

A Causal Model for Environmental Design of Residential Community for Elderly Well-Being in Thailand

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Abstract—This article is an extension of previous research presenting the relevant factors related to environmental perceptions, residential community, and the design of a healing environment, which have effects on the well-being and requirements of Thai elderly. Research methodology began with observations and interviews in three case studies in terms of the management processes and environment design of similar existing projects in Thailand. The interview results were taken to summarize with related theories and literature. A questionnaire survey was designed for data collection to confirm the factors of requirements in a residential community intended for the Thai elderly. A structural equation model (SEM) was formulated to explain the cause-effect factors for the requirements of a residential community for Thai elderly. The research revealed that the requirements of a residential community for Thai elderly were classified into three groups when utilizing a technique for exploratory factor analysis. The factors were comprised of (1) requirements for general facilities and activities, (2) requirements for facilities related to health and security, and (3) requirements for facilities related to physical exercise in the residential community. The results from the SEM showed the background of elderly people had a direct effect on their requirements for a residential community from various aspects. The results should lead to the formulation of policies for design and management of residential communities for the elderly in order to enhance quality of life as well as both the physical and mental health of the Thai elderly.

Keywords—Elderly, environmental design, residential community, structural equation modeling.

I. INTRODUCTION

TREND of the world aging population is being increased obviously. A recent report by the United Nations showed that the percentage of the world population older than 60 years is expected to reach two billion by 2050 [1], making global aging a concern for countries both rich and poor. Thailand is one of many countries facing the problem of an increasing senior population. According to modern medical science and better public health science at present, together with the lack of appropriate planning in population policy, the death rate of the Thai population has decreased. In a yearly report concerning the situation of the Thai elderly [3], it is estimated that the percentage of Thai elderly (60 years and above) will be 19.1%, 26.6% and 32.1% of the total Thai population in 2020, 2030, and 2040, respectively. These estimations lead to a question of how the Thai government will cope with the

situation. To address this issue, the National Committee on the Elderly under the Ministry of Social Development and Human Security Thailand [4] defined a framework for Thai elderly as follows:

- Elderly persons with good living standards are physically and mentally healthy, have a happy family, and social care, as well as an enabling and friendly environment, stable security, and access to appropriate welfare and services. These factors lead to a valuable life with dignity, autonomy and independence, allowing them to serve with central reliability and participation in their family, community and social activities, as well as keep access to data, information and news.
- The family and community serve as a strong institution and key sector of efficient support for the elderly.
- Welfare and service systems should ensure a high quality of life and full participation for elderly persons in both their community and family.
- All sectors and parties shall take part in the welfare and service system accessible and usable by the elderly, where safeguards are needed to protect the elderly as a group of consumers.
- Proper undertakings and settings should be performed to enable elderly persons who face difficulties and are in need of care to be recognized and included as members of their community in all areas.

The defined framework led to the next question of where a large number of the elderly would live after their retirement and while facing the inevitable degeneration of their bodies. They need assistance from their children or others when they have to go hospital or a clinic. For these reasons, a residential community for the enhanced well-being of the elderly is the answer. The author was committed to studying "a place that has all facilities for Thai elderly living and needs, with people available and competent to care for them when they get sick as well as good social environmental management. Such a place could be part of society with happiness and a place where it is convenient and safe to live until their final days of life". What should the place be like? A previous study identified by the author called [2] "Modeling Design and Management of Residential Community for Enhancing Elderly Well-Being in Thai Cultural and Spiritual Environments", studied the design and management of a residential community for Thai elderly. However, the study focused only on certain characteristics among Thai elderly, including health and age. As such, a gap exists in research concerning how other background factors

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(e.g. education, economic status) of the elderly would affect the design. Therefore, the objective of this research is to study the impact of background factors for Thai elderly and their requirements on the environmental design and management of a residential community using SEM. This article is an extension of a previous study by the author investigating the background factors of Thai elderly. In order to achieve these objectives, this research conducted the following:

- (1). Identifying the components of requirements among Thai elderly and their measurement.
- (2). Developing a SEM that demonstrates the relationships between elderly backgrounds, elderly requirements, and elderly willingness to join a residential community.
- (3). Recommending policies for the design and management of a residential community to enhance the well-being of the elderly in the context of a Thai residential community.

