,199m	1,199m	596m	596m
路線長度		7.80km	7.80km	6.40km	6.40km
概估單程旅行時間		18 分 23 秒	25 分 02 秒	21 分 06 秒	16 分 27 秒
載運量		100~150 人/車廂	4~12 人/車廂	100~150 人/車廂	4~12 人/車廂
特色		●有利於承載量管制 ●運輸速率高 ●容許跨距大惡劣氣候仍可行 ●可階段性施作 ●登玉山者可搭至西峰，再至排雲山莊，以節省時間及體力 ●視覺景觀破壞程度低	●私密性高 ●行駛速度快 ●運量較高 ●可階段性施作登玉山者可搭至西峰，再下坡行至排雲山莊，以節省時間及體力	●有利於承載量管制 ●運輸速率高 ●容許跨距大 ●惡劣氣候仍可行 ●登玉山者可直接搭至排雲山莊，以節省時間及體力	●私密性高 ●行駛速度快 ●運量較高 ●登玉山者可直接搭至排雲山莊，以節省時間及體力

2.纜車系統評估準則架構

本研究案依塔塔加至玉山主峰線之特性，所建構的可行性綜合評估架構詳如圖 2 所示。評估準則包括：1.整體發展層面：「遊憩與公共服務功能」及「遊憩整體發展」是整體發展層面中主要評估準則，前者是玉山國家公園對整體遊客基於遊憩共享之原則下所提供之遊憩服務之功能作評估；後者則是考量是否符合當前觀光發展政策配合及是否有利於本遊憩區整體永續發展。2.市場需求面：市場需求層面中則是以「景觀視野吸引力」、「票價接受度」、「搭乘便利性」及「遊客數」等決定日後纜車營運績效知因子來進行評估。3.法令層面：法令層面中則是以「國家公園法」及「民間參與法令符合度」來進行評估，其中前項係探討「國家公園法」條文中，設置空中纜車之可行性作評估。後者則衡量各方案是否符合「獎參條例」或「促參法」等相關民間投資法令。4.環境保育層面：環境保育層面將依「自然生態環境影響」及「景觀美質影響」等二項評估準則，對於下列作評估：a.各方

案對於經過地帶水質、水文、景觀之影響、環境敏感之影響及營運後可能產生噪音、震動及空氣污染之程度。b.各方案路線行經沿途呈現景觀美感及視覺接受程度。5.工程技術層面：在土地使用層面部分，將探討「基礎施工困難度」及「架設工程困難度」於地形、地質、坡度、腹地容納量考量下纜車基礎及各式纜車架設垮距、高度施工難易度 。6.財務層面：財務層面主要為纜車系統運作相對之兩大指標「營運收入」、「營運成本」及「投資成本」作初步評估，了解纜車營運期間直接門票收入量及其他間接配合營運各多角經營之收入、維持纜車操作營運及其他配合經營事業所需直接費用及纜車系統建設所需投入直接工程建設成本及其他間接配合營運配合之多角經營費用。

