Ideological Smart Home in Ageing Society: A Case Study on the Elderly Living in Bangkok, Thailand

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Abstract

Ageing society trend in Thailand has brought a challenging context to real estate industry in the country and it actually can be an all-or-nothing opportunity depending on how each developer conceives the topic and sees the demand in conjunction with their abilities to come up with a project that matches to what the "society" wants or needs in order to stand stably and profitably strong in the market. This research therefore represents the ideology of a smart home where supporting the elderly with safety and health, yet actually with a design that is meant for everyone in the family to live comfortably in together over time. This research assesses the significant predictor(s) of the possibility that the elderly would be likely to acquire technology for their dwellings. The analysis of the data collected from 312 sets of questionnaires on older adults living in five different areas in Bangkok, Thailand, grouped by decade. The questionnaire was dichotomized that Binary Logistic Regression was performed to assess the attitude of the elderly toward technology and the socioeconomic characteristics that cases would significantly associate with the analysis. For the analyses, P-value of <0.01 and0.05 were used. The embedded findings show predictors that actually significantly affect the attitude of the Thai elderly toward smart home technology are not actually due to the limitations of being aged as a major concern. Meanwhile, having an absolute homeownership was a strong predictor that significantly associated with the statistic results, so does the trait of having living assistants, but not living with a family that is statistically shown as in an adverse predictor. Considered the technology components in conjunction with the analysis, technology with the purpose of keeping health and safety was a significant predictor even after controlling for socioeconomic characteristics. Despite the sensory changes research in parallel to the associated technology as a home element to the extent of the environmental gerontology context, the findings from this research, however, have explanatorily shown that, at the end of the day, the elderly prefer to stay in a place even though they could be a burden to their families.

Keywords*: *Ageing Society*, *Smart home*, *Technology integration*, *Age-related sensory changes*, *Elderly*, *Older adults

1. Introduction

In the real estate industry, increasing population projects a progressive opportunity in estimating future potential demand on dwellings. The significant increase in global ageing population has been recognised for decades in connection with the trends in morbidity and mortality of older adults has continuously dropped. So does in Thailand, referring to the annual publications of National Committee for the Elderly since 2009, it has always been highlighted that Thai ageing population whose aged 60 years old and above has been statistically striking up (Siriphanich, 2017). The United Nations also estimated the total number of Thai populations aged 60 and above that, by 2050, the number will reach 20,961,000 from the current number at 13,412,000 (Vichit-Vadakan et al, 2002; AgeingAsia, 2019; United Nations, 2019) The aforementioned annual report also added that Thailand enters to ageing society very much faster than other developed countries in the world. This is due to, according to the report, an astonishing success of the birth control campaign to the extent that Thai people have a longer life expectancy. Healthcare is also being concluded as one of the reasons that significantly proven contributing to the increase of population. In 2018, Keith Pollard—a CEO of LaingBuisson International Limited, a web publishing business in the healthcare sector—ranked Thailand as one of the best medical travel destinations for the global healthcare quality and safety (Pollard, 2018). The extend of our advanced medical technology and facilities with licensed and accredited medical professionals while the costs—comparing to other countries where offer an equivalent service—are much lower.

In the meantime, Bangkok has been expected to become "Smart Cities" (Krasaesan, 2016) in which the city must be in accordance with the International Standards as ideally projects the safety,

reliability and compatibility of diverse technologies. The residents shall be fully aware of the united objective to the extent of its righteous and in a balance aspect of economics and technology. Provided which, Internet of Things (IoT) has proven its innovation that its utilities are practically assistive to ageing users to their patterns of life and not limited to living at home and IoT will be even more efficient when each device is connected to each other and constantly collects and exchanges data. Technology can ensure one's Quality of Life regardless of the place which is presently in use. Nowadays, IoT devices have seamlessly become a great element of our typical day. Inside our house or outdoor, in a building or on all cars, there is at least one object that has been embedded in. Thus, this research believes that by allowing them to be one of the accountable components for assisting the elderly with any activities, starting at their own house, such balance between technology and senior dwellings shall improve the idea of further better livings where meant not only for seniors but to be all ages-friendly environments for the whole family to live soundly and conveniently with assistive technology together. While 'healthy ageing' is one of the concepts that is being promoted in order to positively urge the attention of the society to of quality of life, this research explores an approach to a dwelling where efficiently produces such optimistic to not only the elderly but ideally their family members with the "ideology" of dwelling elements where promotes a "smart" way of living that embraces the 'independence' in the essence given the 'age-related sensory changes' context-oriented in its core design to be prosperous to ageing society that Thailand has entered in.