II. RESEARCH BACKGROUND

A. Elderly

The National Committee on the Elderly under the Ministry of Social Development and Human Security Thailand [3] stated, “the elderly are not a vulnerable nor social burden, but are able to take part in social development resources, so they shall be entitled to recognition and support by the family, community and the state to lead a valuable life with dignity and sustain their healthiness and living standards as long as possible”. The World Health Organization (WHO) [5] stated on their website that most developed world countries have accepted the chronological age of 65 years as an age for the designation of ‘elderly’ or older person. However, this does not adapt well for the situation in Africa, like many other westernized concepts [5]. At the moment, there is no United Nations (UN) standard numerical criterion, but the UN has agreed to a cutoff age of 60 years and up as referring to the ‘older population’. In this research, Thai elderly has been defined as those of an age 60 years and above. Further, the health condition of the elderly has been classified into five levels, including: (1) strong, can help themselves with everything, (2) sometimes need assistance, (3) need assistance at most times, (4) need assistance at all times, and (5) totally dependent and need assistance at all times.

B. Environmental Design

Plunz [6] stated that environment design is “the process of addressing the surrounding environmental parameters when devising plans, programs, policies, buildings, or products”. Environmental design can also refer to the sciences and applied arts dealing with the creation of human-designed or built environments. The fields include architecture, urban planning, geography, landscape architecture, and interior design. Generally, environmental design studies and analyzes physical surroundings of natural and built facilities that provide the setting for human activities ranging from buildings, parks, green spaces, and communities [7]. Environmental design is defined as the physical and constructed environment in which people live, work, and recreate on a day-to-day basis. Furthermore, environmental

design is concerned with the methodology these places are used and experienced, as well as other aesthetic elements that lead to the quality of such community environments [7]. Environmental design is considered in this research in terms of the requirements of the Thai elderly population.

C. Healing Environment

Jonas and Chez [8] believed “an emphasis on healing is a key to the future medical management of chronic illness and the establishment of sustainable approaches in health care”. Defined as the process of recovery, repair, and return to wholeness, healing is the foundation for a vision of medicine that integrates diverse approaches from around the world for the alleviation of suffering, the enhancement of well-being and the treatment of chronic illness. Healing is facilitated through the development of proper attitudes and intentions in both the provider and the recipient, the use of personal self-care practices, and creating healing relationships, as well as applying the knowledge of health promotion and maintenance, and the appropriate integration of complementary and conventional medical practices. Nelson et al. [9] described a “healing environment” as being synonymous with a therapeutic environment. A therapeutic environment is one that is designed not only to support and facilitate state-of-the-art medicine and technology, patient safety, and quality patient care, but also to embrace the patient, family and care providers in a psychosocially therapeutic environment. A healing environment would be checked and compared with the mentioned literature and existing cases in Thailand. Subsequently, the concluded result would be used in the questionnaire design.

D. Residential Community

Paul et al. [10] stated that “a community is a social unit of any size that shares common values, or that is situated in a given geographical area (e.g. a village or town)”. It is a group of people who are connected by durable relations that extend beyond immediate genealogical ties, and who mutually define that relationship as important to their social identity and practice. The WHO Regional Office for Europe [11] defined “a community residential health facility as a non-hospital, community-based mental health facility that provides overnight residence for people with mental disorders”. The facilities include supervised housing and unstaffed group homes; group homes with some residential or visiting staff; hotels with day and night staff; hostels and homes with 24-hour nursing staff; halfway houses; and therapeutic communities. Both public and private not-for-profit and for-profit facilities are included. Perkins et al. [12] stated in a text book of “building type basics for senior living” that common facilities within a skilled-nursing facility serving all of the nursing units may include: a multipurpose room, a coffee shop/snack bar, a gift shop, a library, outdoor terraces and recreation areas, art/activity, clinic, rehabilitation. The text book also stated that, in adult communities, landscaped and natural areas should be developed for walking, contemplation, golf, lawn sports, shuffle board, gardening activities, fishing,

and other recreational activities.

III. RESEARCH METHODS

A. Case Studies

According to the author's previous research [2], the research process started with observations and interviews in three case studies in terms of management processes and environment design. The three cases are comprised of existing elderly community projects operating in Thailand. The three cases include:

Case Study 1. Case study 1: A private project with 600 single houses, three condominium buildings, and facilities related to the elderly. The project is suitable for elderly people with families, patients with chronic diseases, and people who need special care or rehabilitation. The project is located in Chang-Lek, Bangsai, Ayutthaya.

Case Study 2. Case study 2: A governmental foundation project with 163 rooms in a building (8-story), 300 rooms in eight additional buildings (6-story), and associated facilities. This project is suitable for the elderly at the beginning of their retirement, who live alone and are strong, therefore able to take care of themselves. The project is located in Pathumwan, Bangkok.

