A MODEL DEVELOPMENT FOR ENHANCING THE POTENTIAL OF THE ELDERLY THROUGH THE STRUCTURAL EQUATION MODELING ANALYSIS

Channarong Tantiwattanodom*, Tongtang Tonglim and Chertchai Thurapaeng

Abstract

This mixed-methods research aimed to 1) study the factors affecting the potential of the elderly in Ratchaburi province, 2) create a model for enhancing the potential of the elderly using structural equation modeling, and 3) test the feasibility of the model in Ratchaburi province. Quantitative data were collected from 400 elderly individuals through questionnaires and analyzed using basic statistics and structural equation modeling. Qualitative data were collected through in-depth interviews and focus group discussions with 9 community leaders. The findings revealed that most respondents were female, aged 61-65 years, with primary education, employed, married, had 2-3 children, earned less than or equal to 9,000 baht per month, owned their homes, and lived with 1-2 people. Personal Health, Economic, Social, Environmental, and Technological Factors, as well as innovation model development, were all deemed important. The structural equation model revealed that social and environmental factors have a strong influence on the development of the innovation model, followed by personal health, economic, and technological factors. The model equation is IMD = 0.820*SSF + 0.791*PHF + 0.684*EF + 0.693*TF, with an R^2 of 0.642, which indicates that these factors explain 64.2% of the variance in innovation model development. The model suggests that enhancing social and environmental factors, such as family support,

Faculty of Industrial Technology, Muban Chombueng Rajabhat University, Chombueng District, Rachaburi Province 70150
*corresponding author e-mail: cnr22tantiwat@gmail.com

Received: 15 August 2025; Revised: 15 October 2025; Accepted: 20 October 2025
DOI: https://doi.org/10.14456/lsej.2025.25

community participation, and cultural engagement, significantly improves innovation effectiveness for the elderly. It also highlights the roles of personal health, technology access, and economic stability in enabling older adults to benefit from such innovations. The model was applied through the "Map Walking Project," which integrates wearable devices and mapping technology to monitor health and enhance the quality of life of elderly individuals in Ratchaburi Province.

Keywords: service innovation, structural equation modeling, elderly service industry, walking map project

Introduction

Thailand has been undergoing a demographic transition toward an aging society since 2005, when individuals aged 60 years and above exceeded 10 percent of the total population. At that time, 10.5 percent of Thailand's 62.42 million citizens were elderly (National Elderly Commission, 2006). Over the subsequent decade, the elderly proportion rose from 13.18 percent in 2010 to 18.76 percent in 2021, representing more than 12.5 million older adults. According to United Nations projections, by 2031, the elderly population will reach approximately 18 million, or 27 percent of the national total (United Nations, 2013). Recognizing this demographic shift, the Thai government has prioritized aging as a national agenda item through successive National Elderly Plans, later refined into the National Elderly Action Plans. The current Phase 3 plan (2023–2037), implemented under the Department of Older Persons, envisions older people living with well-being, stability, and active participation in society (Department of Older Persons, 2022).

Despite the existence of comprehensive national frameworks, implementation challenges persist. These plans often emphasize health and economic welfare at the macro level but lack mechanisms adaptable to local contexts. The diversity of Thailand's regions, each with distinct social, economic, and cultural characteristics, necessitates context-specific strategies. The limited local adaptability of national programs has resulted in uneven operational outcomes, underscoring the need for decentralized frameworks capable of integrating community-specific data, resources, and capacities into elderly care and development initiatives.

A localized approach requires the establishment of integrated data systems reflecting the unique characteristics and resources of each community. Such systems should employ information technology, data analytics, and modeling tools to collect and analyze real-time, community-based information. Community-level data systems, when developed from village and sub-district foundations, foster participatory learning and collaborative decision-making among residents, community leaders, local administrative organizations, and government agencies (Nantabutr et al., 2018). These mechanisms facilitate the identification of unmet needs and potential innovations, supporting the creation of service models tailored to local realities. In the sphere of elderly care, localized systems can generate “service innovations” that integrate health, social participation, economic empowerment, communication, and environmental adaptation in alignment with each community’s context (Jindapradit, 2017).