In Thailand, the investors come up with different techniques used in the design of specialty and services mechanism for senior's assisted living. However, given the complexity of being age and being a part of a society, these projects are either too specific—given the chronic conditions and variety of diseases in ageing people— or too general—where nothing is rarely different except the label due to the developer's feasibility matter. Hence key factors to a successful senior living project in Thailand are 1) In medical terms: A full range of medical facilities and certified professional services with a well-trained team member; 2) In project development terms: A suitable well-design building and environment specifically supporting older adults, including location aspect as its surrounding area should not be constrained to the elderly to access and live in peacefully; and 3) Creditability of both major parties—well-reputative medical facilities centre and a well-recognised real estate developer, for the Quality of Life is eventually considered very essential for the longevity of life. Partnership definitely makes it possible and 'strong' considered from how some of the successful senior living projects in Thailand came from. Senior livings comprise of some specialty essences; this therefore brings about risks to developers who may possess some limitations in regards of the Time-Cost-Quality concerns for one project as a unit price in these projects is considerably high regardless of the technology chosen to be integrated for the residency's ideal smart quality of life. Thus, this is affordable to only some groups of families in a society, and the mortgage for senior citizens is understandably aggressive such as the loan amount is only all-inclusive 60% granted while the asset price must not be lower than 1.5m baht and the loan term is limited and up to 85 years old. This results in how the project that might have a well combination of technology and the least basic ageing people-oriented strategy in its core design of a senior living in the market in Thailand is yet to be a true ideal project that meant truly for the elderly in Thailand. And to date, there is no research with an ideology of technology-integrated ageing people-oriented livings.

Thailand as in Aging society. Our country has already become ageing society since year 2003 according to the National Committee for the Elderly—Foundation of Thai Gerontology Research and Development Institute—who was assigned to stipulating the preparation of an annual report on the status of the elderly for submission to the Cabinet accordance with the Elderly Act of 2003 (Siriphanich, 2017). *Term of Aging Society*—Referring to the definitions of Aging society announced from the United Nations in 2006, the terms are grouped as follows: *Aging Society* – The society where the ratio of population aged over 60 years old is over 10% of its total population, or population aged over 65 years old is over 7% of its total population. (Byrnes et al, 2006) *Aged Society* – The society where at least 20% of its total population aged over 60 years old; or 14% of its total population aged over 60 years old. (Luken & Vaughan, 2003) Super-Aged Society – The society where its total population aged over 65 years is equivalent to or higher than 20% of total population (Siriphanich, 2017). *Age Range Category of Elderly*—Groups older adults by decade of age that are relative to data on the national statistics in older adults, so we use the Sexagenarian

(60-69 years old); Septuagenarian (70-79 years old); Octogenarian (80-89 years old) (Hebert, 2010; Carr, 2019; Roestorf et al, 2019).

Average monthly income per household in Bangkok Thailand—According to the Department of Elderly Affair in Thailand (2019), in Bangkok, the total number of populations is 5,676,648 persons. In this number, those senior persons who age 60 years old and above are 1,020,917 persons. This equals 17.98% from the total population. Additionally, *The National Statistical Office of Thailand* (2019), the total is amounted to approximately 43,286.85 and 43,802.19 Thai baht in 2016-2017 respectively.

2. Objectives

2.1 Use environmental gerontology to explore how IoT and smart home technology can aid the elderly in their day to day activities at home. This will help understand the needs of the older adults in relation to the support that smart home technology can provide.

2.2 To explore the actual impact of smart home technology on elderly people's living and how it aids them in their daily lives and to create a list of technology that is preferred by the Thai older adults.

2.3 To explore the topic of smart dwelling pertaining to the senior population to outline the principles of integrated assistive technology that can be used when creating devices or designing for assisted living. The intention is to help real estate companies and technology start-ups understand the preferences of the elderly in relation to smart living and the circumstances under which they choose to purchase these devices.