Case Study 3. Case study 3: A religious foundation project with 164 rooms/beds in five buildings (2-story), facilities related to the elderly and nursing wards. The project is suitable for elderly people with low incomes, elderly people with amnesia, and elderly people who are unable help themselves. The project is located in Sampran, Nakhon Pathom.

The managers and management staff of the three case study sites were appointed and interviewed at their community locations on the topics of management, environment, facilities, and activities in their community. After the conducted three-case study observations and interviews, the facilities and activities in the cases were classified and defined by item list. The item list results for this part were taken to summarize with related theories and literature for design of the questionnaire in the next section.

B. Questionnaire Design

A questionnaire survey was designed for data collection in the study [2] to confirm the factors and items of requirement in the residential community for a group of Thai elderly. The questionnaire items were designed by referring to the literature review and the case studies mentioned previously. The questionnaire was comprised of three parts, with the first part concerning general information about the respondents including gender, age, health condition, education, and economic status (five questions). The second part was comprised of the requirement items in their residential community where expected (30 questions). The last part asked about willingness among the elderly to join residential community projects (three questions). The first part was measured by the frequency (percentage) of the respondents, while the second and third parts were measured using a 5-level Likert scale measurement ranging from "strongly disagree" to

"strongly agree". The questionnaire items are shown in Table I.

TABLE I
QUESTIONNAIRE ITEMS

Factors	Items
Elderly background	EB1 :Education
	EB2 :Economic Status
Location	Q1 :Calm and natural place
	Q2 :Near religious places
	Q3 :Near hospitals
	Q4 :Health food shop
	Q5 :Convenience shop
	Q6 :Beauty salon
	Q7 :Laundry service
	Q8 :Cleaning service
	Q9 :Building maintenance service
	Q10 :24-hour security guards
	Q11 :24-hour medical center
	Q12 :Care center for the elderly
	Q13 :Sauna and spa
	Q14 :Training center for improving quality of life
Elderly's requirements	Q15 :Library
	Q16 :Computer and Internet room
	Q17 :Karaoke lounge
	Q18 :Swimming pool
	Q19 :Fitness
	Q20 :Outdoor stadium
	Q21 :Garden and outdoor patio
	Q22 :Indoor activities
	Q23 :Religious place
	Q24 :Sidewalks and bike lanes
	Q25 :24-hour fence and gate guards
	Q26 :Religious activities
	Q27 :Recreational activities
	Q28 :Important day activities
Activity	Q29 :Training activities
	Q30 :Excursions programs
Willingness	W1 :Interesting in the community
	W2 :Willingness to live in the community
	W3 :Willingness to recommend the community to others

C. Validity and Reliability

In order to ensure that the items in the research were appropriate for the Thai elderly [2], interviews were held with five experts possessing relevant experience in elderly behavior and residential communities. The experts reviewed the items and offered comments concerning whether the items were accurate representations to measure the model in this research. They also suggested some items which were more appropriate for use in the context of the research. This exercise was useful to provide content validity and ensure that the items were neither ambiguous nor confusing. Cronbach's alpha was used to evaluate the reliability of the questionnaire. A pilot study was conducted with 30 elderly target samples for reliability. The coefficients for location, activity, and facility were 0.942, 0.953, and 0.850, respectively. The value for all items (Q1-

Q30) was 0.964. All coefficients were above 0.7 demonstrated that the questionnaire is reliable [13].

D. Data Collection

Once the questionnaire was designed, a target group of Thai elderly (aged 60 years and older) was selected using a convenient non-probability sampling technique. Almost all of the respondents were in Bangkok, with some in the surrounding areas of Bangkok. A period of survey (three months) using face-to-face interviews was conducted for explaining the details of the questionnaire to ensure respondents' understanding of the survey by the researcher. In total, 550 questionnaires were collected, although 19 were discarded due to incomplete information and/or biased responses. As such, 531 questionnaires were deemed valid and used for analysis in the next section.

