

A STUDY ON THE ESTABLISH AND EVALUATION OF ADULT DAY CARE SERVICE CENTERS

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ABSTRACT

The purpose of this paper is to aid in planning for the provision of adult welfare and care services, and to ensure that strategies are in place to effectively cope with the aging society. This investigation aims to review an operating assessment system for the execution of long-term care within Nantou County, Republic of China. Based on theoretical considerations and a hierarchical model of perspectives, the Balanced Score Card (BSC), was used to evaluate management. We also used a fuzzy Delphi method, and a Fuzzy Analytic Hierarchy Process (FAHP), to assess nonprofit organizations which manage senior day care centers. The model includes financial, customer, internal business process, and learning and growth perspectives. The results show the level of importance of the perspectives was: Internal business process perspectives; Customer perspectives; Learning and growth perspectives; and Financial perspectives. The performance assessment system provides an accurate representation when used to assess long-term care services. The various indicators can guide organizations to continuously improve their services, in order to provide the best possible service for the adults.

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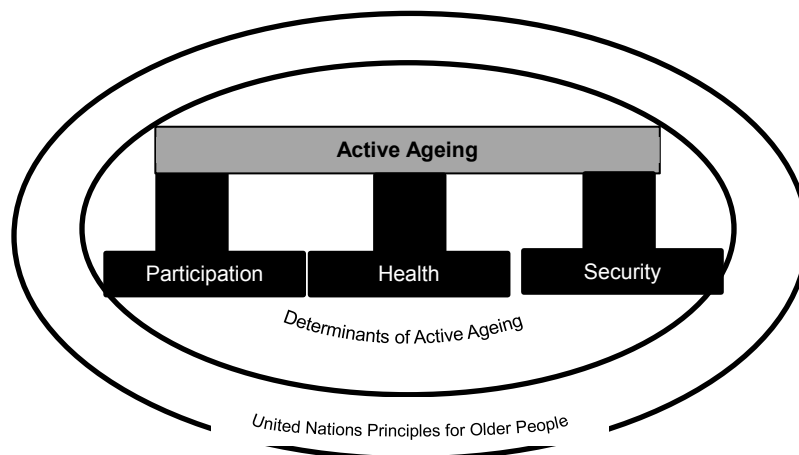
KEYWORDS: Adult Day Care Service Center, Balance Score Card, Fuzzy Delphi Method, Fuzzy Analytic Hierarchy Process

INTRODUCTION

According to figures released by the statistics department of the Ministry of the Interior (MOI), as of the end of 2010 Taiwan had over 24.8 million people older than 65 years. This equates to 10.74% of the total population. Executive Yuan of the Council for Economic Planning and Development (CEPD) forecasts 4,981,000 citizens aged over 65 by 2026, equating to 20.90% of the total forecast population at that time (Department of Health, Ministry of the Interior, Economic Planning and Development, 2009). Facing an ageing population, the Taiwanese government has actively promoted health care strategies including a pilot program for the development of long-term care systems, the new century health care plan, the aged intensive care service, the plan for the development of the care-services and welfare industry, and a ten-year plan for long-term care in Taiwan. In addition, the government is devoted to establishing a complete long-term care system, to plan for the welfare of the elderly, and to satisfying the welfare needs of the elderly, including catering to their probable future needs.

The ageing population trend is common to many countries. The United Nations proposed their Proclamation on Ageing in early 1991, disclosing 5 universal principles that elderly should have access to: independence, participation, care, self-fulfillment, and dignity. They declared 1999 the International Year of Older Persons, in apprehension of world nations adapting to the needs of elderly people. In addition the WHO proposed an active ageing policy framework, defining active ageing as providing the greatest chance of health, social participation, and social security during the ageing process so as to enhance Quality of Life (QOL) in old age (World Health Organization, 2002). A policy framework proposed by the WHO, shown in Figure 1, suggests that an active ageing policy should be built upon the three pillars of health, participation and security. In addition to fostering the mental health of individuals and their connection to society, all plans and policies possess an important goal of prolonging the healthy life expectancy of individuals, and maintaining good QOL during the ageing process.

Figure 1: Policy Framework of Active Ageing



This figure shows the policy framework of active ageing from World Health Organization in 2002. Resource: World Health Organization, 2002

The government needs to ensure that their policy management encompasses supply, demand and management aspects to ensure the elderly receive an active and friendly service environment. In order to combat the currently insufficient and diminishing staffing levels, the use of community resources to jointly promote welfare services has become a popular strategy (Hsu, 1998) , which is also the primary method being utilized to promote the Ten-Year Plan for Long-term Care in Taiwan. However, the lack of competition in partial markets, where welfare services are entirely privatized, reduces the consumer’s choice and results in operational risks. This leads to a situation where the government is required to create standards for the management of welfare services to ensure their quality. As a result, private organizations must adapt to these standards to obtain approval to supply welfare services. This results in the need for a cooperative model between the government and the private providers for the delivery of welfare services. Inevitably, this system will lead to challenges for both government and private organizations. Experience in the execution of welfare services, an understanding of the insufficiency of the current system, and a willingness to improve upon the current system are not only closely associated with the topic of service quality, but are also elements which should guide partnerships between private and public sectors, and the case for utilizing a passive or habitual use of the existing performance management system. Therefore, the government should use inspections for practical operations, and effectively utilize performance reviews for any changes in the general national environment including politics, economics, society and technology. In addition they should propose related improvement measures, and assist under-performing organizations to maximize social welfare for all citizens while using the least resources.

Utilizing empirical research of adult day care centers, this study aims firstly to review the current situation of long-term care execution within Nantou County from a supply and demand perspective. This will enable discussions surrounding performance evaluation indicators for such centers. We also aim to apply a performance management tool, the Balanced Scorecard (BSC), to consolidate the execution process and trends for future development. Secondly, due to limited government resources, the outsourcing of evaluations has become more popular. There is an ongoing discussion surrounding the best methods of performance evaluation in the social service field. While performance evaluation is an imperative tool to ensure government effectiveness for those who support privatization, it is also an important tool to ensure social rights for advocates of social democracy. Performance evaluation must be connected with both service targets and service demand. Balancing various performance indicators from the perspectives of the public, expertise, organizations, and politics requires government input. The benefits of day care services for the elderly can serve as a reference for the improvement of government administration, and its outsourcing process. Therefore, the purpose of this study can be summarized to analyze and establish performance evaluation indicators for adult day care centers.