3. Materials and Methods

This is a mixed-method study, where qualitative and quantitative data is analyzed to determine the behavioural patterns of the Thai elderly who use smart technology. The data was collected through interviews and survey questions to facilitate the behavioural analysis, which is used in the research to understand how different factors impact human behaviour and how this knowledge can be used by practitioners (Luiselli, 2017). A combination of an interview and survey was chosen as an alternative to direct observation, to collect quantitative data for the detection of patterns and qualitative information from the face-to-face interactions with the participants and open-ended questions that can explain the occurrences.

For this research, a random sampling technique was chosen to include a variety of the elderly from Thailand. This approach is relatively unbiased and allows one to examine the behaviour of different types of individuals. The main criteria of choice were the residency of the individuals and their age since this research specifically focuses on people aged 60 years old and above, resulting in 312 randomly chosen individuals, out of the 1,020,917 population of Bangkok and the sample size was chosen based on the computation.

The pilot study with 20 respondents was successful, indicating that no changes to the questionnaires, interviews, or other elements of the research should be made to meet its objectives. This research is designed with Model 1 and Model 2 to have a clear distinction between the demographic characteristics of the sample population and the question relating to the smart home devices. Model 1 also includes some questions about the attitudes towards technology in living spaces. Model 2, in particular, allows the researcher to perform the analysis of statistical significance to evaluate the relationship between the variable and its dependable one.

Sample size requirement— In computing the required sample size in power analysis for Logistic regression test with Binomial distribution, G*Power software version 3.1.9.2 was used. Given two-tailed with an alpha (α) error probability of 0.05 and the power at 95% (1-β err prob) where the odds ratio was 2.33 calculated from 50% of the participants have a positive possibility in acquiring smart home technology, while the otherwise were assumed to be 30% of— i.e. Pr(Y=1|X=1) H1 = 0.5; Pr(Y=1|X=1) H0 = 0.3.

To explore the dependency of the possibility that the elderly to acquire technology for their dwellings with the dependent variables extracted from two responses (yes/no) given the distribution of predictor (y_i) Bin(n_i, π_i) whether a trait is present (y_i=1), or not present (y_i=0), the estimation of the covariation requires 312 of total samples size where Critical z was 1.96 and the actual power equals 0.95.

This research groups older adults by decade of age. It is also relative to data on the national statistics in older adults, so we use the—Sexagenarians (60-69 years old); Septuagenarian (70-79 years old); Octogenarian (80-89 years old).

Study area—The researcher has piloted 20 sets of questionnaires to detect any overlooked errors as well as its comprehensive to the elderly by visiting The Mall Bangkae department store during daytime to test its quality, comprehensibility, and validity. Since there is a considerable number of the elderly aging at home in Thailand, we seek for collaboration from a domestic maid/helper service provider for the elderly in Bangkok area to help on doing the informant questionnaire for us as well.

The questionnaires were distributed to four different parts of Bangkok: Bang Khae district (West), Bang Rak district (Central), Lat Krabang district (East), and Lat Phrao district (North) where each part had one paid volunteer as an interviewer who would be interviewing participants. They were recruited and well-trained. Each of them was provided a questionnaire's introductory instruction paper as they need to transcribe the questionnaires in a synchronous communication. All data collection is done by on site questionnaire survey i.e. interviews. There are no online questionnaires due to the complexity of the requirements of the research.

Data Collection—Present Data was collected by the researcher during face-to-face meetings with the participants. Secondary Data was collected from a journal publication including related topic documents, research survey, and contents on the internet. The questionnaire paper contains two (2) parts in a front and a back of one paper:

Part 1) consisted of 34 variables and indicators items using a binary scale:

- Have you used or are you currently using this technology? (Yes=1/blank=0); If yes, do you find this technology important or useful? (Yes/No); If no, how positive do you perceive this technology's importance to your life? (Yes/No or leave blank if this is not relevant to one's life).
- Do you find it interesting to use? (Yes=1/blank=0);

The other section was a 5-likert scale that later collapsed into binary variables using the same grouping method: values 1 and 2 were combined to describe 0 = not important nor useful; value 3 means not relevant (tick or leave blank); and values 4 through 5 to describe 1 = important or useful. All blanks equal to 0. The converted analyses were:

- If yes, do you find this technology important or useful? (Yes=1/blank=0);
- If no, how positive do you perceive this technology's importance to your life? (Yes=1/blank=0)

Part 2) inquires household demographic characteristics such as total household size, age, gender, marital status, education and latest profession, household income, as well as type of house and form of house ownership.