E. Exploratory Factor Analysis

From the research [2], the exploratory factor analysis (EFA) with varimax rotation was implemented to determine the underlying factor structure construct of the environmental design and management of residential communities in Thailand. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy = .973 (KMO>0.7) [14], Bartlett's test of sphericity has a significant value = .000 (less than .05), Approx. Chi-Square = 15384.567, df = 435. Factor loading values that are less than 0.5 would be eliminated. The EFA output showed three factors of the 30 items (Q1-Q30) were grouped, including Factor 1: Q2, Q4, Q6, Q7, Q8, Q9, Q13, Q14, Q15, Q16, Q17, Q23, Q26, Q28, Q29, and Q30; Factor 2: Q1, Q3, Q5, Q10, Q11, Q12, and Q25; Factor 3: Q18, Q19, Q20, Q21, Q22, Q24 and Q27. Furthermore, the reliability of the questionnaire in terms of the three factors was assessed on the basis of Cronbach's alpha coefficient. According to Nunnally [13], Cronbach's alpha coefficients of 0.7 or higher are recognized as acceptable values. The values of the coefficient were acceptable for all three factors, ranking from 0.928 to 0.964, and the value for all items (Q1-Q30) was 0.975. The outputs for all above are shown in Table II.

In Table II, the EFA resulted in requirements for a residential community of the Thai elderly classified into three factors. In this research, the three factors were named by considering the majority of the items in the factors, including: Factor 1 "Activities and general facilities", Factor 2 "Exercises", and Factor 3 "Health and security".

F. Research Hypotheses

The objectives of this article are to understand the requirements of the elderly in their expected residential communities based on their different backgrounds. The research hypotheses were formulated accordingly. Once the EFA was conducted, the three factors for elderly requirements in a residential community, including "activities and general facilities", "exercises", and "health and security", were treated as mediating variables or mediators [15] between the backgrounds and willingness of the elderly. The three factors for elderly requirements are caused by their backgrounds and would have some effect on the willingness to join a residential

community, which could be presented in a conceptual research model (see Fig. 1). The research hypotheses were developed as follows:

TABLE II
FACTOR LOADING OF THE EFA AND CRONBACH'S ALPHA

Item	Factor loading			Cronbach's alpha
	1	2	3	
Q28	0.78	0.22	0.206	0.964
Q29	0.766	0.178	0.302	
Q14	0.757	0.19	0.278	
Q15	0.752	0.203	0.187	
Q30	0.748	0.11	0.355	
Q2	0.714	0.451	0.086	
Q26	0.713	0.341	0.192	
Q13	0.709	0.226	0.331	
Q9	0.697	0.346	0.271	
Q4	0.694	0.297	0.324	
Q16	0.673	0.109	0.548	
Q23	0.658	0.385	0.186	
Q17	0.65	0.075	0.578	
Q8	0.64	0.349	0.248	
Q6	0.636	0.204	0.473	0.975
Q7	0.63	0.349	0.399	
Q11	0.189	0.853	0.153	
Q10	0.171	0.831	0.188	
Q12	0.384	0.741	0.095	
Q3	0.239	0.735	0.357	
Q25	0.154	0.705	0.424	
Q1	0.36	0.676	0.351	
Q5	0.447	0.566	0.394	
Q19	0.252	0.303	0.807	0.940
Q18	0.386	0.234	0.783	
Q20	0.376	0.366	0.682	
Q22	0.34	0.483	0.621	
Q21	0.362	0.472	0.606	
Q24	0.355	0.508	0.577	
Q27	0.438	0.414	0.553	

- H1. The backgrounds of the elderly will influence the factor of activities and general facilities.
- H2. The backgrounds of the elderly will have influence on the factor of exercises.
- H3. The backgrounds of the elderly will have influence on the factor of health and security.
- H4. The factor of activities and general facilities will have an effect on the willingness of the elderly to join the residential community.
- H5. The factor of exercises will have an effect on the willingness of the elderly to join the residential community.
- H6. The factor of health and security will have an effect on the willingness of the elderly to join the residential community.

IV. RESULTS

A. Descriptive Results

Profile of the data for 531 total respondents comprised of Thai elderly taken for analysis in terms of descriptive results are shown in Table III.

