

Efficiency Evaluation of Welfare Facilities for the Elderly Applying AHP and DEA Techniques

Dong Su Lee¹ and In Hong Chang^{2†}

Abstract

This study examined the factors which have influence on the welfare facilities for the elderly and analyzes their efficiency. It investigated theoretical studies and preceding studies and divided the efficiency evaluation factors into input and output factors. Input factors included budget, the number of workers and clients and facility area and output factors were operation management, the number of clients, profitability and welfare for the elderly. To sum up the analysis results of evaluation factors of welfare facilities for the elderly, the analysis of relative importance of input showed that budget was most important. As a result of analyzing the relative importance among detailed items, balance sheet and professional manpower were highest. Input factors by facility types showed that the budget for utility facilities and living facilities were highest. In output factors, utility facilities and living facilities were highest in management systematization and welfare for the elderly, respectively. In efficiency evaluation, utility facilities for the elderly showed 100% of efficiency in CCR and BCC models. In welfare facilities for the elderly, while CCR model showed 100% of efficiency in facility types A, C, D, and F, the efficiency was low in facility B (79.89%), E (77.14%), and G (80.72%). In BCC model, facility E was low as 78.69%. In efficiency comparison between utility facilities and living facilities for the elderly welfare, the efficiency of utility facilities for the elderly welfare was higher. Therefore, this study investigated the efficiency of welfare facilities for the elderly as its main purpose and presented policy suggestions based on the research results as the alternative.

Keywords: Welfare Facilities for the Elderly, Process of Hierarchical Analysis, Efficiency, Input Factors, Output Factors

1. Introduction

In modern times, living standard has been improved by industrial development and average life span has been continuously extended by the development of medical technology. In addition, birth rate drop and population aging rate have been rapidly developed. The problem of the aged in aging society is not family problem any more, but it has been raised as a social issue to be solved by our society together. Increase in aging population needs personal service and emotional and psychological service other than basic activities and living support services. It also requires the qualitative improvement of welfare facilities for the elderly with

professional competency and technique as well as the simple quantitative expansion of welfare facilities for the elderly. Recently, social welfare facilities in qualitative dimension have been increased. Efficiency evaluation in the areas of administrative organization, electronic government and medical services has been conducted^[1-6]. But, efficiency evaluation only in the part of community welfare center and woman development center has been made in the areas of social welfare^[7,8].

This study is to examine the determinants in efficiency evaluation of welfare facilities for the elderly systematically and show the efficiency of the facilities. It divided efficiency evaluation factors of welfare facilities for the elderly into input and output factors. Input factors were classified into budget, the number of workers and clients and facility area and output factors were into operation management, the number of clients, profitability and welfare for the elderly. The present study analyzed the determinants affecting the efficiency evaluation of welfare facilities for the elderly and proposed

¹Doctor's Course at Dept. of Computer Science and Statistics, Chosun University, Korea

²Professor, Dept. of Computer Science and Statistics, Chosun University, Korea

[†]Corresponding author : ihchang@chosun.ac.kr

(Received: November 18, 2015, Revised: December 16, 2015
Accepted: December 25, 2015)

the policy suggestions to activate the facilities. For this, it examined the preceding studies on the meaning and determinants of efficiency evaluation of welfare facilities for the elderly and suggested analysis framework. It used Analytic Hierarchy Process(AHP) and Data Envelopment Analysis(DEA) for the positive analysis. Efficiency of welfare facilities for the elderly has the important meaning as a chance to improve welfare through concerns and consideration of clients as well as the effectiveness of the facilities.

Determinants of efficiency evaluation of welfare facilities for the elderly were analyzed through Expert choice II program and SPSS 22.0 statistical program as the concrete statistical analysis methods. The efficiency of the factors obtained was analyzed with DEA method. Weight and priority among Expert choice II program factors were compared and analyzed, efficiency of facilities was measured with Frontier Analyst program and frequency analysis was conducted through SPSS 22.0 version program.

2. Theoretical Background

2.1. Meaning of Welfare Facilities for the Elderly

Art. 34 of Constitution states clearly social security, obligation of social welfare, livelihood protection of those who have no ability to work due to physical handicap, diseases and old age, home care service, accident compensation and national protection from accident for establishing a welfare state.

Welfare for the elderly is the organized activity in the public and private sectors to provide resources and services necessary for adapting and unifying to family and society and enjoying life like a human being as a part of efforts among social members to achieve comfortable and satisfactory living conditions for the elderly^[9].

Welfare facilities for the elderly are defined as the place, facility and building prepared for providing those who are 65 years old or below and have difficulty in having home care due to physical, mental, environmental and economical reasons with care, treatment and self-support services or conveniences through outpatient treatment, accommodation and other methods. Self-support is the base of life to make the elderly maintain their livelihood and leisure and treatment service are provided through special programs suitable to their psychosocial and physical conditions^[10]. The welfare

facilities for the elderly mean management organization of facilities, systems and staffs that provide services in place of family care functions to those who cannot perform normal activities or are in poor conditions of self-support due to mental and physical handicap or aging as a part of public welfare services^[11].