Additionally, the researcher had created a 4:49-minute video comprising all situations cited in the questionnaire yet in an animation form. This video was aimed to be a supporting yet entertaining tool for the respondents to complete the questionnaire provided its story telling type that would potentially give a better understanding on the context. Lastly, the initial Part 2 and 3 were combined and moved up to be on the front page so that the interview shall be started off with an informative entertainment that had effectively proven to shorten the total interview time comparing to the no-video session.

Data Analysis—Statistical Analysis—Completed questionnaires were analysed using IBM SPSS Statistics programme version 23 with descriptive and inferential methods. 312 respondents are shown in Table 1. They comprised 51.9% of Sexagenarians age of 60-69, 32.1% of Septuagenarian age of 70-79 years old; and 16% of Octogenarian age 80 and above.

Descriptive Statistics—Frequencies, Mean, Percentage, Standard Deviation were used in order to describe the data statistically. 312 study participants' descriptive characteristics are shown in Table 1.

Table 1 Descriptive Statistics of Socioeconomic Characteristics of Participants (N=312)

	Socioeconomic Characteristics	Frequency (N=312)	%
Gender	Male (Yes=1)	149	47.8
	Female (Yes=0)	163	52.2
Age	Sexagenarians, age 60-69 (Yes=1)	162	51.9
	Septuagenarian, age 70-79 (Yes=1)	100	32.1
	Octogenarian onwards, age 80+ (Yes=1)	50	16.0

Socioeconomic Characteristics	Frequency (N=312)	%
Currently have assistant(s) for day-to-day livings (Yes=1)	86	27.6
Accountable for household expense (Yes=1)	261	83.7
Have a plan to improve their current house (Yes=1)	52	16.7
Household income per month ≥40,000baht (Yes=1)	151	48.4
Need for government support (Yes=1)	48	15.4
Absolute Ownership of current living House (Yes=1)	161	51.6
House type=Single, Twins, Townhome (Yes=1)	257	82.4
Currently living with Family (Yes=1)	254	81.4

With *Exploratory Factor Analysis* (EFA), the factors are analysed based on the correlation matrix in order to extract and group the similarity between each factor considering Factor Rotation and KMO and apply Bartlett's Test where the identity matrix is not in a diagonal form. To test the reliability of this questionnaire, the researcher considers Cronbach's Alpha Coefficient that this research refers to the rule of thumb where the scale should not be lower than 0.7 (Hebert, 2010; Wahl et al, 2013; Karvonen et al, 2020)(Cronbach's Alpha according to all 25 variables processed was 0.7).

Inferential Statistics — Chosen Chi-square to test independent factors. Descriptive framework and statistics of predictors were collaterally analysed.

Correlation was conducted to examine the relationship between X_k with Y (where the conditional probability of Y = 1 which is binary to indicate the strength of the empirical evidence of which predictors by the use of Logistic Regression model (Nunnally, 1978). Assuming that the model of the probability of the elderly acquiring the technology given a trait is:

$$\pi_i = Pr(Y_i = 1|X_i = x_i) = \frac{exp(\beta_0+\beta_1 x_i)}{1+exp(\beta_0+\beta_1 x_i)}$$

π = success probability (always be between 0 and 1)
Y = binary response variable
X = Explanatory variables (predictor)
i = no. Explanatory variables

Table 2 Descriptive Statistics of Predictors by the Spatial Frames (25 items)

#	Predictor	Descriptions	x̄	s.d.
Spatial frame # 1 Integrated Technology				
1)	Glass break detector	Acoustic Glass Break Sensor listens for the frequency of the sound of breaking glass and to get an alert & trip your alarm when it goes off.	4.04	0.70
2)	Water-Leak Detector	Water leak detector residential and shut off valve.	4.08	0.63
3)	Fire & Gas Detection	Kitchen gas leakage detector fire alarm	4.27	0.76
4)	Surveillance cameras	Home Security Cameras & Video Surveillance Systems used for the purpose of observing an area.	4.03	0.68
5)	Electronic Door Lock	Automatic Door/ windows locking system	3.84	0.71
Spatial frame # 2 Assistive Technology				
6)	SOS Medical Alert Devices	Usually a wearable device that comes with an SOS button that would alert an emergency and monitoring center that shall activate the emergency service.	3.72	1.30
7)	Smart Plugs and Outlets	Alert and automatically turn stove or oven off when it has been on longer than usual or have been untouched for 30 minutes long.	3.89	1.16
8)	Health record	Integrate a smartphone or an assistive device into a medical health record.	3.41	1.43
9)	Voice-enabled	An automatic speech recognition and voice control system for home appliances.	3.33	1.13
10)	Universal Controller	Control all home appliances with any remote controls that made compatible to each other as in a single interface.	2.73	1.42
11)	Gates control	Automatically receives signal from a device to open or close	3.42	1.27