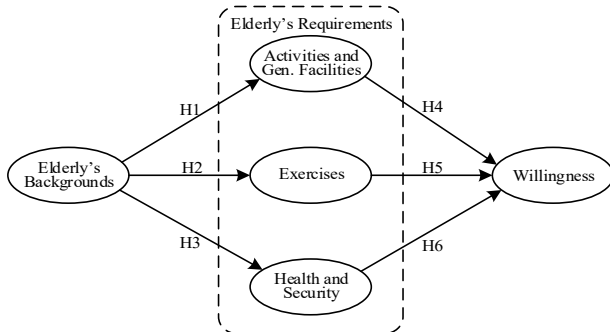


Fig. 1 Conceptual Research Model

TABLE III
DESCRIPTIVE RESULTS

Description	Frequency	Percentage
Gender		
Male	220	41.4%
Female	311	58.6%
Age		
60 -65 yrs.	265	49.9%
66 -70 yrs.	154	29.0%
71 -75 yrs.	79	14.9%
76 -80 yrs.	27	5.1%
More than 80 yrs.	6	1.1%
Health condition		
Strong and can help themselves	282	53.1%
Sometimes need assistance	194	36.5%
Often need assistance	40	7.5%
Need assistance all the time	11	2.1%
Totally dependent unable to move and need assistance all the time	4	0.8%
Education		
No education	24	4.5%
Primary school	62	11.7%
High school	155	29.2%
Bachelor's degree	257	48.4%
Higher than bachelor's degree	33	6.2%
Economic status (last income, before retirement)		
Less than 10,000 Baht/month	93	17.50%
10,000 to 30,000 Baht/month	223	42.0%
30,001 to 50,000 Baht/month	95	17.9%
50,001 to 100,000 Baht/month	85	16.0%
More than 100,000 Baht/month	35	6.6%

A. Structural Equation Model

Byrne [16] stated that a SEM is a model used to explain influences or effects between latent variables on other latent variables in the model. In this research, a latent variable named “background of the elderly” with its two-observed variables, EB1 (education) and EB2 (economic status), was added to the model as an exogenous variable once the EFA

had been done. One more latent variable named “willingness” with three observed variables, including W1 (interesting in the community), W2 (willingness to live in the community) and W3 (willingness to recommend the community to others), was added to the model. Then, the model was analyzed and the output shown in the model was fit by Chi-square = 2057.37, df = 525, $p = 0.06 (>0.05)$, CMIN/DF = 3.919 (<4.0), GFI = 0.820 (>0.8), RMSEA = 0.074 ($0.03 < \text{RMSEA} < 0.08$) [17], as shown in Fig. 2.

The research hypotheses were tested using the outputs of the model as implemented above. Table IV provides the results of the test, with each factor and variable having significant effects (p -values < 0.05) between each other.

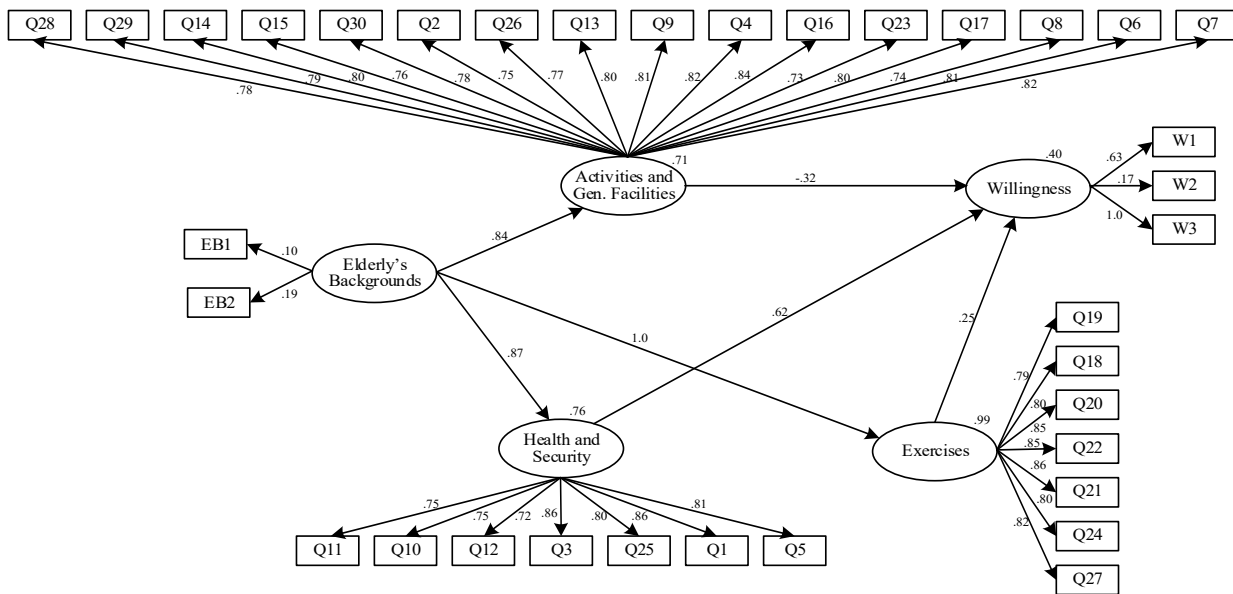
The results of the SEM in Fig. 2 and Table IV showed path coefficients in standardized estimate of regression weight. All hypotheses (H1, H2, H3, H4, H5, and H6) were supported significantly at the 0.05 level.