Welfare facilities for the elderly have the following characteristics. First, the facilities are the places to lead a stable life to the aged residents as the base of their life, accommodate the elderly in poor conditions for self-support due to mental and physical handicap and provide them with emotional stability. Second, the current welfare facilities for the elderly are divided into dwelling facilities, medical facilities and home care facilities for the elderly. Dwelling facilities for the elderly included nursing home, housing for the elderly and community house for the elderly. Medical facilities for the aged are nursing home, community care house and hospital for the elderly. Home care services for the elderly included visit care service, day and night care service, short-term care service and visit bath service. Welfare of the Aged Act classified the welfare facilities for the elderly into dwelling facilities for the elderly, medical facilities for the elderly, leisure facilities for the elderly, and home care facilities for the elderly. Dwelling facilities for the aged included nursing home and welfare housing for the aged, medical facilities for the aged are nursing home and hospital for the aged, leisure facilities for the aged were welfare center for the aged, senior citizen center, senior class, and senior recreation center. Home care facilities for the aged included home care volunteer agency, care center and special care center for the aged. Third, various programs considering characters and locations of facility, specialty and enthusiasm of staffs, community residents' attitude to the facilities and relationship with community organizations should be developed.

Fourth, the facilities should be composed of professionals in the various areas. Since workers and staffs at the welfare facilities for the aged are insufficient compared to those at other facilities, quantity and quality of the service for the facility residents have been lowered. Fifth, the facilities are closed. Most of the welfare facilities for the aged throughout the country are located far away from downtown. Community people consider social welfare facilities as unpleasant and opposed the construction of social welfare facilities in their commu-

nity. So it has entailed several problems.

2.2. Importance of Evaluation Factors of Welfare Facilities for the Aged

Analytic Hierarchy Process(AHP) was developed first by Saaty in 1970s and has been widely used in the areas such as governmental agencies or enterprises as a decision-making method supporting the systematic evaluation of interdependent alternatives for the cases of multiple goals and evaluation criteria of decision making and many interested parties. AHP is a kind of decision-making model as Multiple Attribute Decision Making Tool developed by Thomas L. Saaty in 1971. AHP evaluates qualitative or intangible criteria and quantitative or intangible criteria of decision-making information through ratio scale^[12]. It is helpful in that it subdivides and decompose informal and complex problems into subcriteria, can settle the complex social and political issues^[12] by pairwise comparison and indicate qualitative information into figure by quantification^[12]. In addition, group decision making which reflects individual opinions of members is possible and collecting several opinions from professionals is easy.

AHP has advantages to make qualitative evaluation as well as quantitative evaluation because it stratified and solved decision making problems including multiple goals and evaluation criteria by understandings priority of goals hierarchically and was based on decision maker's long experiences or intuition^[13]. Saaty(1980) defined AHP as multi-criteria decision model using hierarchy or network structure to express decision making problems and develop preference of an alternative based on decision maker's judgment. It divided decision-making process into four stages, analyzed and solved it by stage and reached a final decision making method.

First, the first stage was to gather opinions from interested parties through establishing hierarchical process, understand various problems and characteristics and clarify the goal of evaluation. In this process, important items related to goal should be found and mutual dependence and independent relationship among factors should be grouped. Top level means the final goal of problems, the first hierarchy indicates evaluation criteria affecting the final goal, the second one composes detailed factors affecting the first one and the bottom consists of alternatives for achieving final goal. Factors

affecting the final goal through the repetition of such a process were found and visualized to reach more rational and logical conclusions^[14].

Second, the second stage found out the importance of factors through establishing relative importance using pairwise comparison. The process of pairwise comparison changes qualitative factors into quantitative values and gathers respondents' opinions using 9-point scale. For questionnaire, semantical judgement(very important, a little important or important) was used and then it was changed into figure to reduce respondents' rejection of figure. Values of pairwise comparison can be calculated into weight by factors as final result using eigenvalue theorem^[12]. Matrix of pairwise matrix takes the form of a reciprocal number centering around the opposite angle of matrix.

Third, the third stage is the process of verifying weight estimation and logical consistency and if the relative importance of n factors within a hierarchy is W_i ($i=1, \dots, n$), a_{ij} in the above pairwise comparison matrix can be assumed as w_i/w_j ($i, j=1, \dots, n$) and the following expression between a_{ij} and w_i is set^[14].

$$a_{ij} = w_i/w_j \quad (i, j = 1, \dots, n)$$

where, all factors of matrix can be expressed as follows.

$$\sum_j^n a_{ij} \cdot w_j \cdot \frac{1}{w_i} = n \quad (i, j = 1, \dots, n)$$

Matrix A composed of factor a_{ij} is as follows

$$A = \begin{bmatrix} w_1/w_1 & w_1/w_2 & w_1/w_3 & \dots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & w_2/w_3 & \dots & w_2/w_n \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ w_n/w_1 & w_n/w_2 & w_n/w_3 & \dots & w_n/w_n \end{bmatrix}$$

by eigenvalue method, the following can be obtained $A \cdot w = n \cdot w$

where, $w = [w_1, w_2, w_3, \dots, w_n]$: right eigenvector of A , $n : w$ in eigenvalue of matrix A can be obtained.