#	Predictor	Descriptions	x̄	s.d.
		the door that also triggers a flashing light when the door is opened		
Spatial frame # 3 Home automation				
12)	Smart laundry	An internet-connected washing machine that has sensors to weigh each load and can automatically adjust cycle settings accordingly to help reduce water, time and energy and also allowing users to control and monitor wash cycles from their smartphone.	3.14	1.15
13)	Thermographic camera	Thermal imaging and video-based fall detection.	2.94	1.02
14)	Robot Vacuums	The Automated House-Cleaning Robot with Smart Self-Program that relatively clean floor with Intelligent Mapping System, Efficient Cleaning Path with smart navigating sensor that has Self-Charging and empties itself automatically.	3.17	1.14
Spatial frame # 4 Smart kit				
15)	Smart Home Hub Application	A smart home gadget unifying all connected home devices that to be controlled from one app, instead of many.	3.79	0.93
16)	Health Cloud	A cloud-based storage service that comes with a healthcare plan that compatible with the elderly patient's smartphone or wearable device that consolidates users' health data through an application to the healthcare system on cloud that the professional doctor can access in order to provide a Real-time patient care to the elderly users.	3.38	1.33
17)	Smart Home Remote Control	Home Automation Hubs & Controllers gives a full control over home entertainment and smart home devices	3.33	1.03
18)	Monitored Medical Alert Systems	Allows the elderly with a health condition to be connected to an emergency monitoring medical service through smartphones or a feature on home security systems that they can check on their smartphones or computers.	3.21	1.33
Spatial frame # 5 Home Appliances				
19)	Home Entertainment Appliances	Simplify all the entertainment control scheme and putting away the pile of remotes for a more elegant solution that interact seamlessly with users such as automatically turn TV off when no activities detected.	3.06	1.20
20)	Door control units	Door Entry Direct, Door entry systems, Intercoms, Access Control and CCTV	3.63	1.22
21)	Smart Home Climate Control	Smart Home Thermostat; Smart AC Controller; Smart Air Purifier; Smart Home Humidifier; Smart Home Dehumidifier; Smart Air Conditioner; Smart Weather Station; Smart Space Heater; Smart Fans; Smart Blinds.	3.49	1.05
Spatial frame # 6 Access Automation				
22)	Motion Detection Lighting	Reactive Lighting such as automated LED Stair Lighting.	4.44	0.87
23)	Smart outdoor lighting	Smart bulbs, sconces, path lights, and spotlights for backyards, pathways, walkways to ensure that outdoor areas are safe.	4.04	1.06
24)	Biometric Door or Access system	Work just like the biometric sensors on a smartphone, with the Fingerprint, a pin code, or a mechanical key is to entitle a total security at door.	3.38	1.02
Spatial frame # 7 Cloud-based technology for home use				
25)	Digital assistants over cloud	To learn users' behaviours and seamlessly embed assistive technology into the elderly's lives to support independent livings.	3.33	1.31

4. Results and Discussion

Part 1 consisted of 34 variables and indicator items using a binary scale: Have you used or are you currently using this technology? (Yes/No); If yes, do you find this technology important or useful?

(Yes/No); If no, how positive do you perceive this technology's importance to your life? (Yes/No or leave blank if this is not relevant to one's life).

Given the responses collected in the questionnaire Part 1, the researcher aggregated them to capture the positivity toward the smart home technology regardless of the item possession status of each individual. The possibility to acquire technology for their dwellings of the respondents (where Y =1) was the dependent variable and various potential predictors (X_k), and to estimate the parameters in regards of exploratory variable (x_i), all independent socioeconomic variables were univariately entry as well as into another two blocks: Block 1) Twelve (12) items of Socioeconomic factors; and Block 2) Twenty-Five (25) items of Technology from the questionnaire. With the *Logistic Regression* performed for the binary outcome measure, all 312 samples were undergone the maximum likelihood estimation (MLE) under Enter mode. Considered the odds scale that got multiplicative per every unit increase of $\exp(\beta_1)$, the covariant affected where—If $\beta_j > 0$, then $\exp(\beta_j) > 1$, and the odds increase; If $\beta_j < 0$,then $\exp(\beta_j) < 1$, and the odds decrease.