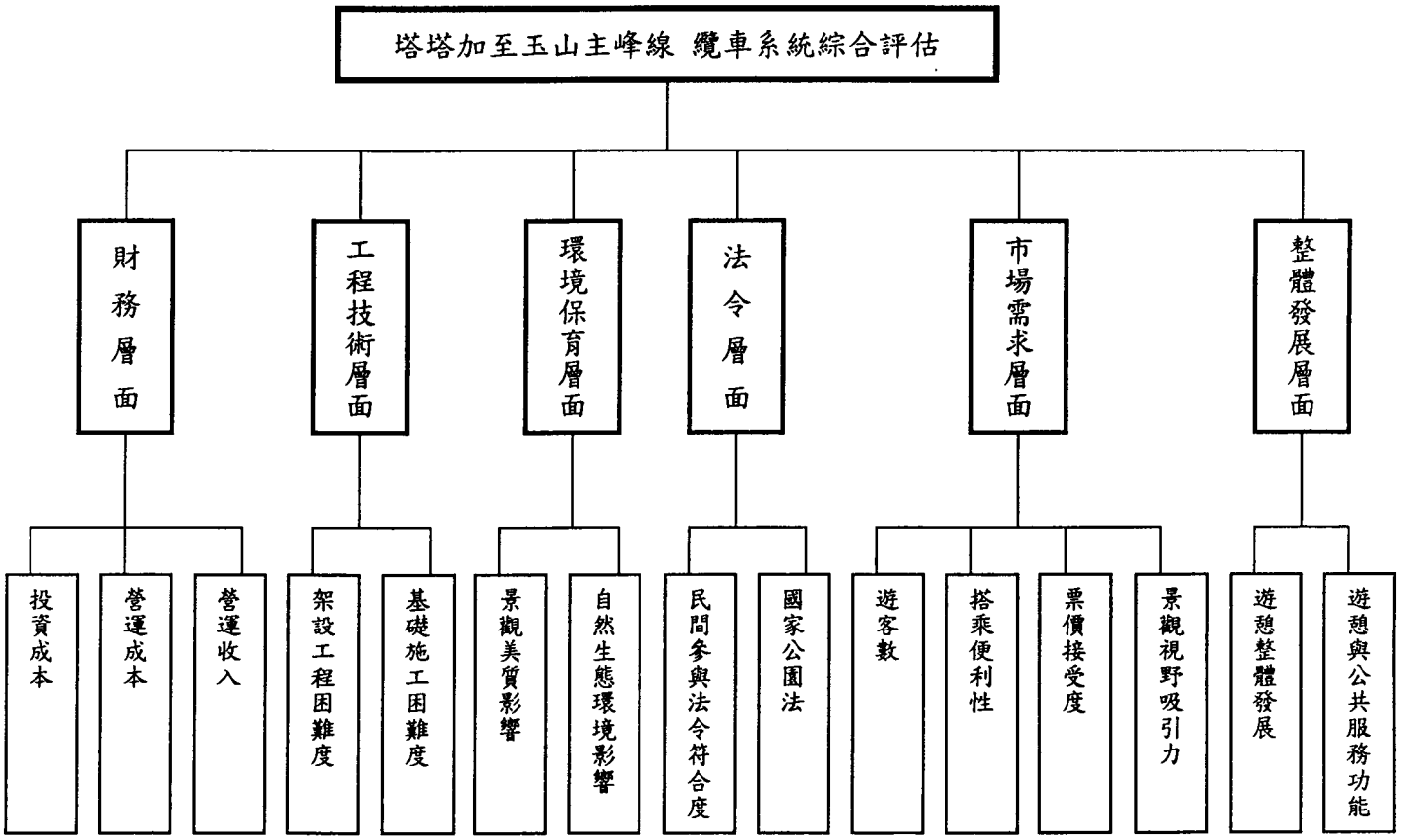


圖 2 塔塔加至玉山主峰線纜車系統可行性綜合評估架構圖

3.評估準則權重分析

本研究共對 15 位專家學者發放問卷，回收問卷達 15 份，回收率 100%， 先由電腦軟體對 15 位專家所填問卷進行主準則之一致性檢定後， 評估準則權重分析結果如表 7 所示。主評估準則以「整體發展層面」、「環境保育層面」所佔權重值最高，次評估準則中則以「遊憩整體發展」、「景觀視野吸引力」、「國家公園法」、「自然生態環境影響」、「架設工程困難度」、「投資成本」所佔權重值較高。