But since it is assumed in AHP that evaluator doesn't know accurate w and assumes exact evaluation by pairwise comparison is impossible, w can be assumed by the following expression. That is, when weight w for each factor of pairwise comparison matrix A is not known, this matrix is A^1 and weight estimation of this

matrix w^1 can be obtained with the following expression.

$$A^1 \cdot w^1 = \lambda_{\max} \cdot w^1$$

where, λ_{\max} : the largest eigenvalue of

Eigenvalue of $n \times n$ matrix can be obtained by characteristic equation. But, since the process of calculating eigenvalue in the questions including large matrix (n is over 3) accompanies several calculative difficulty, another method to calculate eigenvalue is required.

where, since λ_{\max} is always bigger than or same as n , calculated λ_{\max} is closer to n , values of pairwise comparison matrix A have consistency. Degree of such a consistency can be calculated through consistency index (CI) and consistency ratio (CR).

$$\text{Consistency} \in \text{dex (CI)} = (\lambda_{\max} - n) / (n - 1)$$

$$\text{Consistency Ratio (CR)} = (CI / RI) \times 100\%$$

Fourth, the fourth stage is the process of generalizing the hierarchy structure and the feedback process is another feature of AHP. This process is for review when decision makers' answers lose consistency. AHP is the process of repetition which decides question factors, questions and answers related to those questions. All questions should be answerable because ambiguity in the process of questioning may lead decision makers to a wrong criteria or alternative. AHP application stages can be summarized in <Table 1>.

Relative importance analysis and priority of efficiency evaluation factors of welfare facilities for the aged are decided through AHP application stage. There is no preceding study on welfare facilities for the aged through AHP method. So efficiency evaluation factors of welfare facilities for the aged are drawn through studies on other areas and relative importance analysis and priority of evaluation factors drawn are decided.

Preceding studies using AHP method have been con-

ducted in the various areas.^[1,2,4,5,15]

Saaty and Cho conducted AHP to know the greatest concerns of America on trade policies between America and China before voting on trade policy by the United States Congress. This study divided trade policy of America with China into four factors including benefit, cost, opportunity and risk and examined positive and negative aspects of these four factors. Total 15 attributes were used for this study and as a result of sensitivity analysis, it was found that giving the position of permanent normal trade relations to trade policy of America with China was most desirable.

Seong Do Gyeong and Jang Cheol Young selected total 4 indices including maintenance of e-government distribution base, enhancement of electronic document availability, activation of common administrative information use and legal and institutional reorganization as the main indicator to perform the research on deciding priority of embodying electronic government and selected and analyzed total 12 indices such as establishing intranet among government departments, standardization of electronic document distribution system, and digitalizing all administrative information as sub-indicator. Consequently, it was concluded that digitalizing administrative information, prevention of adverse effect from information spill and consolidation of security and will to use common digital information were important factors.

2.3. Efficiency Evaluation of Welfare Facilities for the Aged

DEA (data envelopment analysis) analysis is management analysis method advocated by Charnes, Cooper and Rhodes in 1978 and it is also called CCR after their names. They considered efficiency of non-profit organizations such as hospital, public agencies, and government investment agencies were measured from relative view because there were no market price

Table 1. AHP Application Stage

Analysis Stage		Contents
1st Stage	Establishing hierarchy process	- Find out important items related to goal, grasp mutual dependence and independence to set hierarchy of factors found through this process and group them.
2nd Stage	Pairwise comparison of evaluation criteria	- Evaluation of relative importance of criteria in direct subclass - Process of indicating evaluation results to matrix
3rd Stage	Setting weight	- Making pairwise comparison matrix - Calculate eigenvector and eigenvalue and set weight among evaluation items

to combine input and output and suggested a model based on Farrell's efficiency. DEA model used for evaluating organizational efficiency and exploring improvement process has some important attributes^[16]. First, plural input and output were included and weight is not applied to individual input or output. Second, since practical value of decision making units makes an efficient frontier, an inefficient decision making unit can be inefficient as it produces lower output a unit price. Third, when controllable input is included, development of management strategy for improving efficiency is possible. For achieving efficiency, increase of output, decrease of input or both are selected to perform the improvement strategy. Fourth, price of input or output factors is not required. Since there are many cases that factors which cannot be changed into the price of public sector are included, limitation to quantify can be overcome. Finally, cases of producing multiple outputs can be easily treated.

Existing studies used DEA methods for measuring productivity and evaluation efficiency of local governments.^[4,5,7,8] It is also considered that these methods are most suitable in efficiency evaluation of this study. It has the following availability compared to other methods^[17]. First, plural input and output factors can be included in the model at the same time. Second, an availability can be found in the form of data drawn. Third, a specific function of measured model needs not be assumed. DEA method can compare productivity of other agencies only with input and output data if production function is not known under complex production system. When productivity of public sectors is evaluated, simple method which depends on addition score of evaluation indices is used because production function which input is changed into output is not known^[3]. If evaluation methods are divided into those by data system and quantification model, the latter has advantage to set no subjective weight among evaluation indices, but disadvantage to assume a fixed production function. But, since DEA is quantification model but doesn't assume a specific production function, it has real adaptability to efficiency evaluation in the elderly welfare compared to other methods.