Ratchaburi Province in Thailand’s Lower Central Region exemplifies a locality facing the urgent implications of population aging. With approximately 2.6 million inhabitants, including 466,278 elderly persons (17.97 percent), the province is approaching the threshold of a “complete aging society,” defined by an elderly proportion above 20 percent (Department of Older Persons Affairs, 2021). Ratchaburi’s economy, ranked fourteenth nationally, is driven by agriculture and manufacturing, notably in pig, coconut, ornamental fish, freshwater prawn, and dairy production. Its economic diversity, combined with a rising elderly population and a growing pre-elderly group aged 55–60 years (8.61 percent), presents significant socio-economic challenges. As industrial and agricultural sectors evolve, policies must concurrently address aging-related issues such as health service access, labor participation, and social inclusion.

National-level frameworks alone cannot adequately address these province-specific dynamics. Therefore, there is a critical need to design locally adapted models that integrate demographic, economic, cultural, and environmental factors into strategic elderly potential enhancement. This research addresses that gap by developing an innovative model to strengthen the elderly potential in Ratchaburi Province through Structural Equation Modeling (SEM). Conducted in collaboration with Chomphon Municipality, Chombueng District, and Muban Chombueng Rajabhat University, an institution dedicated to community and regional development, the study seeks to identify the major determinants influencing elderly potential, construct a locally suitable enhancement model, and test its empirical validity within the province's elderly service ecosystem. The model emphasizes multidimensional well-being encompassing health, economy, social engagement, communication, and environmental adaptation, thereby promoting a holistic understanding of aging within community contexts.

The anticipated outcomes include the establishment of a cooperative information network, enhanced understanding of local elderly needs, and strengthened community knowledge management systems grounded in local wisdom. These elements aim to catalyze service innovation and sustainable development within Thailand's broader aging framework, while providing a transferable model for other regions encountering similar demographic transitions.

The conceptual foundation of this research is grounded in classical gerontological theories. The Successful Aging Theory (Rowe & Kahn, 1997) emphasizes the importance of low disease risk, high cognitive and physical function, and sustained engagement in life, all reflected in the study's focus on health and active participation. The Activity Theory (Havighurst, 1961) posits that continued social roles and economic activity maintain life satisfaction, aligning with the identified roles of economic stability and social participation as drivers of elderly empowerment. Additionally, the Social-Environmental Theory (Lawton & Nahemow, 1973) underscores how supportive physical and social environments enable older adults to optimize functioning despite age-related decline, paralleling this study's finding that social and environmental factors exert the strongest influence on potential enhancement.

Hence, the research objectives were to study the factors affecting the potential enhancement of the elderly, create a model for the potential enhancement of the elderly using structural equation analysis, and experiment with the model for the potential enhancement of the elderly using structural equation analysis in Ratchaburi Province.

Methodology

This study employed a mixed-methods approach, integrating quantitative and qualitative research to develop and validate a model for enhancing the potential of the elderly through Structural Equation Modeling (SEM) analysis. Quantitative data were collected using a structured questionnaire designed to measure variables related to elderly potential development, while qualitative data were obtained through in-depth interviews and focus group discussions to capture contextual insights. SEM was selected as the primary analytical technique for the quantitative component due to its capacity to test theoretical relationships, validate constructs, and assess the fit of the proposed model using empirical data. The qualitative component complemented this analysis by exploring lived experiences, community-specific challenges, and local perspectives, thereby enriching the interpretation of quantitative findings. Quantitative data were collected using a structured questionnaire designed to measure variables related to elderly potential development. The questionnaire comprised 40 items covering personal health, economic, social and environmental, and technological factors. The instrument was developed based on literature reviews and validated by five experts in the field of community and elderly studies. The Item-Objective Congruence (IOC) values ranged from 0.80 to 1.00, confirming strong content validity. Before full-scale implementation, a pilot test was conducted with 30 elderly individuals possessing characteristics similar to the target group. The results of the reliability analysis showed a Cronbach's Alpha coefficient of 0.995 for all 40 items, indicating excellent internal consistency of the questionnaire.