4.塔塔加遊憩區空中纜車路線方案綜合評估

另由十五位專家填寫纜車路線替選方案問卷統之績效值經由平均統計後，在與各評估準則乘值相加後所得之綜合評估值如表 8 示，方案路線一所得值數最高。

表 7 估準則權重表

主評估準則	權重值	次評估準則	權重值
整體發展層面	0.23	遊憩與公共服務功能	0.23
		遊憩整體發展	0.77
市場需求層面	0.14	景觀視野吸引力	0.44
		票價接受度	0.15
		搭乘便利性	0.25
		遊客數	0.16
法令層面	0.17	國家公園法	0.75
		民間參與法令符合度	0.25
環境保育層面	0.23	自然生態環境影響	0.74
		景觀美質影響	0.26
工程技術層面	0.16	基礎施工困難度	0.49
		架設工程困難度	0.51
財務層面	0.07	營運收入	0.28
		營運成本	0.34
		投資成本	0.38

表 8 塔塔加遊憩區空中纜車路線方案綜合評估

層面	評估準則	路線方案一績效平均值	路線方案二績效平均值	路線方案三績效平均值	路線方案四績效平均值
整體發展層面	遊憩與公共服務功能	6.6	6.8	5.7	6.7
	遊憩整體發展	6.9	6.3	5.6	6.0
市場需求層面	景觀視野吸引力	7.9	6.8	5.6	5.4
	票價接受度	5.9	5.7	5.2	6.2
	搭乘便利性	6.5	6.0	4.8	5.6
	遊客數	6.3	5.7	4.7	5.5
法令層面	國家公園法	6.0	5.6	4.9	5.2
	民間參與法令符合度	5.5	5.8	4.7	5.4
環境保育層面	自然生態環境影響	7.6	6.2	5.9	5.8
	景觀美質影響	7.2	5.3	5.3	5.6
工程技術層面	基礎施工困難度	8.1	7.0	6.6	6.6
	架設工程困難度	7.2	7.0	6.2	6.7
財務層面	營運收入	6.8	6.3	6.1	6.6
	營運成本	6.2	6.4	4.8	5.7
	投資成本	6.9	6.4	6.3	5.9
績效綜合評估值		6.95	6.23	5.22	5.88

伍、結論與建議

5.1 結論

本研究以遊歷過塔塔加遊憩區之遊客作為主體，除就遊客遊憩滿意度及搭乘纜車意願作深入探討外另對專家學者利用層級分析法(AHP 法)所篩選出最佳纜車營運路線及纜車型式作評估，歸納後綜提以下之結論：

1. 遊客性別以男性居多；年齡以 31~40 歲佔多數；教育程度以專科較多；職業以公教人員為主；婚姻狀況則是已婚-有小孩居多；家庭平均月收入為 40001~50000 元；居住地主要為苗栗、台中、彰化、雲林、嘉義、南投等中部地區為主。

2. 旅遊資訊來源以旅遊雜誌最多；交通工具以自用車為主；旅遊同伴主要為家人親戚；前來次數以第一次前來之遊客最多；停留時間為多為一天；到本遊憩區旅遊目的主要為欣賞風景；重遊意願以回答願意者居多。

3. 對於是否贊成於玉山國家公園塔塔加設置纜車，則有 80.9%之訪客表達贊成(內含 16.4%視票價而定)；有 87.9%之訪客願意搭乘(內含 20.2%視票價而定)；一般認為 100~300 元為合理票價(57.8%)；搭乘纜車的主要理由為欣賞玉山鳥瞰生態風光；纜車塔站設置地點多數訪客以玉山主峰下約 10 分鐘路程平台為宜；纜車站附近所提供之服務則以遊客資訊服務為最多；纜車開發經營模式以民間開發及經營管理；政府監督較能為多數訪客所接受(43.4%)；最後則有 84.6%的訪客表達強烈的重遊意願。由上述顯示遊客普遍能接受於玉山國家內架設纜車，且有強烈的搭乘意願，若達遊客所認定之合理票價程度，將大幅提高遊客搭乘及日後重遊搭乘之意願。