DEA(data envelopment analysis) model has a high potential to have insignificant analysis results and 100% of efficiency of evaluation items if it has many input and output variables. Therefore, it can select most prof-

itable weight for each evaluation item. DEA model can be helpful in case that multiple input and output variables cannot be generalized into one index. Input minimization indicates how much input should be reduced in fixed output level to achieve 100% of efficiency. Output maximization shows how much output should be increased in fixed input level to achieve 100% of efficiency. When most of evaluation items were judged as efficient, limiting weight to input and output can solve the problems.

Preceding studies using DEA were conducted in the various areas such as public education, medical assistance, and social welfare. Ryu Young Ah set welfare manpower and budget as input factors and welfare facilities, the number of inmates, and the facility area as output factors with 88 local governments and analyzed them with CCR and BCC models. Kim Gun Wi, *et al.* evaluated relative efficiency of Eup and Myeon administrative organizations using DEA. They measured relative efficiency through two input variables(budget and manpower) and six output variables (resident's longcherished project, family welfare, forest, agricultural production, community development and water management). Relative efficiency scores were measured by CCR model analysis which assumes invariable return to scale. Yoon Gyeong Joon analyzed the efficiency of 54 public health centers in 54 cities with CCR model. Moon Shin Yong and Yoon Gi Chan evaluated efficiency with Seoul Women Development Center, set input factors such as manpower and budget and output factors including the number of qualification acquisition and employment and self-profit. Kim Yong Min evaluated efficiency with Gwangju Social Welfare Center. Input factors included settlement account, the number of staffs and workers and social workers, and donation. Output factors included the number of annual programs and users, which were analyzed with CCR model.

3. Research Design

3.1. Analysis Methods

3.1.1. Importance by AHP Method

AHP is based on the principles of structuring hierarchy, setting priorities and logical consistency. Composition of AHP methods for calculating weight of efficiency evaluation factors in the elderly welfare facilities is as follows^[18].

First, complex decision making problems should be subdivided to use AHP in structuring hierarchy, factors are arranged depending on their influential or contribution and hierarchy should be structured. Efficiency evaluation factors of the elderly welfare facilities is set in the top level, classification items affecting the final goal in the middle and detailed items affecting the items in the bottom. The bottom level has a kind of connection of goal-means. Priorities of decision making are delivered to sub-factors.

Second, important characteristics of AHP by pairwise comparison are in deciding relative priorities when each alternative or item was evaluated with attributes of higher class as evaluation indicator.^[19]

As in <Table 2>, items of direct sub-class had pairwise comparison and matrix was made, giving importance to the degree of their contribution to superior class with nine-point scale and then if sub-class has n items, it has comparison of $n(n-1)/2$.

Analytic hierarchy process of efficiency evaluation factors for the elderly welfare facilities is shown in <Fig. 1>. Input factors are divided into facility area, budget, clients and staffs. Output factors into operation management, clients, profitability and the elderly welfare. Detailed items included management documents, settlement account, volunteers, family and community cooperation as management items. Clients included current, annual and dropped members. Profitability included legal subsidy, income, support from social welfare organization, support from enterprises, donations and supports. Welfare for the aged included treatment program, educational program, meals & food, professionals, hygiene management, convenience facilities.

Table 2. Pairwise Comparison Scale of Relative Importance

Importance	Definition	Remark
1	Equally important(equal)	Tow factors are equally important
3	Moderate important(moderate)	A factor is more important than another
5	Strongly important(strong)	A factor is more strongly important than another
7	Very strongly important(Very strong)	A factor is very strongly important compared to another
9	Extremely important(extreme)	A factor is extremely important compared to another
2, 4, 6, 8	Moderate importance between adjacent numbers	
Reciprocal number	In case that factor a is more important than factor b, importance of b has a reciprocal number compared to importance of a.	

Data: Thomas L. Saaty(1980), The Analytic Hierarchy Process, Mcgraw-Hill, p. 54.