LITERATURE REVIEW

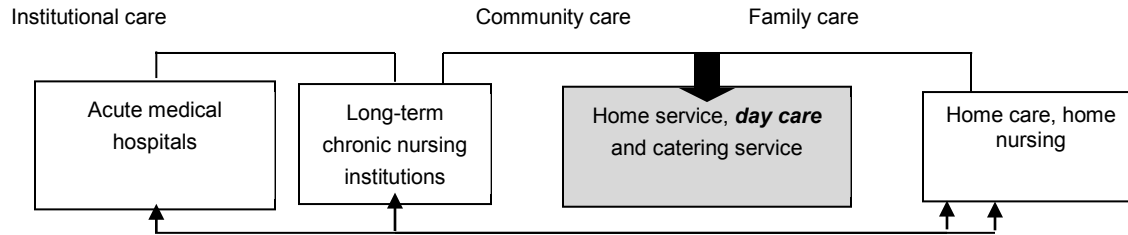
The type of care that a particular care service industry provides can vary significantly. There are many terms used to describe the different industries, such as long-term care, community care, home care, day care, or respite care. According to Yeates (2005), care is defined as the provision of social and health care services by either a private or public service, which can be paid or unpaid. According to this definition, it is not simply catering, cleaning, ironing, and maintenance of household affairs. This definition is generalized, and is not limited to elderly citizens. In addition, while living assistance and nursing care is essential, it cannot replace or mimic the care-giving abilities of family members, such as the physical contact and long-term close interaction that they generally provide.

The provision of care is a service industry, and while an individual may be able to experience the quality of service, it is difficult to detect poor service, due to its intangibility. Moreover, the heterogeneity of available services sets the care service industry apart from other service industries. According to both Yang (2009) and Zhuang (2008), the care service industry has the following characteristics: 1.) It has a high degree of customer contact. Unlike standardized products, in the provision of elderly care the formation, contents and mode of delivery varies with the individual's needs, and therefore a high degree of contact is required to enable a sufficient understanding of their preferences. 2.) There is a need for customer participation in the service offering. Consumers of products are not usually involved in the production process, and their primary concerns are the product's cost and value. Conversely, elderly people and their relatives are normally involved in tailoring care to the individual, including the selection of a service, its contents, and the drafting of a care plan. 3.) There is difficulty in service and performance standardization. The demands and requirements of service vary with the individual, which has led to difficulties in both standardizing the care service industry, and in the measurement of performance and quality of service. It is difficult to judge which providers are more efficient and which provide superior service quality, which has caused issues in the management and supervision of such services. 4.) It is not possible to pre-produce services. Unlike the provision of goods, there can be no pre-production in the service industry, as the service and production happen simultaneously. This causes difficulties in capacity management. 5.) It is labor intensive. Unlike automated production seen in the manufacturing industry, the care service industry is labor intensive. Services largely need to be provided by people, and cannot be mass produced. As such, a reduction in staff, equipment, or costs can often lead to a reduction in quality. 6.) There is a relatively high degree of risk. The recipients of care are invariably weak or vulnerable. This means that when offering home based care, which is usually in a private setting, there is an increased risk of complaints. It is difficult for the care-giver to defend themselves against these complaints. This is especially true of illegal actions or misunderstandings between caregivers and care recipients. 7.) There is a public cultural benefit to their provision. Care services to the elderly are not simply the provision of essential services, there also needs to be some attention given to their cultural and social needs. This includes service philosophy, and the creation culture specific strategies, which can enhance customer satisfaction in a more natural way.

Day Care

Currently, long-term service organizations are categorized into nursing homes, nursing, maintenance, and long-term care. Care methods can be categorized as: home care, community care, and institutional care, all of which form a continuum between care and comprehensive care, varying by age, health, and dependence as can be seen in Figure 2. The scope of community care includes home based care, day care, and catering services. According to current regulations, day care is considered a form of social care, as opposed to nursing homes, nursing, and community care.

Figure 2: Long-term Care Models



This figure shows the long-term service organization categorized from department of health in Taiwan. Source: Department of Health, Ministry of the Interior, Economic Planning and Development (2009)

Day care service is normally provided during the day in fixed locations, with recipients usually returning home during the night, or sometimes to respite care. The services provided vary between professional and semi-professional providers. Day care services can include recreation, catering, transportation, nursing, health promotion, occupation competency language rehabilitation, and memory retention therapy. These services not only relieve the pressure and burdens on primary caregivers, but also enable social interaction, which some researchers believe is its biggest advantage (Hooymann and Kiyak, 2008). Primary care givers can then continue working (Crewe and Chipungu, 2006). Depending on the specific provider, day care and nursing centers can be divided into 3 types (Naleppa, 2004) 1.) Social-based where the society-based day care center mainly provides social contact, creative classes, educational activities, catering, nutrition management, and other such services. 2.) The medical-based day care center mainly provides nursing, medical care, and services such as physical therapy or occupational therapy. 3.) The hybrid-based day care center provides a mixture of the two above day care center types.

In the Ten-Year Plan for Long-term Care in Taiwan it was stated that centers will be categorized by services offered. Those governed by social administrative units will be termed day nursing centers (Crewe and Chipungu, 2006). The ten year plan mostly deals with the management of disabled people, while day care centers usually deal with a more diverse range of patients who can be categorized by their care needs under the terms disabled, health, and comprehensive. The term disabled is used to describe people who require help with more than two activities of daily living (ADL), and the term comprehensive is used to describe people who require help with one or more ADL.