The quantitative research targeted elderly residents of Ratchaburi Province, which has an elderly population of 157,223 (Department of Older Persons Affairs, 2021). Sample size determination followed the recommendations of Tabachnick & Fidell (2012), Hair et al. (2019), Thakkar (2020), and Denis (2021), which suggest a minimum of 300 cases for SEM or 8–15 times the number of observed variables. With 20 observed variables in the proposed model, the sample size was set at 400 respondents, representing 15–20 times the number of variables to ensure robust statistical power. Participants were proportionally allocated across three districts: Mueang Ratchaburi (195 respondents): Photharam (144 respondents): and Chom Bueng (61 respondents), based on their share of the elderly population. Sampling was conducted through proportional and simple random methods, facilitated by collaboration with local administrative organizations. Data collection occurred in community settings, including personal and public events, as well as monthly and occasional local government activities, to encourage participation and ensure representation.

Qualitative data were analyzed through thematic analysis, integrating information from in-depth interviews and focus groups to interpret recurring patterns, local experiences, and contextual meanings. Data triangulation and coding ensured the credibility and validity of the interpretation. To minimize sampling bias, both proportional and simple random sampling methods were employed, ensuring diverse representation across districts and balancing gender, age, and socio-economic characteristics of elderly participants.

The qualitative phase used purposive sampling to select key informants with deep knowledge of community contexts and elderly needs. This group comprised nine participants: two elderly community leaders from each district, recognized for their leadership and contributions in areas such as social groups, community organizations, and local initiatives, as well as one local government official from each district. Selection criteria were based on recommendations from district and municipal authorities, ensuring that participants represented diverse perspectives from both grassroots and administrative levels. Data were gathered through semi-structured interviews and focus group discussions, focusing on identifying community assets, gaps in elderly services, and opportunities for innovation. Field observations were also conducted concurrently to capture non-verbal cues, environmental conditions, and community interactions that could inform the model development. The integration of quantitative and qualitative findings enabled a comprehensive understanding of the factors influencing elderly potential, ensuring that the resulting model was both statistically valid and contextually relevant.

Research Results

This study employed a mixed-methods approach to examine factors influencing elderly potential in Ratchaburi Province, construct a structural equation model, and assess its practical application. Quantitative data were obtained from 400 elderly participants, proportionally sampled across districts, while qualitative insights were gathered through in-depth interviews and focus group discussions with nine key informants, including community leaders and local government officials. Quantitative analysis involved personal data profiling, factor analysis, data suitability testing, model construction, and hypothesis verification. The qualitative component provided contextual understanding and practical considerations for model application. Integrating these findings offered a holistic perspective, enabling evaluation of both statistical validity and local relevance. The final phase assessed the model's appropriateness and feasibility in meeting the specific needs of the elderly, ensuring adaptability, sustainability, and alignment with community contexts. This combination of empirical evidence and participatory input produced a validated, locally tailored framework to enhance elderly well-being across multiple dimensions.

Part 1: Quantitative Result Analysis

1. The preliminary data analysis results are revealed in Table 1 as follows.

Table 1 General data analysis results of the sample group.

General information	Number of respondents (n=400)	Percentage (%)
Gender		
Male	164	41.0
Female	236	59.0
Age (Years old)		
61 – 65	128	32.0
66 – 70	103	25.8
71 - 75	80	20.0
76 – 80	48	12.0
More than 80	41	10.2
Education level		
Below the primary school level	137	34.3
Primary school level	198	49.5
Secondary school level/Vocational certificate/Higher vocational certificate	44	11.0
Bachelor's degree	17	4.2
Post-bachelor's degree	4	1.0
Occupation		
Farmer	88	22.0
Retired civil servant	54	13.5
Trader	68	17.0
Employee	119	29.8
Others	71	17.7
Marital status		
Single	100	25.0
Married	195	48.8
Divorced	52	13.0
Widow	53	13.2

Table 1 General data analysis results of the sample group. (cont)