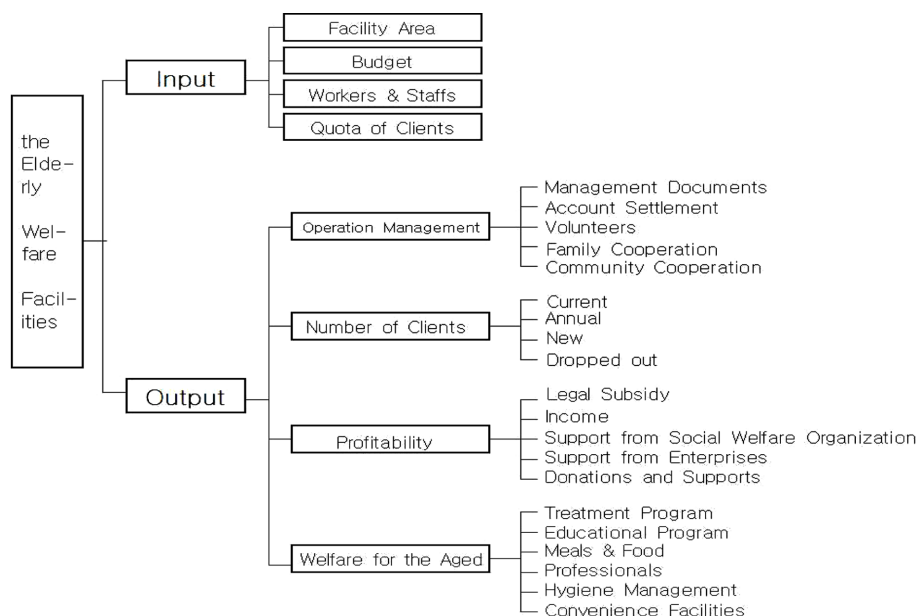


Fig. 1. Hierarchy Model of Evaluation Factors of Welfare Facilities for the Aged.

included legal subsidy, income, support from social welfare organization and enterprises, donation and sponsor. The elderly welfare included treatment and educational programs, meals and food, professionals, hygiene management and convenience facilities.

3.1.2. Efficiency Evaluation by DEA Method

Efficiency is the quantitative expression of effectiveness and efficiency for our behavior. For measuring it, efficiency measurement is needed, which means the process of quantifying effectiveness and efficiency of a behavior and performance measures which are numerical variables used for measuring the performance are needed. General concept of efficiency evaluation is considered as systematic evaluation of quality and result of public services and contains satisfaction of residents' needs through public services. This efficiency evaluation has been discussed from the standards of efficiency, effectiveness, correspondence and equity^[20].

Studies by other researchers should be reviewed to set the criteria of efficiency evaluation. Ammons^[21] classified them into four categories such as workload, efficiency, effectiveness and productivity and Rogers^[22] divided them into economy, efficiency, effectiveness, service level and correspondence. Many scholars classified them into input, output, process, efficiency, productivity, and quality of service depending on their concerns and measurement subjects. However, as described above, the most general selection criteria

included efficiency, effectiveness, equity and correspondence. Efficiency is defined as the input to output ratio^[22] and effectiveness contains the concept of quality and quantity as goal-oriented concept unlike efficiency. This study selected the managers of the elderly welfare facilities and conducted questionnaire of efficiency evaluation for the elderly welfare facilities.

Variables and measurement indicators of questionnaire of efficiency evaluation for the elderly welfare facilities are shown in <Table 3>. Input variables included facility area, budget, clients, and staffs. Total 8 output variables such as operation management, clients, profitability and elderly welfare, etc. were set.

3.2. Setting Analysis Framework

Efficiency evaluation factors based on theoretical and preceding studies are divided into input and output factors. Input factors included facility area, budget, clients and staffs. Output factors were operation management, clients, profitability and the elderly welfare. Detailed items included management documents, settlement account, volunteers, family and community cooperation as management items. Clients included current, annual and dropped members. Profitability included legal subsidy, income, support from social welfare organization and enterprises, donation and sponsor. The elderly welfare included treatment and educational programs, meals and food, professionals, hygiene management and convenience facilities.

Table 3. Evaluation Index

Division	Variables	Measurement Index	Measurement Unit
Input Variables	Facility Area	scale of facility	m ²
	Budget	annual budget	amount
	Clients	standard	person
	Staffs	number of staffs and workers	person
Output Variables	Operation Management	management settlement volunteers family and community cooperation	case
	Clients	current, annual, new and dropped out	person
	Profitability	legal subsidy, income, support from social welfare organizations, industrial support, donation and sponsor	amount
	Welfare for the Aged	treatment, education, meals & food, professionals, hygiene and convenience	person

3.3. Operational Definition of Variables

Major variables of efficiency evaluation for the elderly welfare facilities were suggested by the results of theoretical and preceding studies.

The first class of this study was the efficiency evaluation of the elderly welfare facilities and the second class suggested input and output factors as classification items. Input factors included budget, staffs, and clients. Output factors were operation management, clients, and welfare for the aged. The third class included 20 detailed items. Determinants which affect the efficiency evaluation of the elderly welfare facilities were measured through pairwise comparison of each item. Operational definition of items measured was summarized as follows.

First, input factors included total budget for 1 year and staffs and workers approved who were serving at the elderly welfare facilities. Clients meant the number of clients approved.

Second, operation system factors in output factors meant the whole management system in the maintenance of the elderly welfare facilities. Operation system factors included management documents, budget accounting, annual volunteers, family and community cooperation of the elderly welfare facilities.

Third, clients meant the number of clients managed by the elderly welfare facilities for one year. Client factors included current, annual, new and dropped members of the elderly welfare facilities.

Fourth, profitability factor of the elderly welfare facilities was the profit from the process of the facility for one year. Profitability factors included legal subsidy, general income, supports from social welfare organizations and enterprises, and other donations.