Currently, day care centers established domestically are mostly society based, including private community caring centers, which are operated by community groups and community development associations and are highly advocated by the MOI, and day care centers. Day care centers under the commission of various city or county governments use community or unit volunteers to provide care, and health care professionals to plan the educational and recreational activities for those patients who are relatively healthy. These centers usually operate at hours which suit the needs of the patients and their care plans, which usually coincide with normal working hours. These centers allow patients to engage in activities and educational sessions which deal with strategies to reduce the impact of ageing, and provide an opportunity for socialization. In addition, some centers engage volunteers to conduct phone calls and home visits, to allow for those who cannot be present at the center to receive the same care.

Case background- Adult Day Care Center in Nantou Country

As of the end of 2010, Nantou County reported a population of 71,366 people over 65 years of age, comprising 13.56% of the total population. This is higher than the national average, of 10.74%. Nantou County has the fourth largest population of citizens aged over 65 in the Republic of China (ROC). Owing to the high ratio of the ageing population in Nantou County, it is important to provide an effective welfare

delivery system. As such, since 2000 there has been a trial of adult day care centers in three centers in Nantou County. These trial centers provide daytime life care services, programs to recover functions, nursing and health care services, educational sessions, counseling, catering, and recreation activities. These centers target citizens aged over 65 who reside in Nantou County (Sun, Xiao, Zhang, Kuo, and Hung, 2009) , and who have a physical or mental health problem, but are still able to care for themselves. In recent years, the Nantou government has continuously commissioned the establishment of multiple day care community centers and day care centers to educate the elderly on disease prevention and health promotion, and to provide support and socialization to reinforce health, social participation, and security, all of which further enhance their QOL. The current performance review program for these day care centers, run by the Social Welfare Division of the Nantou County government, includes evaluations of the administrative management, life care services, catering services, exercise programs for function recovery, nursing and health care services, educational sessions, counseling services, staff qualifications, staff training and job requirements, strategic and innovative management, integration of community resources, and satisfaction surveys. The satisfaction surveys cover 28 evaluation items.

Balance Scorecard (BSC)

Performance indicators, usually derived from private enterprise, are generally used to evaluate the activities of an organization so that organizational performance can be supervised (Challis, Clarkson and Warburton, 2006) . Kaplan and Norton (1999) jointly announced *The Balanced Scorecard: Measures that Drive Performance in the Harvard Business Review*, which has aroused attention from various circles. Financial performance is often the key consideration for an enterprise, which is true for non-profit organizations as well. However, there are two major flaws in evaluating performance management by financial means alone: 1.) research shows that financial indications are not good predictors of success, and 2.) it is normal for the current market value of an enterprise to exceed its market value. Tobin's q-value calculates the ratio of company market value to assets, while additional market value can be found from intangible assets. Financial reports do not reflect these assets. As far as future business performance is concerned, financial statistics are not a particularly good indicator.

Kaplan and Norton summarized the three major advantages of the BSC method as: 1.) it focuses on the most important affairs of the business, which enables other areas to enhance their value once the key functions are controlled; 2.) it helps business integrate multiple project plans, such as quality versus quantity management, work flow reform, and customer service plans; and 3. it removes any ambiguity from the strategic targets of the organization, which ensures that managers and staff understand the key goals and requirements of the organization, and how their performance will affect them.

The BSC is a tool for strategic planning, and also a performance management tool which enables business to execute their vision and strategies. Business performance is measured based on four perspectives: financial, customer, internal business processes, and learning and growth. These four perspectives are not invariable, as, for example, a non-profit organization can be evaluated by their satisfaction of community needs. The BSC is scored in terms of the following four observations for each perspective: 1.) the primary purpose of the organization, for example profit or growth; 2.) the parameters which will be used to measure the achievement of goals, for example using net marginal profit growth to measure profit growth; 3.) the targets for achievement, for example a 7% annual reduction rate in disconnected business production; and 4.) Motion indicating concrete items or plans which ensure goals can be realized. The modern business relies on the measurement and monitoring of performance. Measurement methods must relate to business strategies, and provide information regarding work flow, outcomes and products. There are many possible statistics, including: customer retention, product or service performance, operation efficiency, market position, comparisons with competition, supplier pricing, employee satisfaction, cost minimization, and finance goals. The process of statistical analysis includes utilizing trend analysis to

precede prediction and other ad hoc analysis. It is imperative to have correct information, as statistics and data analysis support many business activities, such as strategy planning, performance evaluation, operation improvement and performance comparisons with competitors and benchmarks.

METHODOLOGY

This study investigates the problem of achieving consensus in group decisions when utilizing the fuzzy Delphi method (FDM) and Fuzzy Analytic Hierarchy Process (FAHP) and uses the following approaches: 1. The study utilizes FDM not only to save money and time, but also to faithfully represent of group views, 2. The study utilize FAHP to reverse the program, 3. The study adopts a straightforward process of building fuzzy numbers, 4. The study uses simple procedures to handle multi-level, multi-attribute and multi-program decision-making problems. Consequently, this investigation uses FDM and FAHP as a research methodology. The fuzzy theory was proposed by Zadeh (1965) at the university of California at Berkeley. Dr. Zadeh was of the opinion that traditional scientific methods often ignored the uncertainty and ambiguous existence of human life, so he set out to use fuzzy sets theory and adopt the fuzzy logical concepts to process. Buckley (1985) incorporated the fuzzy set theory into the traditional AHP. FAHP thus became a suitable tool for solving real-world multi-criteria decision- making (MCDM) problems (Buyukozkan, 2004; Huang and Wu, 2005) .

This study introduces fuzzy theory into the Delphi method by integrating the points of view of many scholars, including Hsu (1998) and Chen (1997) . In order to improve the problems faced by the traditional Delphi method, this study uses the bi-triangular fuzzy arithmetic to integrate the advice of experts and has then tested the convergence effect recognized by experts that refers to the gray zone test method. The fuzzy Delphi method is established by means of the following steps: Step1) Each expert respectively offers a possible interval value to each assessed item. The minimum value of this interval number represents the most conservative perceived value given by the expert to the quantitative score of the assessed item and the maximum value represents the most optimistic perceived value given to the quantitative score of the assessed item. Step2) involves performing an analysis of the most conservative and optimistic perceived values given to each assessed item i by all of the experts. After the extreme values falling outside the two times the standard deviation are eliminated, the minimum value C_L^i , the geometric mean C_M^i , and the maximum value C_U^i of the most conservative perceived value that has not been eliminated, as well as the minimum value O_L^i , the geometric mean O_M^i and the maximum value O_U^i of the most optimistic perceived value are determined. Step3.) Through the foregoing steps, the triangular fuzzy number $C^i = (C_L^i, C_M^i, C_U^i)$ of the most conservative perceived value and the triangular fuzzy number $O^i = (O_L^i, O_M^i, O_U^i)$ of the most optimistic perceived value of each assessed item i can be established. Step 4.) Finally, the following methods can be applied to verify the degree of consensus by experts.