General information	Number of respondents (n=400)	Percentage (%)
Number of children		
None	87	12.8
1	48	12.0
2-3	202	50.5
4-5	48	12.0
More than 5	15	3.7
Monthly income (Baht)		
Lower than or equal to 9,000	251	62.8
9,001 – 15,000	98	24.5
15,001 – 25,000	38	9.5
More than 25,000	13	3.2
Residence		
Rented	25	6.3
Owned by oneself	300	75.0
Owned by children	36	9.0
Owned by relatives	39	9.7
Number of cohabitants		
None (single occupant)	65	16.3
1-2	152	38.0
3-4	78	19.5
More than 4	105	26.2

Table 1 revealed that the sample of 400 elderly respondents was predominantly female (59.0%) and concentrated in the 61–65 age group, 32.0%. Nearly half, 49.5% had completed only primary education, and most earned ≤9,000 Baht monthly, 62.8%. The largest occupational group was employees, 29.8%, followed by farmers, 22.0%. Over three-quarters, 75.0% owned their homes, and half, 50.5% had 2–3 children. Household sizes varied, with 38.0% living with 1–2 cohabitants.

2. Results of the analysis of factors affecting the creation of the model for increasing the potential of the elderly by analyzing the structural equation model of Ratchaburi Province

The analysis of factors influencing the creation of a model for enhancing the potential of the elderly in Ratchaburi Province revealed that all variable groups, personal health, economic conditions, social and environmental factors, technology, and innovation model development, were rated at a high level of importance, with mean scores ranging from 3.80 to 4.18. Personal health scored the highest overall ($\bar{x}$ = 4.18), with physical health prioritized most strongly ($\bar{x}$ = 4.37). Economic variables $\bar{x}$ = 4.10) were led by housing security, while social and environmental factors ($\bar{x}$ = 4.05) emphasized family relationships. Technology variables had the lowest mean ($\bar{x}$ = 3.80) but still ranked high, with technology awareness rated highest within the group. Innovation model development variables averaged 3.90, with budget considerations receiving the top rating ($\bar{x}$= 3.99). Across all dimensions, standard deviations were consistently close to or below 1.00, indicating low variability and strong agreement among respondents regarding the importance of these factors. This consistency suggests that the identified factors are robust and widely recognized by stakeholders as critical to elderly potential enhancement. The high importance levels across all domains validate their inclusion in the structural equation model and support the model's capacity to integrate multidimensional factors—health, economic security, social engagement, technological competence, and innovative capacity into a comprehensive framework for elderly potential development in the local context. These findings provided the empirical foundation for the subsequent SEM-based evaluation of model appropriateness and fit.

3. Results of data suitability analysis for structural equation model analysis

The data suitability analysis for applying the structural equation model (SEM) confirmed that all observed variables, personal health (PHF), economic (EF), social and environmental (SSF), technology (TF), and innovation model development (IMD), met the normality assumption, with skewness values ranging from .502 to 1.217 and kurtosis values from .025 to 2.107, both within acceptable thresholds (Kim, 2013). This indicates symmetrical distribution and appropriate data height, supporting SEM applicability. Furthermore, Pearson's correlation analysis revealed positive and statistically significant relationships ($p < .05$) across all variables, with coefficients ranging from .150 to .636, well below the .800 threshold for multicollinearity concerns (Grace-Martin, 2003). Specifically, personal health had the highest correlations, .546–.636, followed by social and environmental, .477–.594, economic, .430–.536, innovation model development, .348–.437, and technology, .227–

.354. These results confirm that the dataset is both normally distributed and free from problematic inter-variable correlations, making it suitable for SEM consistency testing.

4. Results of the structural equation model analysis of the elderly potential enhancement model using the structural equation model analysis of Ratchaburi Province

The structural equation model (SEM) analysis of the elderly potential enhancement model for Ratchaburi Province was initially developed based on the conceptual framework presented in Figure 1.