Fifth, the elderly welfare factors meant the degree of welfare service provided to the elderly in living and use facilities. The elderly welfare factors included treatment program, educational program related to emotional activity, quality of meals and food, hygiene management, and entertainment and convenience facilities.

Questionnaire items based on the above research model were composed of nine-point scale of pairwise comparison.

4. Positive Analysis

4.1. Sample Characteristics

Data for verifying the relative importance among factors were questionnaire. This study referred to preceding studies to establish content validity of construct

Table 4. Respondents' Characteristics

Variable	Division	Frequency (person)	Ratio (%)
Gender	Male	21	55.3
	Female	17	44.7
Education	below junior college	4	10.5
	university	17	44.7
	over graduate school	17	44.7
Age	below 30	2	5.3
	31-40	13	34.2
	41-50	18	47.4
	over 51	5	13.2
Kind of Facility	Use facility	24	63.2
	Living facility	14	36.8
Type of Facility	Nursing home for the aged	3	7.9
	Medical facility for the aged	11	28.9
	Welfare agency for the aged	11	28.9
	Welfare center for the aged	13	34.2
Workplace	city	11	28.9
	county	13	34.2
	ward	14	36.8

concepts, developed items related to efficiency evaluation of the elderly welfare facilities.

For sampling, quota sampling and judgement sampling were used. Therefore, 38 respondents' responses and characteristics from the questionnaire are summarized in <Table 4>.

4.2. Analysis of Relative Importance

Analysis of relative importance using AHP method was described by classification items and finally relative priority among items was verified through the whole research hierarchy model.

First, the analysis results of relative importance by factors affecting the elderly welfare facilities are shown in <Table 5>. Community cooperation was highest in use facility as 0.106 and donation, support and professional were highest in living facilities as 0.086.

As a result of analysis, use facilities showed relative importance like community cooperation, family cooperation and professionals(0.095), settlement(0.075), and

management document(0.071). Living facilities showed relative importance like donation·support, settlement (0.075), and hygiene management(0.072). Consistency was valid as use facilities 0.03 and living facilities 0.04.

Priority affecting the elderly welfare facilities was different in weight between use and living facilities. Therefore, different approach depending on use and living facilities should be taken to activate the elderly welfare facilities.

4.3. Efficiency Analysis

CCR model was developed by Charnes, Cooper and Rhodes^[23] and based on the method converting multiple inputs and outputs in decision making unit level into a single comprehensive scale. BCC model was developed by Banker, Charnes and Cooper^[24] and called VRS (Variable Return to Scale) in that it assumes return from scale. BCC model is the method analyzing output when all input factors are proportionally increased. But, CCR model is called Constant Return to Scale in that it

Table 5. Relative Importance of Details by Facilities

Classification	Item	Weight		Priority		Consistency Ratio (CR)	
		Use	Living	Use	Living	Use	Living
Operation Management	Management Paper	.092	.071	5	5	.03	.04
	Settlement	.093	.075	4	3		
	Volunteers	.060	.035	6	16		
	Family Cooperation	.096	.059	2	7		
	Community Cooperation	.106	.059	1	7		
2. No. of Clients	Current members	.058	.047	7	10		
	Annual members	.040	.052	12	9		
	New members	.041	.039	11	14		
	Members dropped out	.019	.034	16	17		
3. Profitability	Legal subsidy	.036	.060	14	6		
	General income	.011	.022	20	19		
	Support by social welfare center	.013	.032	18	15		
	Industrial foundation support	.012	.041	19	13		
	Donation·Sponsor	.016	.086	2	1		
4. Welfare for the Aged	Treatment program	.048	.020	9	20		
	Educational program	.038	.023	13	18		
	Meals and food	.042	.045	10	11		
	Specialists	.095	.086	3	1		
	Hygiene control	.051	.072	8	4		
	Convenience facilities	.031	.042	15	12		

assumes invariable return to scale. Therefore, even DMU shown as inefficient in CCR model judges whether it is by pure technical factor or by scale factor in BCC model. BCC model was developed to overcome weakness of CCR model and measure pure technique to assume changes in return.

First, efficiency comparison between the elderly welfare use facilities and the elderly welfare living facilities is shown in <Table 6>. The elderly welfare use facility showed 100% of efficiency in CCR and BCC models. CCR model of the elderly welfare living facilities showed 100% of efficiency in facilities A, C, D and F and low efficiency in facilities B(79.89%), E(77.14%),

and G(80.72%). BCC model showed low efficiency in facility E(78.69%). Efficiency of the elderly welfare use facilities was higher in the comparison of efficiency between the elderly welfare use facilities and the elderly welfare living facilities.