In some instances the Grey Zone does not exist. If $C_U^i \leq O_L^i$, namely, the bi-triangular fuzzy number has no overlap, the interval values given by the experts share the common section. That is the most conservative perceived values given by each expert to the assessed item i tend to move towards the section scope of the triangular fuzzy number of the most conservative perceived value, and the most optimistic perceived value given by each expert to the assessed item i tends towards the section scope of the triangular fuzzy number of the most optimistic perceived value. This implies that the most conservative perceived values and the most optimistic values given by all of the experts have reached a consensus as far as the assessed item i is concerned. Therefore, the value G^i regarding the importance of the degree of consensus of the assessed item i shall equal the mean value of C_M^i and O_M^i , and its operational formula is seen as follows:

$$G^i = (C_M^i + O_M^i) / 2 \tag{1}$$

In other instances the Grey Zone exists, and a small difference exists among the experts' advice. If $C_U^i > O_L^i$, namely, the bi-triangular fuzzy number has an overlap, and when the gray zone of the fuzzy relation $Z^i = C_U^i - O_L^i$ is smaller than the interval value $M^i = O_M^i - C_M^i$ between the geometric mean of the optimistic perceived value and the geometric mean of the conservative perceived value given by the experts to the assessed item, although the interval value given by each expert produces a fuzzy section, the extreme values given by some experts do not greatly differ from the ones given by the other experts, and so no differences and divergences in terms of the value are caused. Therefore, the value G^i of the importance of the degree of consensus of the assessed item i shall equal the fuzzy set $F^i(\chi_j)$ resulting from the intersection (min) operation for the gray zone of the fuzzy relation of the bi-triangular fuzzy number, and the quantitative score of the maximum value of the membership grade $\mu_{F^i}(\chi_j)$ owned by the fuzzy set shall then be figured out. Its operational formulas are seen as follows:

$$F^i(x_j) = \left\{ \int_x \{ \min [C^i(x_j), O^i(x_j)] \} dx \right\} \tag{2}$$

$$G^i = \left\{ \chi_j \mid \max \mu_{F^i}(\chi_j) \right\} \tag{3}$$

In yet other instances the Grey Zone exists, and big differences exist among the experts' advice. If $C_U^i > O_L^i$, namely, the bi-triangular fuzzy number has an overlap, and when the gray zone of the fuzzy relation $Z^i = C_U^i - O_L^i$ is bigger than the interval value $M^i = O_M^i - C_M^i$ between the geometric mean of the optimistic perceived value and the geometric mean of the conservative perceived value given by the expert to the assessed item, it means that the interval value given by each expert will be seen to produce a fuzzy section, and the extreme values given by some experts greatly differ from the ones given by other experts, so differences and divergences in the values are caused. Therefore, “the geometric mean of the optimistic perceived value” and the “geometric mean of the conservative perceived value” of the assessed items that have not reached convergence must be provided for the experts as the references. Then, Steps 1 to 4 shall not be repeated to conduct the next questionnaire survey until all the assessed items reach convergence, and “the value of the importance of the degree of consensus” G^i is calculated. The higher the value of the degree of the importance degree of each item figured out respectively in the foregoing paragraphs, the higher the degree of consensus among the experts it stands for. The arithmetic mean could then be calculated by using of the geometric mean of the most likely single value for each item, and be taken as the threshold value for the research to select a suitable number of assessment criteria featuring the consensus reached by of the experts.

In incorporating the Fuzzy Theory into the Analytic Hierarchy Process developed by Saaty (1980), we evaluate the weight attached to various assessment criteria and identify their importance through which more objective and reasonable key success factors could be induced. This analytical process combines the concepts of several scholars, including Buckley (1985), and Hsu (1998). It has the advantage in that experts need to fill in only one definite value when making paired comparisons, without falling into the dilemma of not knowing how to specify the fuzzy number or the need to understand its definitions. Step1) Establish the Hierarchy Structure. Based on the assessment criteria screened out by the Fuzzy Delphi Method and the sequence of the terminal target, secondary target, and assessed items, the hierarchal structure is established, and each level has seven elements at most. Step2.) Establish the

Pairwise Comparison Matrix. The opinion of expert K at Level L on the relative importance of any two assessed items at Level L+1 could be obtained through the questionnaire survey, by which the pairwise comparison matrix A, $A = [a_{ij}]$ could be established. Step 3.) Establish the Triangular Fuzzy

Number. This study has adopted the geometric average to represent the consensus of most experts as the model of the triangular fuzzy number. Afterwards, triangular fuzzy numbers were established based on the FDM to integrate experts' fuzzy opinions on the relative importance of paired elements. It may be expressed as follows:

$$\tilde{a}_{ij} = (\alpha_{ij}, \delta_{ij}, \gamma_{ij})_{L-R}, \quad \alpha_{ij} \leq \delta_{ij} \leq \gamma_{ij}, \quad i, j=1, 2, \dots, n \quad (4)$$

$$\alpha_{ij} = \text{Min}(B_{ijk}) \quad k = 1, 2, \dots, n \quad (5)$$

$$\delta_{ij} = \left(\prod_{k=1}^n B_{ijk} \right)^{1/n} \quad (6)$$

$$\gamma_{ij} = \text{Max}(B_{ijk}) \quad k = 1, 2, \dots, n \quad (7)$$

\tilde{a}_{ij} : Triangular fuzzy number

α_{ij} : Minimum from expert countering the relative importance of both of criteria i and j

δ_{ij} : Geometric average from expert countering the relative importance of both of criteria i and j

γ_{ij} : Maximum from expert countering the relative importance of both of criteria i and j

B_{ijk} : Expert K's subjective opinion on the relative importance of attributes i and j, which is a definite value.