Socioeconomic characteristics data (12 traits) and the components emerged from the standardized questionnaire (25 items) were analysed using logistic regression based on a nonlinear probability distribution (See Table 2). These two sets of explanatory variables as in correlated predictors analysed in the testing parameters were meant to predict the value of an observed dichotomous dependent variable regardless of the degree of freedom tests.

Table 3 Binary Logistic Regression Results: Attitude toward Technology —Possibility that the Elderly to Acquire Technology for Their Dwellings.

Variable	Model 1					Model 2				
	B	S.E.	Wald	P	Exp (B)	B	S.E.	Wald	P	Exp (B)
Socioeconomic Characteristics										
Gender(Male=1)	-0.52	0.32	2.54	0.11	0.6	0.65	0.72	0.82	0.37	1.92
Sexagenarians(Yes=1)	0.89	0.47	3.66	0.06	2.44	-1.07	1.13	0.89	0.35	0.34
Septuagenarian(Yes=1)	0.79	0.5	2.44	0.12	2.19	0.59	1.22	0.23	0.63	1.8
Assistant(s) (Yes=1)	2.16	0.52	17.04	0.00**	8.7	1.88	0.94	3.98	0.04*	6.58
Household expense(Yes=1)	1.13	0.45	6.34	0.01**	3.1	0.46	0.95	0.24	0.63	1.59
Home improvement plan(Yes=1)	1.37	0.75	3.36	0.07	3.92	2.3	1.24	3.42	0.06	9.97
Household income≥40,000(Yes =1)	0.81	0.33	5.87	0.02*	2.25	-0.01	0.77	0	0.99	0.99
Need for Gov. support(Yes=1)	-1.55	0.46	11.63	0.00**	0.21	-0.85	0.95	0.8	0.37	0.43
Absolute Ownership (Yes=1)	2.23	0.37	36.19	0.00**	9.31	2.04	0.89	5.31	0.02*	7.69
House type=Single (Yes=1)	0.49	0.39	1.58	0.21	1.63	1.37	0.95	2.06	0.15	3.92
Living with Family(Yes=1)	-1.73	0.48	13.34	0.00**	0.18	-2.37	0.97	6.05	0.01*	0.09
category # 1 Integrated Technology										
Glass break detector						0.48	1.19	0.16	0.69	1.61
Water-Leak Detector						-0.86	1.04	0.68	0.41	0.43
Fire & Gas Detection Systems						1.81	0.92	3.86	0.05*	6.09
Surveillance cameras						0.85	0.58	2.13	0.15	2.34
Electronic Door Locks						-1.73	0.7	6.09	0.01**	0.18
category # 2 Assistive Technology										
SOS Medical Alert Devices						1.27	0.49	6.74	0.01	3.55

Variable	Model 1					Model 2				
	B	S.E.	Wald	P	Exp (B)	B	S.E.	Wald	P	Exp (B)
Smart Plugs and Outlets						1.64	0.53	9.61	0.01 **	5.17
Health record						-0.96	0.51	3.51	0.06	0.38
Voice-enabled						0.18	0.34	0.27	0.6	1.19
Universal Controller						-1.1	0.34	10.7	0.00 **	0.33
Gates control						-0.32	0.31	1.01	0.32	0.73
category # 3 Home automation										
Smart laundry						-0.61	0.38	2.59	0.11	0.54
Thermography camera						-0.77	0.54	2.06	0.15	0.46
Robot Vacuums						-0.49	0.46	1.15	0.29	0.61
category # 4 Smart kit										
Smart Home Hub Application						0	0.42	0	1	1
Health Cloud						0.08	0.3	0.06	0.8	1.08
Smart Home Remote Control						-0.97	0.41	5.69	0.02 *	0.38
Monitored Medical Alert Systems						-0.16	0.32	0.26	0.61	0.85
category # 5 Home Appliances										
Home Entertainment Appliances						-0.11	0.32	0.12	0.73	0.9
Door control units						0.81	0.41	4.03	0.05 *	2.25
Smart Home Climate Control						0.11	0.38	0.09	0.77	1.12
category # 6 Access Automation										
Motion Detection Lighting						0.04	0.42	0.01	0.92	1.04
Smart outdoor lighting						0.39	0.35	1.25	0.26	1.48
Biometric Door or Access system						0.16	0.4	0.17	0.69	1.18
category # 7 Cloud-based in-home technology										
Digital assistants over cloud						-0.23	0.32	0.5	0.48	0.8
Constant	-0.89	0.72	1.52	0.22	0.41	-0.78	2.97	0.07	0.79	0.46
No. of observation	312					312				
Chi-square	133.89					155.45				
Initial – 2 Log likelihood	432.52					432.52				
Step1 – 2 Log likelihood	244.54					89.09				
Cox & Snell R Square	0.35					0.60				
Nagelkerke R Square	0.5					0.86				
Percentage correct	80.80					94.90				