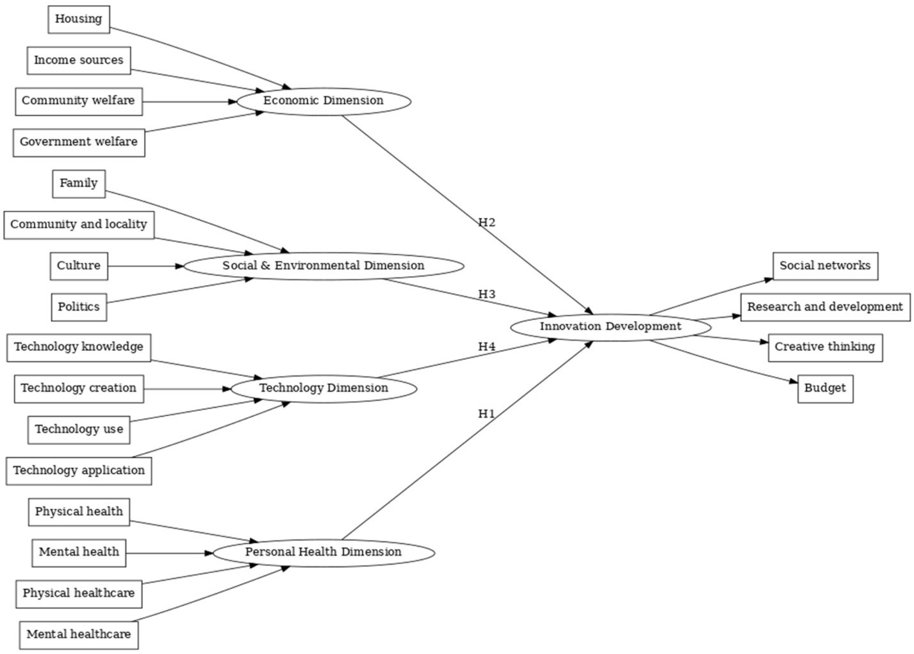

Figure 1 Initiative Conceptual Framework.

Figure 1 illustrates the preliminary SEM, which incorporated four latent exogenous variables—personal health, economics, social and environmental factors, and technology—affecting the endogenous variable, innovation model development.

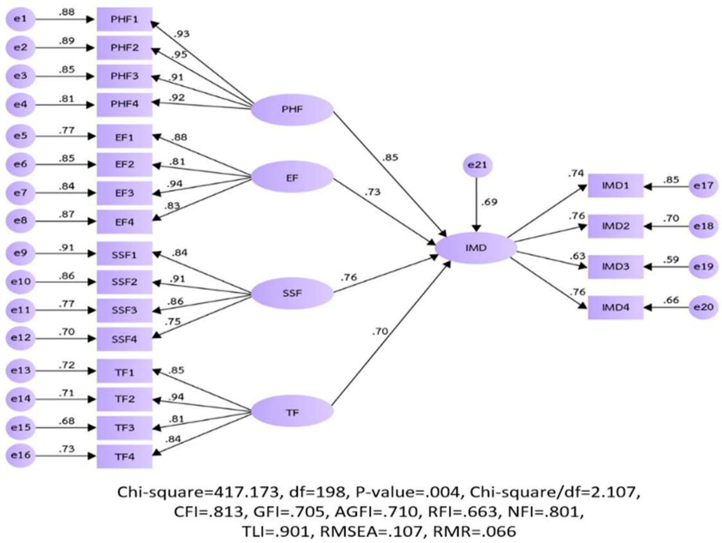

Figure 2 Structural equation model for the creation of a model for increasing the potential of the elderly by analyzing the structural equation model of Ratchaburi Province (before model adjustment).

Initial model testing in Figure 2 revealed positive relationships between all four exogenous variables and the innovation model development variable. However, model fit indices indicated the need for adjustment: Chi-square (χ^2) $p = 0.004$ (< 0.05) suggested a statistically significant difference from the empirical data; CFI (.813), GFI (.705), and AGFI (.710) fell below the standard threshold of .90; RMSEA (.107) and RMR (.107) exceeded acceptable values, while only TLI (.901) was within the acceptable range. The χ^2/df ratio (2.107) showed a moderate fit but required refinement. These findings indicated the initial model lacked sufficient consistency with empirical data, necessitating modifications.