$L - R$: Fuzzy interval of triangular fuzzy numbers

Step4.) is to establish a Fuzzy Positive Reciprocal Matrix. Triangular fuzzy numbers are established to express the phenomenon of assessing experts' fuzzy opinions. Hence, a fuzzy positive reciprocal matrix \tilde{A} could be established.

$$\tilde{A} = [\tilde{a}_{ij}] = \begin{bmatrix} \tilde{a}_{11} & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ \tilde{a}_{21} & \tilde{a}_{22} & \dots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \dots & \tilde{a}_{nn} \end{bmatrix}, \quad i, j = 1, 2, \dots, n \quad (8)$$

$$\tilde{a}_{ij} = [\alpha_{ij}, \delta_{ij}, \gamma_{ij}], \quad \tilde{a}_{ij} \times \tilde{a}_{ji} \approx 1, \quad \forall i, j = 1, 2, \dots, n \quad (9)$$

Step5.) Fuzzy Matrix: \tilde{A} Consistency Verification. We assume $A = [a_{ij}]$ is a positive reciprocal matrix

and $\tilde{A} = [\tilde{a}_{ij}]$ is the corresponding fuzzy positive reciprocal matrix. Hence, $A = [a_{ij}]$ is consistent,

as well as $\tilde{A} = [\tilde{a}_{ij}]$, by which we can judge the validity of the questionnaires. If experts think criterion i

is more important than j , then the fuzzy paired comparisons are:

$$\tilde{a}_{ij} = (\alpha_{ij}, \delta_{ij}, \gamma_{ij}), \quad \alpha_{ij}, \delta_{ij}, \gamma_{ij} \in \{1, 2, \dots, 9\}, \quad \text{while} \quad (10)$$

$$\tilde{a}_{ji} = (\tilde{a}_{ij})^{-1} = (\gamma_{ij}^{-1}, \delta_{ij}^{-1}, \alpha_{ij}^{-1})$$

If experts think criteria i and j are equally important, the fuzzy pair wise comparisons are $\tilde{a}_{ij} = (1,1,1)$.
 Step6.) Calculate the Fuzzy Weight of the Fuzzy Positive Reciprocal Matrix.

$$\tilde{Z}_i = \left[\tilde{a}_{ij} \otimes \dots \otimes \tilde{a}_{in} \right]^{\frac{1}{n}}, \forall i, j = 1, 2, \dots, n \quad (11)$$

$$\tilde{W}_i = \tilde{Z}_i \otimes \left(\tilde{Z}_i \oplus \dots \oplus \tilde{Z}_n \right)^{-1} \quad (12)$$

\tilde{Z}_i : Geometric average of triangle fuzzy numbers

$$\tilde{a}_1 \otimes \tilde{a}_2 \cong (\alpha_1 \times \alpha_2, \delta_1 \times \delta_2, \gamma_1 \times \gamma_2) \quad (13)$$

$$\tilde{a}_1 \oplus \tilde{a}_2 \cong (\alpha_1 + \alpha_2, \delta_1 + \delta_2, \gamma_1 + \gamma_2) \quad (14)$$

$$\tilde{Z}_1^{-1} = (\gamma_1^{-1}, \delta_1^{-1}, \alpha_1^{-1})_{L-R} \quad (15)$$

$$\tilde{a}_1^{\frac{1}{n}} = \left[\alpha_1^{\frac{1}{n}}, \delta_1^{\frac{1}{n}}, \gamma_1^{\frac{1}{n}} \right] \quad (16)$$

Step7.) Defuzzification. Since the weight of every element and assessed item is a fuzzy value, the single fuzzy weight must be obtained by the defuzzification process. This study has adopted the gravity method for defuzzification and it is expressed as follows:

$$W_i = \frac{W_{\alpha_i} + W_{\delta_i} + W_{\gamma_i}}{3} \quad (17)$$

W_{α_i} : the left end fuzzy weight value of triangular fuzzy numbers, namely the minimum.

W_{δ_i} : the value of the grade of membership of the triangular fuzzy numbers' fuzzy weight which is 1.

W_{γ_i} : The right end fuzzy weight value of triangular fuzzy members, namely the maximum.

W_i : Convert the fuzzy weight of the triangular fuzzy numbers into a single value.

Step8.) Normality Weight values obtained are normalized to compare easily the importance of various major structural dimension criteria and secondary assessment criteria so that their sum is 1. The formula for weight normalization is as follows:

$$NW_i = \frac{W_i}{\sum_{i=1}^n W_i} \quad (18)$$

NW_i : normalized weight

W_i : single fuzzy weight

Establishing a Hierarchical Structure of Performance Measurement Indicators for Day Care Centers in Nantou County

This study evaluates the use of the four major perspectives of the BSC method, finance, customer, internal business flow, and learning and growth, as a performance indicator for day centers in Nantou County in 2008. The performance evaluation system is established by hierarchical methods, utilizing focus groups, a

fuzzy Delphi, and a fuzzy FAHP applied to various performance indicators. This study will comprise of a questionnaire targeting designated personnel of adult day care centers in Nantou County. The primary purpose of this research is to establish performance measurement indicators which can be used to evaluate day care centers. First we examine the related performance of domestic and overseas adult day care centers, which we utilized in the questionnaire design through a fuzzy Delphi method. We also examine benchmark screening, to facilitate the subsequent empirical study. Figure 3 details the primary perspectives and the 28 performance evaluation indicators which will be used in this study.

RESULTS

As of 2010, there are eight day care centers in Nantou County. Also, due to the vast geographical size of Nantou County, the poor transportation system, and other reasons, these eight centers were divided into 16 sub branches, based on organizational resources (including HR resources, funding, market expansion ability, and other factors). In the first stage, 15 fuzzy Delphi expert questionnaires were distributed between February 15 and 27, 2011. There were 13 valid questionnaires returned representing an effective response rate of 86.7%. During the second stage, a further 13 fuzzy Delphi expert questionnaires were distributed between March 7 and 18, 2011. There were 12 valid questionnaires returned, implying an effective response rate of 92.3%.