Second, DMU and potential in reference group and potential of the elderly welfare facility CCR are shown in <Table 7>. Facilities D and F of facility B showed relatively higher potential. In particular, facility F showed higher potential in such variables as budget, staffs, facility area, operation management and clients. Facilities D and F of facility E showed relatively higher potential. Most of input and output variables showed

Table 6. Efficiency Comparison of Use of welfare for the Aged and Living Facilities CCR/BCC Models Unit: %

DMU	Facilities using welfare for the aged		Living facilities in welfare for the aged	
	CCR	BCC	CCR	BCC
Facility A	100.00	100.00	100.00	100.00
Facility B	100.00	100.00	79.89	100.00
Facility C	100.00	100.00	100.00	100.00
Facility D	100.00	100.00	100.00	100.00
Facility E	100.00	100.00	77.14	78.69
Facility F	100.00	100.00	100.00	100.00
Facility G	100.00	100.00	80.72	100.00

Table 7. CCR Reference Group and Potential of Living Facilities for the Aged Unit: %

DMU	Reference Group	Input Variables					Output Variables		
		Budget	No. of Clients	No. of Staffs	Facility Area	Operation Management	No. of Clients	Profitability	Welfare for the Aged
FacilityB 79.89	F-B	-64.39	38.68	-48.58	-54.14	0.00	-20.11	0.00	104.33
	F-D	27.77	16.12	18.45	50.51	10.18	24.63	77.48	4.73
	F-F	72.23	83.88	81.55	49.49	89.82	75.37	49.49	95.27
FacilityE 77.14	F-E	-47.28	0.00	-55.01	-45.77	10.39	-22.86	0.00	276.48
	F-D	33.02	19.77	22.49	56.69	12.69	29.53	81.52	5.99
	F-F	66.93	80.23	77.51	43.31	87.31	70.47	18.48	94.01
FacilityG 80.72	F-G	-70.53	0.00	-56.67	-53.56	117.92	-19.28	0.00	137.50
	F-D	39.76	24.81	27.97	63.66	16.29	35.94	85.52	7.86
	F-F	60.24	75.19	72.03	36.34	83.71	64.06	14.48	92.14

Table 8. BCC Reference Group and Potential of Welfare Facilities for the Aged Unit: %

DMU	Reference Group	Input Variables					Output Variables		
		Budget	No. of Clients	No. of Staffs	Facility Area	Operation Management	No. of Clients	Profitability	Welfare for the Aged
FacilityE 78.69	F-E	-42.95	0.00	-52.75	-43.08	11.82	-21.31	0.00	273.57
	F-B	10.48	3.00	7.66	7.92	4.18	5.00	3.57	2.12
	F-D	29.37	19.03	20.61	51.98	12.06	27.87	78.57	5.81
	F-F	60.15	77.96	71.73	40.10	83.76	67.14	17.95	92.07

higher potential of facility F. Facilities D and F of facility G showed higher potential. Facility D showed higher potential in facility area and profitability. and other variables of facility F showed higher potential.

Third, DMU and potential in reference group and potential of the elderly welfare facility BCC are shown in <Table 8>. Facility E showed relatively higher potential in facilities B, D and F. Facility F showed higher potential in budget(60.15%), clients(77.96%), staffs (71.73%), and total clients(67.14%), and facility D showed higher potential in facility area(51.98%) and profitability(78.57%).

5. Discussion of Analysis Results and Suggestions

This study analyzed determinants of efficiency evaluation and its efficiency for the elderly welfare through welfare facilities for the aged.

Determinants of efficiency evaluation of the elderly welfare facilities were set through theoretical and preceding studies and weight of each determinant was analyzed with Saaty's AHP and DEA.

The results of analyzing the efficiency evaluation of the elderly welfare facilities can be summarized as follows.

First, as a result of analyzing relative importance of facility factors, community cooperation was highest in use facilities and donation, support and professionals were highest in living facilities.

Second, CCR and BCC models showed 100% of efficiency in the elderly welfare use facilities, facilities A, C, D and F of CCR model in the elderly welfare living facilities showed 100% of efficiency and facilities B(79.89%), E(77.14%), and G(80.72) showed low efficiency. Facility E(78.69%) of BCC model showed low efficiency. Efficiency comparison between the elderly welfare use facilities and the elderly welfare living facilities showed higher efficiency in the elderly welfare use facilities.

Third, it was found that DMU (decision making unit) and potential as reference groups of DMU in CCR reference group and potential of the elderly welfare living facilities showed relatively higher potential in facilities D and F of facility B. Facilities D and F of facility E showed relatively higher potential. It was also found that DMU and potential in BCC reference group and

potential showed relatively higher potential in facilities B, D and F of facility E.

Some concrete suggestions based on the above results can be summarized as follows.

First, as budget was highest in use and living facilities of classification items of the elderly welfare facility input, the security of budget was very important for improving the elderly welfare through the elderly welfare facilities. In particular, it was found as a result of efficiency that budget in living facilities was very poor. Therefore, for the security of budget of the elderly welfare facilities, dependence on external donation should be reduced and method of securing income is required.

Second, different approach to facility types is required to improve the elderly welfare through the elderly welfare facilities. Document date, settlement, family and community cooperation are important as the client management in use facilities and the elderly welfare should be focused in living facilities, and effective management in the side of program, professionals and hygiene management should be made.

Third, as a result of analyzing relative importance among facility items affecting the elderly welfare facilities, community cooperation was highest in use facilities and donation and professionals were highest in living facilities. Therefore, it is considered that attracting active community cooperation using community network in use facilities is necessary.