V. DISCUSSION

As described in Section III, the requirements of the elderly were classified into three factors including “activities and general facilities”, “exercises”, and “health and security”. For the factor of activities and general facilities, all 16 variables similarly reflected on the factor (0.73 to 0.84), with the top five reflected variables being the requirements of computer and Internet room (Q16; 0.84), health food shop (Q4; 0.82), laundry service (Q7; 0.82), building maintenance service (Q9; 0.81), and beauty salon (Q6; 0.81). For the factor of exercises, there were seven variables that similarly reflected on the factor (0.79 to 0.86), with the five highest reflected variables being the requirements of garden and outdoor patio (Q21; 0.86), outdoor stadium (Q20; 0.85), in door activities (Q22; 0.85), recreational activities (Q27; 0.82) and sidewalks and bike lanes (Q24; 0.80). For the factor of health and security, there were seven variables that similarly reflected on the factor (0.72 to 0.86), with the five highest reflected variables being the requirements of calm and natural place (Q1; 0.86), near hospitals (Q3; 0.86), convenience shop (Q5; 0.81), 24-hour security guards (Q25; 0.80), and 24-hour medical center (Q11; 0.75).

In the SEM (Fig. 2), the backgrounds of the elderly had a positive effect on exercises (1.0), health and security (0.87), and activities and general facilities (0.84), meaning that, the Thai elderly with higher backgrounds (e.g. higher education, economic status) needed all the mentioned facilities and activities. On the other hand, the Thai elderly with less fortunate backgrounds did not need certain facilities and activities in a residential community. Activities and general facilities had a negative effect on willingness (-0.32), meaning that the Thai elderly who required the activities and general facilities were not quite willing to join the residential community. Exercises had a positive effect on willingness (0.25), meaning the Thai elderly who required exercises may have had willingness to join the residential community. Finally, health and security had a positive effect on willingness (0.62), meaning the Thai elderly who required health and security were quite willing to join the residential

community.



CMIN/DF = 3.919 (<4.0), GFI = .820 (>.8), RMSEA = .074 (.03<RMSEA<.08)

Fig. 2 Structural Equation Model

TABLE IV
RESULTS OF THE TESTED HYPOTHESES

Hypothesis	Relationship	Standardized Path Coefficient	Result	Significant (p)
H1	Backgrounds of elderly → activities and general facilities	0.84	Supported	***
H2	Backgrounds of elderly → exercises	1.0	Supported	***
H3	Backgrounds of elderly → health and security	0.87	Supported	***
H4	Activities and general facilities → willingness	-0.32	Supported	***
H5	Exercises → willingness	0.25	Supported	.015
H6	Health and security → willingness	0.62	Supported	***

Note = *** :p <0.001

VI. CONCLUSION

This paper is an extension of an article from previous research [2] that studied the factors related to environmental perceptions, residential community, and design of a healing environment, which have effects on the well-being and requirements of Thai elderly. The respondent profile is shown in Table III. According to the results in this research, it could be concluded that Thai elderly with higher backgrounds (education, economic status) needed all the facilities and activities in residential communities. This result was different from previous research [2] that showed Thai elderly being old and in weak health and not desiring the facilities and activities in residential communities. The five most significant requirements in terms of activities and general facilities were computer and Internet room, health food shop, laundry service, building maintenance service, and beauty salon. The five most significant requirements in terms of exercises were garden and outdoor patio, outdoor stadium, indoor activities, sidewalks and bike lanes, and recreational activities. The five most significant requirements in terms of health and security were calm and natural place, near hospitals, convenience shop, and 24-hour medical center.

24-hour security guards, and 24-hour medical center. In the aspect of willingness to join the residential community, the factor that had the highest effect on the elderly would not be activities and general facilities or exercises, but health and security in the residential community. Finally, the Thai government should prepare to cope with the increase of the Thai elderly population in the near future, as defined in the framework (Section I) by The National Committee on the Elderly under the Ministry of Social Development and Human Security Thailand [3]. Policies for enhancing the well-being of the Thai elderly should conclude that the facilities in a residential community for the elderly focus on elements of health and security such as calm and natural place, near hospitals, convenience shop, 24-hour security guards, and 24-hour medical center.

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