This investigation proposed a program based on the fuzzy Delphi operation model in the statistical software EXCEL Expert Choice 2000, to calculate the relative number. Our study utilized a bi-triangle fuzzy number to identify evaluation criteria, and then analyzed the outcomes. We utilized a threshold value of 7.6, meaning that if the value of G^i for each criterion exceed 7.6 then they would be retained. We deleted 9 evaluation criteria and retained 19, giving an effective ratio of 67.86% as shown in Table 1.

Based on the results obtained during the first stage, in the second stage we designed a FAHP questionnaire. We utilized the retrieved questionnaires to construct the fuzzy positive reciprocal matrix, and used consistency verification to measure the consistency index (C.I.) and the consistence ratio (C.R.). Next, we calculated the fuzzy weight and normality weight values of the evaluation criteria for each concept. Finally we utilized these results to rank the importance of the weights, and adopted the FAHP analytical software, run in Expert Choice 2000, to calculate the key judgment values.

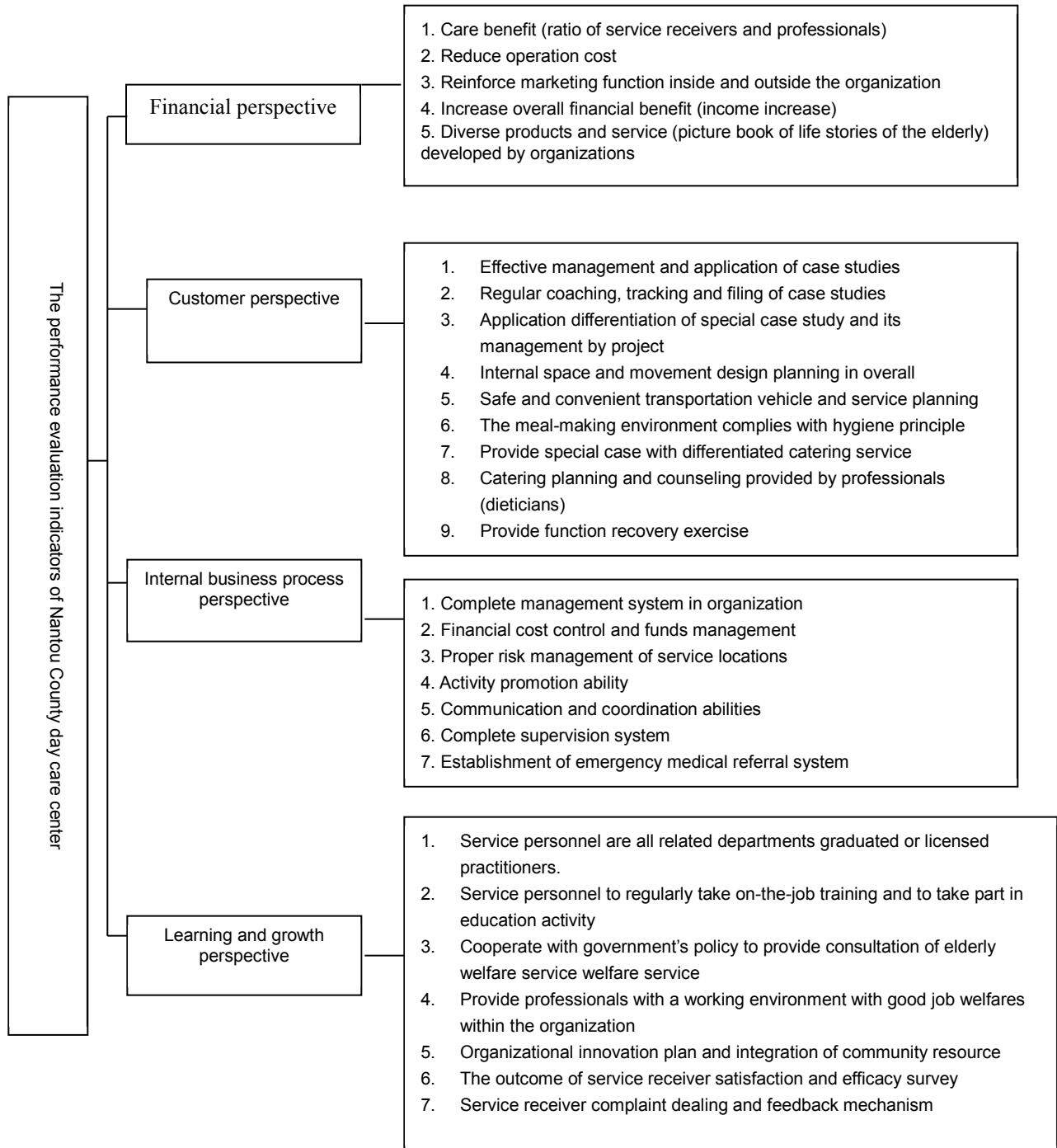
Statistics from the Second Stage Questionnaire

During the second stage, a further 30 fuzzy Delphi expert questionnaires were distributed between April 21 and 31, 2009. There were 22 valid questionnaires returned, for an effective response rate of 73.3%. Firstly, a triangle fuzzy number is applied to establish a fuzzy positive reciprocal matrix as shown in Table 2, which is then regarded as the calculation base of the fuzzy weight number shown in Table 3. This allows us to conduct consistent examinations of the fuzzy positive reciprocal matrix upon the crisp value given on the expert questionnaire.

As can be seen in Table 2, the consistent indicator values are $CI=0.07$ and $CR=0.08$, both of which are within an acceptable error range of $CI \leq 0.1$. Therefore, the reports of our expert participants show consistency. According to the results of the weight analysis, the level of importance for the four evaluation perspectives was: 26% weighted value for internal business process, 25.3% weighted value for customer perspective, 24.7% weighted value for learning and growth perspective, and 24% weighted value for financial perspective. The results show, the expert participants considered the internal business processes of the day care centers to be subject to financial cost control and proper funds management indicators, service location risk management fitness, liaison and communication capabilities, complete supervision management systems, and a focus on developing capabilities with regards to long-term care policy in Taiwan. Additionally, the indicator highlights that an emergency medical referral system must

be established for day care centers. The internal business process perspective is more focused on indicator reviews of software elements than operation management perspectives within the organization.