Fourth, as a result of efficiency analysis, the efficiency of input and output variables in the elderly welfare use facilities was high. But, budget, staffs, facility area and clients were inefficient in the elderly welfare living facilities. Budget and profession have important managing in the elderly welfare living facilities as in priority of factors through AHP.

This study examined the efficiency evaluation of the elderly welfare facilities. It will be more desirable to consider and approach use and living facilities to active the elderly welfare facilities. Therefore, enhancing the efficiency of determinants in the elderly welfare facilities will activate the elderly welfare.

Acknowledgements

This study was supported by research funds from Chosun University, 2015.

References

- [1] G. W. Kim, H. Y. Lee, and H. Y. Park, "Measuring relative efficiency of local government's field administration, eup and myun, by use of DEA/AHP model", *The Korean Journal of Local Government Studies*, Vol. 8, pp. 299-316, 2004.
- [2] T. S. Kim and H. J. Jeon, "Analysis on information security manpower policy by the analytic hierarchy process", *The Korean Institute of Communications and Information Sciences*, Vol. 31, pp. 486-493, 2006.
- [3] T. I. Kim, "Critical discussion of productivity evaluation of local governments by data envelopment analysis", *The Korean Association for Policy Analysis and Evaluation*, Vol. 10, pp. 185-207, 2000.
- [4] E. Y. Ryu, "Analysis on efficiency of E-government among the local governments", *Journal of Korea Policy Society*, Vol. 16, pp. 255-278, 2007.
- [5] Y. A. Ryu, "A study on the efficiency evaluation of the local administration : The data envelopment analysis of social welfare services", Ph.D diss., Sunggyungwan University, 2006.
- [6] D. G. Seong and C. Y. Jang, "A study on deciding priority of E-government embodiment strategy using AHP", *Korea Association for Governmental Studies*, Vol. 14, pp. 353-372, 2002.
- [7] S. Y. Moon and G. C. Yoon, "An analysis of the performance of social welfare service -focused on the methods of DEA and SERVQUAL-", *Korean Public Administration Review*, Vol. 38, pp. 201-224, 2004.
- [8] Y. M. Kim, "A measurement of community welfare center's relative efficiency using DEA", *Journal of Local Government Studies*, Vol. 16, pp. 133-153, 2004.
- [9] S. C. Jang, I. Gang, G. M. Kim, Y. J. Kim, C. J. Bae, S. G. Yang, S. M. Lee, Y. H. Lee, J. M. Lee, and J. S. Lee, "Welfare for the aged", Paju: Gyomoon Publishers, 2006.
- [10] O. N. Yang, H. G. Kim, M. S. Kim, and S. D. Jung, "Theory of welfare for the aged", Goyang: Knowledge Community, 2007.
- [11] J. S. Hwang, "Theory of policy of welfare for the aged", Seoul: Hansung University press, 2005.
- [12] T. L. Saaty, "The analytic hierarchy process: planning, priority setting, resource allocation", New York: McGraw-Hill, 1980.
- [13] J. C. Yeom and H. N. Park, "The location decision of family restaurant using AHP", *Journal of Food-service Management*, Vol. 6, pp. 161-178, 2003.
- [14] G. T. Cho, Y. G. Cho, and H. S. Gang, "Decision making by analytic hierarchy process", Seoul: Donghyeon Publishing Co, 2005.
- [15] T. L. Saaty and Y. Cho, "The decision by the US congress on China's trade status: a multicriteria analysis", *Socio-Economic planning science*, Vol. 35, pp. 243-252, 2001.
- [16] Y. B. Lee, "The problem and policy for improvement of the local government finance", *Journal of Social Science Research*, Vol. 5, pp.163-178, 1998.
- [17] G. J. Yoon, "Using DEA to measure the efficiency of local health centers", *Journal of Korean Policy Society*, Vol. 5, pp. 80-109, 1996.
- [18] Y. M. Park, "A study on importance evaluation of internal control system of administrative information by AHP", Ph.D diss., Seoul National University, 1994.
- [19] H. J. Kim, "An application of AHP method to the decision making of tourism policy priority", *Journal of Tourism Sciences*, Vol. 22, pp. 367-374, 1998.
- [20] P. D. Epstein, "Measuring the performance of public service", ed. M. Holzer, *Public Productivity Handbook*, New York: Marcel Dekker Inc, pp. 161-193, 1992.
- [21] D. N. Ammons, "Overcoming the inadequacies of performance measurement in local government: The case of libraries and leisure service", *Public Administration Review*, Vol. 55, pp. 37-47, 1995.
- [22] S. Rogers, "Performance management in local government", London: Longmann, 1990.
- [23] A. Charnes, W. W. Cooper, and E. Rhodes, "Measuring the efficiency of decision making units", *Eur. J. Oper. Res.*, Vol. 2, pp. 429-444, 1978.
- [24] R. D. Banker, A. Charnes, and W. W. Cooper, "Some models for estimating technical and scale inefficiencies in data envelopment analysis", *Management Sci.*, Vol. 30, pp. 1078-1092, 1984.