4. 塔塔加遊憩區遊客之旅遊動機最強為欣賞風景；其次為登山健行及森林浴；最弱為繪畫寫生及公務。

5. 遊客至塔塔加遊憩區行前期望最高為鬆弛身心；其次為體驗大自然；低者為尋求孤獨體驗及整體體驗。遊客至塔塔加遊憩區實際體驗滿意度分析，最高為體驗大自然；其次為鬆弛身心；低者為心理綜合體驗及尋求孤獨體驗。

6. 纜車營運路線、型式之評估準則權重分析，在主評估準則項以「整體發展層面」及「環境保育層面」所得權重最高，在次評估準則項，則以「遊憩整體發展」、「景觀視野吸引力」、「國家公園法」、「自然生態環境影響」、「架設工程困難度」、「投資成本」分別在各主評估準則項內所佔權重最高。

7. 纜車營運路線、型式績效分析及綜合評估路線方案一，最為專家學者所接受。以對開式纜車系統由塔塔加遊客中心為起點，經由玉山西峰作中間站，到達玉山北風為終點站之方案。此條路線不僅可以分段分期方式興建，解決資金困窘及探討成效外，並可於玉山西峰處轉送徒步登山客至排雲山莊，節省攀登主峰時間，及直接載送一般遊客至玉山北風遠眺玉山主峰正景，對空中纜車架設所繁生之視覺景觀破壞問題，亦可降至最低，同時因對開式纜車系統之營運，對旅客承載量的控制將達預期的功效，符合現行「承載量管制」政策，此驗證結果已解本研究

目的四之分析。

5.2 建議

綜合前述的研究結果，對塔塔加－玉山主峰線設置空中纜車提出以下建議，以供參考。

1. 配合現行觀光政策，以遊客為導向、真正發揮國家公園功能。依國家公園法第一條規定：為保護國家特有之自然風景、野生物及史蹟，並共國民之育樂及研究，特制定本法。顯現出國家公園除負有保育環境之本職外，如何以寓教於樂之方式教育遊客，讓絕多數遊客能在國家公園作生態旅遊時，依其所見、所聞、所聽之深度體驗，去了解生態保育之成果及重要性。研究中發現絕多數旅客均有強烈搭乘纜車去體驗玉山國家公園生態之意願，管理單位應同時檢討過去十餘年登山步道開發策略所花經費之效益、實際受惠遊客數量、保育推廣成效，並配合現行政策，以現有科技及尊重多數遊客意願，詳盡、客觀評估纜車推行對環境實際衝擊程度及營運後之整體效益，以作為國家公園日後制定能兼顧保育、育樂發展策略之參考。

2. 考量民間參與纜車系統建設之可行性，近年來政府為提高國家競爭力與經濟，持續進行各項公共建設，並積極鼓勵民間參與投資。玉山國家公園具有世界級的知名度，若能透過有效且可行務實的規劃，民間亦將具有極高之投資意願。建議依促參法及相關子法規定，考量研擬最適宜的民間參與投資方式。

3. 規劃更完善住宿、解說設施，提高遊客實際體驗滿意度，依回收之問卷內容顯示，遊客對塔塔加遊憩區有很高之重遊意願，對「體驗大自然」、「鬆弛身心」功能，均有極大之滿意度，惟在「整體體驗」略顯偏低。依實際訪查遊客意見後發現，塔塔加區現有品質低劣、量少之住宿設施，是造成遊客遊憩不連貫，影響遊憩「整體體驗」之一大要素。另對現場解說教育的周延性、豐富性仍嫌不足，無法發揮國家公園教育的功能。有關單位應考量住宿、解說服務在高度生態旅遊所佔比重，期使生態旅遊能連貫性之意旨下，以彈性手法解決現有住宿公營、解說不足現象，以確實發揮國家公園之育樂、教育功能。