Figure 3: The preliminary Hierarchical Structure



This figure shows the preliminary hierarchical structure forms from the Fuzzy Delphi Method in this research.

Table1 : Fuzzy Delphi Questionnaire Analysis

Concept	Evaluation criteria	The most optimistic perceived values (O_L^i, O_M^i, O_U^i)			The most conservative perceived values (C_L^i, C_M^i, C_U^i)			Geometric mean	M ⁱ	Z ⁱ	Interval value of expert opinion	G ⁱ
Financial perspective	Care benefit (ratio of service receivers and professionals)	8	9.1	10	4	6	8	7.5	3.1	0	o	7.6
	Reduce operation cost	6	9.1	10	3	5.7	8	7.3	3.4	2	★	7.1
	Reinforce internal & ext. mkt. function	8	9.5	10	3	6.4	8	7.7	3.1	0	o	8.0
	Increase overall financial benefit (income increase)	7	8.6	10	3	5.7	8	7.4	2.9	1	★	7.4
	Diverse products and service (picture book of life stories of the elderly) developed by organizations	8	9.3	10	2	5.8	8	7.6	3.5	0	o	7.6
	Effective management & application of case studies	8	9.0	10	4	6.2	8	7.5	2.8	0	o	7.6
	Regular coaching, tracking and filing of case studies	9	9.9	10	5	7.1	9	8.1	2.8	0	o	8.5
Customer perspective	Application differentiation of special case study and its management by project	7	8.5	10	3	5.3	9	6.9	3.2	2	★	7.6
	Internal space and movement design planning in overall	6	9.0	10	4	5.9	8	7.8	3.1	2	★	7.2
	Safe and convenient transportation vehicle and service planning	8	9.4	10	5	6.4	9	7.8	3.0	1	★	8.4
	The meal-making environment complies with hygiene principle	8	9.3	10	2	5.8	8	7.6	3.5	0	o	7.6
	Provide special case with differentiated catering service	9	9.9	10	5	7.2	9	8.4	2.7	0	o	8.6
	Catering planning and counseling provided by professionals (dieticians)	9	9.8	10	2	6.7	9	8.0	3.1	0	o	8.3
	Provide function recovery exercise	9	9.9	10	5	7.3	9	8.4	2.6	0	o	8.6
	Complete management system in organization	7	8.8	10	2	5	7	7.4	3.8	0	o	6.9
	Financial cost control & funds management	9	9.8	10	2	6.7	9	8.0	3.1	0	o	8.3
	Proper risk management of service locations	8	9.5	10	3	6.6	9	7.9	2.9	1	★	8.4
Internal business process perspective	Activity promotion ability	7	9.3	10	2	5.6	7	7.4	3.6	0	o	7.4
	Communication and coordination abilities	8	9.5	10	5	6.5	8	8.0	3.1	0	o	8.0
	Complete supervision system	8	9.5	10	5	6.8	8	8.3	2.7	0	o	8.1
	Establishment of emergency medical referral system	8	9.2	10	4	6.1	8	7.7	3.1	0	o	7.7
	Service personnel are all related departments graduated or licensed practitioners	8	9.4	10	4	6.0	7	7.7	3.4	-1	o	7.7
	Service personnel to regularly take on-the-job training and to take part in education activity	8	9.5	10	5	6.5	7	8.2	3.0	-1	o	8.0
	Cooperate with government's policy to provide consultation of elderly welfare service welfare service	8	9.2	10	3	5.5	7	7.3	3.0	0	o	7.4
Learning and growth perspective	Provide professionals with a working environment with good job welfares within the organization	7	8.9	10	3	5.4	8	7.4	3.5	1	★	7.4
	Organizational innovation plan and integration of community resource	9	9.7	10	4	6.3	8	7.9	3.4	-1	o	8.0
	The outcome of service receiver satisfaction and efficacy survey	7	8.9	10	2	5.4	7	6.8	3.5	0	o	7.2
	Service receiver complaint dealing and feedback mechanism	7	8.9	10	3	5.9	8	7.4	2.9	1	★	7.5
Threshold value							7.6					

This table shows the relative number from the method proposed a program based on the fuzzy Delphi operation model in the statistical software EXCEL Expert Choice 2000 in this research. 「○」 indicate $C_U^i \leq O_L^i$ that experts' opinions in the consensus section, and utilizes

$G^i = (C_M^i + O_M^i)/2$ to calculate. 「★」 indicate $C_U^i > O_L^i$, and $Z^i = C_U^i - O_L^i \leq M^i = O_M^i - C_M^i$ that experts' opinions not difference. It might calculate fuzzy set by min and get G^i . Grey-region indicates the evaluation criteria are deleted.

Table 2: Consistency Verification of Primary Perspectives

Perspective	Fuzzy Positive Reciprocal Matrix			
	Financial Perspective	Customer Perspective	Internal Business Process Perspective	Learning & Growth Perspective
Financial perspective	(1.00 , 1.00 , 1.00)	(0.11 , 1.38 , 9.00)	(0.13 , 1.52 , 9.00)	(0.11 , 1.36 , 8.00)
Customer perspective	(0.11 , 0.72 , 9.09)	(1.00 , 1.00 , 1.00)	(0.11 , 1.74 , 9.00)	(0.14 , 1.31 , 9.00)
Internal business process perspective	(0.11 , 0.66 , 7.69)	(0.11 , 0.57 , 9.09)	(1.00 , 1.00 , 1.00)	(0.11 , 0.59 , 8.00)
Learning & growth perspective	(0.13 , 0.74 , 9.09)	(0.11 , 0.76 , 7.14)	(0.13 , 1.69 , 9.00)	(1.00 , 1.00 , 1.00)

This table shows the consistency verification between the four primary perspectives. $\lambda_{max}=4.21$ C.I.=0.07 C.R.=0.08

Secondly, the customer perspective should be the highest priority, and should include the provision of the highest quality service as well as attention to individual needs. This should also include the provision of individually managed cases based on each patient’s needs, as well as effective tracking and review to ensure that their care remains appropriate. This may also include differentiated and professional services for special cases. Furthermore, there should be an ability to deliver nutritious meals, and to educate patients on how to hygienically prepare their own meals. In addition there should be the provision of convenient and safe transport planning, and the ability to provide exercise classes to recover functions. These performance indicators will assist the elderly to attain the goal of successful ageing, which is the key purpose of the day care centers in Nantou County.