** Significant at p < 1%
* Significant at p < 5%

The Enter mode on the binomial logistic regression was used in order to assess the strengths of the variable independently affecting the possibility in acquiring the smart home technology of the elderly (as a single-derivation cohort—Bangkok, Thailand). Model 1 explains the relative importance of Socioeconomic characteristics as the variable predictors: gender, age group, having living assistant(s), being accountable for their household expense, having home improvement plan, having the household income≥40,000, having needs for government support, being an absolute ownership of their house, current house type is either single, double, or town home, and currently living with family. Model 2, meanwhile, included the Attitudes

data extracted from the questionnaire to control for the effects of the statistic result significantly as well in order to predict the relationship between the dependent effect and variables.

Model 1 indicates that *Having an absolute ownership of the current dwellings* (B=2.23, p<0.01) and *Currently having assistant(s) to their livings at home* (B=2.16, p<0.01) were statistically significant predictors of increase in possibility which results a great extent the same in Model 2 (B=2.04, and 1.88 respectively with Confident Intervals of 95%). The inverse association of *Living with family* was a significant contribution to a decrease of the statistic result in Model 1 and 2: B = -1.73, -2.37, p<0.05 respectively. The other significant predictors merely shown significantly in Model 1 and not so do in Model 2 were the inverse association of *Need for government support* (B= -1.55, p<0.01) as well as the direct associations of *Being accountable for the household income* (B=1.13, p<0.01) as well as *Having household income of* ≥$_{40,000}$ *Thai baht monthly* (B=0.81, p<0.05). Provided the logistic regression analysis where concluded from Socioeconomic characteristics alone—the results statistically indicate the increase in the probability that the elderly would acquire the technology for their dwellings when having an absolute house ownership or having at least one living assistant(s) is true, no matter the presences of other variables according to the components from the questionnaire. Meanwhile, the elderly who living with family, however, are not likely to acquire technology for their dwellings even after controlling of attitudes towards the components from the questionnaire regarding the technology. To consider the characteristic of each variable here, having an absolute house ownership exhibits a personality trait of spending power as they are likely to be a decision maker to at least some investment on their own house regardless of the accountability on their household income or expense of their livings; similar to having living assistant(s) that projects the financial comfortability of either individual or a family consider the importance in hiring a living assistant to assist themselves or the older adults in the family. This demonstrates the openness to adopt a new arrangement or mode of assistive devices for their better convenient livings that would be open-minded in embracing integrated home technology meaning both predictors were associated with a higher probability that the elderly would acquire home technology in all measures. So does when considering the elderly who living with family independently, the result, though adversely, predicts that they are comfortable with living with other members in the family and likely to resist to adopt any changes into their traditional way of livings regardless of their family financial status whether they would increase the possibility to acquire new mode of assistive livings or not. Another inverse predictor, *Need for government support*—that independently predicts the decrease in the probability—assumed the status of the respondents that they may not comfortable to invest in technology for their dwelling themselves, however, given the lost its predictive value when further controlling of the attitudes toward the technology in regards of the questionnaire and supportive video presentation.