參考文獻

1. 蔡佰祿(1990)，國家公園管理策略之研究，內政部營建署玉山國家公園管理處。
2. 陳水源編譯(1980)，觀光遊憩計畫論，日本洛克計劃研究所。
3. 陳昭明(1981)，台灣森林遊樂需求、資源、經營之調查與分析，台灣大學森林系森林遊樂研究所。
4. 交通部觀光局(2002)，中華民國 90 年台灣地區國民旅遊狀況調查報告。
5. 徐國士、黃文卿、游登良(1995)，國家公園概論，國立編譯館。
6. 內政部營建署玉山國家公園管理處(1999)，玉山國家公園(第二次通盤檢討)計

畫。

7. 張有恆(1990)，運輸經濟學理論與實務，華泰書局。

8. 洪志宏(1997)，大型遊樂園參觀運輸系統之研究，國立交通大學交通運輸研究所碩士論文。

9. 呂適仲(2000)，雪霸國家公園武陵遊憩區發展生態旅遊之遊憩資源效益評估，東海大學景觀學系碩士論文。

10. 吳坤泉(1990)，綜合性觀光遊憩區開發考量因子之研究，國立成功大學建築研究所碩士論文。

11. 陳復漢(2001)，民間參與公共建設可行性評估要項之研究，國立中央大學土木工程研究所碩士論文。

12. 孫文山(2001)，應用層級分析法於空中纜車場址評選模式分析--以北投線空中纜車，中華大學科技管理研究所碩士論文。

13. 內政部營建署玉山國家公園管理處(1988)，玉山景觀公路(路林山自然公園)規劃研究報告。

14. 周文樹(2003)，台南縣尖山埤水庫風景區遊客滿意度之研究，逢甲大學土地管理學系碩士論文。

15. 內政部營建署玉山國家公園管理處(2002),玉山國家公園塔塔加、東埔、梅山地區遊憩衝擊暨經營管理策略之研究。

16. 交通部觀光局(2000)，觀音山設置纜車系統規劃—可行性評估。

17. 交通部觀光局(2001)，台灣高山地區建置纜車系統之可行性評估。

18. 中央營建技術顧問研究社(1998)，陽明山國家公園—北投線纜車規劃及初步設計，營建署陽明山國家公園管理處。

19. 亞聯工程顧問有限公司(2002)，民間參與日月潭纜車系統發展可行性評估及先期規劃，交通部觀光局。

20. 王柏青（1995），遊客之生態觀光環境態度及生態旅遊經營管理之研究，東海大學景觀學研究所碩士論文。

21. Hauff, V. (ed.) (1987) Unsere Gemeinsame Zukunft, Greven: Eggenkamp Verlag.

22. Kirkby, J., O`Keefe, P. and Timberlake, L. (1995) The Earthscan Reader in Sustainable Development, London: Earthscan.

23. Irakaya, E. et al. (1999), "Attitudinal Compliance with Ecotourism Guidelines", Annals of tourism research, 24(4), 919- 950.

24. The Ecotourism Society (1993), "Eco- tourism: A Guide for Planners and Managers. North Bennington", The Ecotourism Society.

25.Valentine, P. S. (1993), "Ecotourism and Nature Conservation: a Definition with Some Recent Development in Mic- ronesia", Tourism Management, 14(2), 22-36.

26.Wight, P. A. (1996), "North American Ecotourism Markets: Motivation, Prefe- rence, and Destination", Journal of Travel Research, 34(1), 3-10.

27.Meric, H. J. and Judith, H. (1998), "Ecotourists' Motivational and Demog- raphic Characteristics: A Case of North Carolina Travelers", Journal of Travel Research, 36(4), 57-61.

28.Miller, M. L. (1993), "The Rise of Coastal and Marine Tourism", Ocean and Coastal Management, 20, 181-199.

29.http://www.banffgondola.com/default_htm，2003.04.15

30.htty://geocilies.com/spicyfish/h_htm，2003.04.22

31.htty://home.pchome.com.tw/a44396，2003.04,29