Importance ranking of Performances Evaluation Indicators for Day Care Centers in Nantou County

We calculated a 0.07 consistency ratio hierarchy (CRH) that constructs various performance evaluation indicators of Nantou County day care centers, which is within the acceptable range of $CRH < 0.1$. This value shows that the hierarchical structure established by our study demonstrates a proper allocation of relatedness between various performance evaluation indicators, and hence the consistency of our architecture model is acceptable.

Lastly, our study conforms to relative comparative and relative priority (local propriety) generated from the performance evaluation indicators of various perspectives. The key aim was to understand the weight ratio of various performance evaluation indicators in the overall structure, and to select the importance ranking of various performance evaluation indicators for the establishment of day care centers in Nantou County. This would be done in terms of absolute weighted value and the importance ranking of various performances evaluation indicators as shown in Table 3.

Table 3: Weight Analysis of Primary Perspectives

Perspective	W_{ai}	$W_{\bar{a}i}$	$W_{\bar{b}i}$	Normality Weight Value	Importance Ranking
Financial perspective	0.192	0.165	6.079	0.240	4
Customer perspective	0.395	0.237	6.161	0.253	2
Internal business process perspective	0.203	0.272	6.512	0.260	1
Learning & growth perspective	0.010	0.312	6.307	0.247	3

This table shows the weight analysis of the four primary perspectives in this research. W_{ai} the left end fuzzy weight value of triangular fuzzy numbers, namely the minimum, $W_{\bar{a}i}$ the value of the grade of membership of the triangular fuzzy numbers' fuzzy weight which is 1, $W_{\bar{b}i}$ The right end fuzzy weight value of triangular fuzzy members, namely the maximum.

CONCLUSION AND COMMENTS

This study introduced the concept of the BSC to construct a performance evaluation hierarchical system for Nanto County day care centers. In addition, it analyzed of the elements of the hierarchical structure, and provided weighted ratios of the various performance measurement indicators in order to create a

structure for the performance evaluation indicator system. The performance evaluation system truly shows the performance and differentiation of services provided by the various day care centers, which are regarded as the best indicators of self-improvement by assessing their mechanisms and outcomes. In order to review and discuss the performance evaluation indicator system, we used a fuzzy Delphi's method, as well as a FAHP, as the analytical methods to re-construct the assessment indicators of existing day care centers in Nantou County.

According to our research outcomes, the level of importance for the assessment of various perspectives of day care centers in Nantou County is as follows: 1. internal business process perspectives, 2. customer perspectives, 3. Learning and growth perspectives, and 4. financial perspectives. The internal business process perspectives of day care centers covers financial cost control, proper funds management indicators, service location risk management, liaison and communication capabilities, complete supervision management, and a focus on the development of capabilities with regard to long-term care policy in Taiwan. The latter capability highlights that internal business processes are more focused on reviews of software elements.

The customer perspective refers to the views of the recipients of care at the day care centers. The provision of the highest quality care and attention to individual needs should be the highest priority. This should include individual case management, as well as effective tracking and evaluation to ensure that the care remains appropriate. In addition, this may include the provision of differentiated and professional services in special cases. Furthermore, this may include professional planning of meals, as well as educational sessions devoted to the preparation of hygienically prepared, nutritious meals. Also, there should be the provision of convenient and safe transport for patients, as well as exercise sessions to aid in the recovery of mobility. All of these steps will ensure that the goal of successful ageing will be achieved through the day care centers.

The learning and growth perspective refers to the expertise and continued training of employees. This perspective includes innovative integration with other community resources. Finally, in respect to the financial perspective, most day care centers are run by non-profit organizations. This means that instead of actively seeking funding, they must wait to receive funds from the governments or through donations. Therefore, this is a less important assessment indicator.

The Performance assessment system was an accurate measure for long-term care service. The system could be combined with performance incentives to increase cooperation between government and industry, as well as encourage innovative solutions and management. The Taiwanese government evaluates the service outsourcing process through a system analyzing input-process-output-outcome. The outcome is not usually a concern for the government, as their policies are often limited to an analysis of ratios of input to output. The assessment of day care services is the primary tool for governments to take control of the industry, and the results of assessments can affect who will be granted contracts to provide such services. However, most of the evaluation indicators refer to administration, finance, personnel, environment, and service perspectives, which mainly measure quality of care, instead of QOL.

According to WHO policy, active ageing should enhance QOL for seniors, which has also been shown in past studies (Kane, Kling, Bershadsky, Kane, Giles, Degenholtz, and Cutler, 2003) . Recently, more studies have considered the concept and measurement of QOL with regard to long-term care, and have concluded that they should adopt a customer perspective. Pieper and Vaarama (Pieper and Vaarama. 2008) argued that QOL should be the key feature of health models. Currently, a report on the home care subsidy user condition survey, published by MOI (Department of Health, Ministry of the Interior, Economic Planning and Development, 2009) , found that current measurement tool to improve QOL is relatively insufficient when applied within the care services commissioned by various local governments. They state

that the reason for this was a long-term preference for the outsourcing of services within the public sectors, as well as a shortage of local manpower.

Due to complexities associated with demanding quality service for elderly citizens during the process of care service privatization, health professionals need to argue for effective reform. Effective management of outsourced care service, which are evaluated by life quality indicators. will not only guarantee benefits to the elderly, but also for the government. It will show accountability, enable partnerships between private and public sectors, and extended the use of existing management assessment tools.

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