Model 2 indicates that *Fire & Gas detection systems* and *Electronic door locks* were statistically significant predictors to the result even though the increase effect the former item had (B=1.81, p<0.05) and the decrease of the latter (B= -1.73, p<0.01) [Attitude toward the items in Integrated Technology category]. *The Smart plugs and Outlets* (B=1.64, p<0.01) and *SOS Medical Alert devices* (B=1.27, p<0.01) in the Assistive Technology category increased the odds of the result although the *Universal controller* inversely affected it (B= -1.10, p.<0.01). *Smart home remote control* was an inverse significant predictor (B= -0.97, p.<0.05) [Attitude toward this item in Smart Kit category]. The last significant predictor was the *Door control units* in Home Appliances category (B=0.81, p.<0.05). This means that when determining the significant attitude toward technology variables independently, logistic regression models indicates the *Fire & Gas detection system* in a category of Integrated Technology strongly affected the attitude of the elderly toward the technology that increase the possibility that they would acquire it for their dwellings. However, although statistically categorized in the same group, *Door control units* did not contribute to the increase but a mere decrease in the result. Two items in Assistive Technology were also statistically significant predictors: *SOS medical alert devices* and *Smart plugs and outlets*. Given the purpose of each item, both are for the safety of the users. Provided the sensory impairments due to age as the stimulus, the risk to their poor health is accordingly increased and might lead to any unexpected event anytime, anywhere not only outside their houses. The similar purpose applies to the *Smart plugs and* that keep the safety to the elderly

living in their houses due to the impairments in sensory receptors where the sensory memories located (Ben-Nun, 2016). In association with some respondents' direct experience shared with the researcher during the interview session about the time that they forgot to turn off the stove that the ceiling above the stove got almost burnt before got suppressed safely 10 minutes later. The other predictor yet inversely affects the probability was *Universal controller*. Interestingly consider the next item in the Smart Kit category characterize similarly: *Smart home remote control*—having the inverse association—that was also a significant contribution to a decrease of the statistic result. The last item was in the Home Appliance category in the variable set as a predictor yet the least significant effect to the result. *Door control unit* in the Home Appliance category was purposively to check and monitor the front door to support any age-related impairments such as in hearing that they may not be aware of the front door bells, or in visual that might not able to see through the eyelet at door—where the electronic door locks, as a home appliance, it can be connected to a smart watch that the wearer would receive a haptic notification on the watch when any visitors were detected at the front door even before the bells were rang which would also send the notification through the smartwatch. Meanwhile the *Door control unit* in the Integrated Technology category—even though the item has become extensively used not only in Bangkok, the system, however, referring to the input collected from the interview session— has a major trade point due to the condition of the smart home appliances that relies on stability of local internet connection that brings about to the down times that the doors becomes unsmart that more or less causes discomforts to the users despite the usefulness of the presence. This item was still an inverse predictor of this logistic regression analysis. Additionally, nevertheless, the age range of the older adults have negative odds that significantly decrease effect on the possibility to acquire smart home technology for their dwellings unsurprisingly. This actually supports greatly to this research objective for technology that is meant actually to support people at all age.

5. Conclusion

The fact is that aging society has been a trend for decades; a plan for a longevity of life till aged would not be limited to only the elderly. Referring to the objectives of this research, they explain the reasoning for choosing smart home technology as an option based on a sample of Thai elderly people. Since smart home technology is designed to make living easier as they provide, one can assume that the elderly would benefit from acquiring them to their dwellings. As the aforementioned, this research focused on how to create an environment where anyone with age as older adults can be living happily as independently and comfortably in their desire dwellings whenever the age becomes the condition of one's life in the family. Given the results from this research, the real estate developers or start-ups can conceive ideas from this in depth understanding on how they can develop a project that is truly designed to support the sensory impairments of older adults with the ideology of a smart home. This study can also help technology companies and manufacturers design appropriate smart home devices for elderly people where real estate companies shall be truly understanding the correspondence in the elderly preferences that this research learned in collateral with the context of environmental gerontology in relation to smart living projects that could be thoughtful with essential designs that dwell from the idea of senior-friendly livings that older adults can live independently and comfortably in. However, some barriers exist, and as this research suggests, older people living with their families are more reluctant to purchase smart home technology. Owing to the "sensory" matter of this research yet that technically is in every one's body, the output of this smart dwelling where to support older adults shall actually be a normal smart living for other members in their families whose health haven't been impaired due to age and/or other conditions yet. The future customers are likely to look for the dwellings that project the purposively design as an all-ages friendly living project which has a sense of a house where anyone in the family can live in. At the same time, considered some participants' responses that shown in the table, there are expectations that the government should be up to support with necessary technology that shall fulfil the least basis to meet people' well-being of at least to those in needs to meet the idea of Thailand's smart city plan in the era of ageing society. For future research, it is important to localise the similar research in order to understand the real demands correctly with that the prospective real estate projects shall successfully be meaningful for the local residents i.e. the demands.

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