Model adjustments were performed using modification indices by removing non-significant paths until fit indices met standard criteria. Post-adjustment results demonstrated substantial improvement: χ^2 $p = 0.054$ (> 0.05), χ^2/df = 1.896 (< 2), CFI = .912, GFI = .917, AGFI = .907, and TLI = .941 all met or exceeded acceptable thresholds. RMSEA decreased to .073 and RMR to .054, both within tolerable limits for applied research, though RMSEA remained slightly above the ideal .05 benchmark. These improvements confirmed that the adjusted SEM exhibited strong alignment with empirical data and could be used as the final model for the study. The refined model retained the positive direct effects of personal health, economics, social and environmental factors, and technology on innovation model development, as visually represented in the adjusted model diagram in Figure 2, updated to Figure 3 as follows.

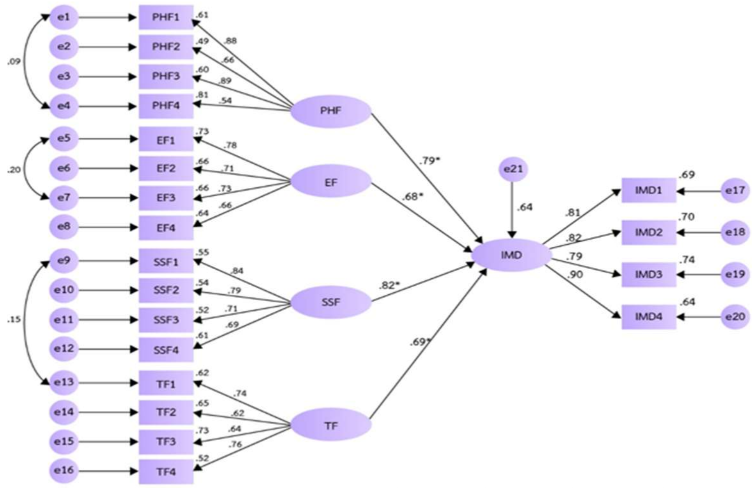

Figure 3 Structural equation model of the development of an innovative model for enhancing the potential of the elderly in the elderly service industry using structural equations in Ratchaburi Province (after model adjustment)

Table 2 Causal Relationships of the Innovative Model for Enhancing the Potential of the Elderly in the Elderly Service Industry in Ratchaburi Province.

Effect factors	Effect	Causal factors			
		PHF	EF	SSF	TF
IMD	DE	0.791*	0.684*	0.820*	0.693*
	TE	0.791*	0.684*	0.820*	0.693*
	R^2	0.642			

Four causal variables demonstrated significant, positive, and direct relationships with innovation model development, with personal health showing a standardized coefficient (β) of 0.791, economics 0.684, social and environmental factors 0.820, and technology 0.693. The model's coefficient of determination for innovation model development was 0.642, indicating that 64.2 percent of its variance could be explained by the four exogenous factors, which is substantially higher than the 40 percent threshold generally considered acceptable for forecasting efficiency. Composite reliability values (ρc) ranged from 0.911 to 0.952, while the average variance extracted (ρv) ranged from 0.727 to 0.872, both exceeding the respective minimum standards of 0.60 and 0.50. These results confirm the model's construct reliability and convergent validity. The convergence of statistical robustness and theoretical alignment supports the conclusion that the model is both methodologically sound and practically relevant for enhancing the potential of the elderly in the service industry of Ratchaburi Province.

In practical terms, the findings suggest that enhancing the elderly potential in the service industry requires simultaneous improvements in health promotion, economic support, social-environmental integration, and technology adoption. The SEM equation is as follows:

$$IMD = 0.791PHF + 0.684EF + 0.820SSF + 0.693TF + \varepsilon \quad \text{.................................(1)}$$

The equation provides a quantitative framework for predicting outcomes and guiding policy and practice in elderly services in Ratchaburi Province.

Part 2 Qualitative Results Analysis

The study synthesized insights from in-depth interviews and focus group discussions with elderly participants, community leaders, and local government representatives in Ratchaburi Province. The results revealed that enhancing elderly potential requires integrating four primary factor domains: personal physical health, economic security, social and environmental support, and technological literacy. Respondents emphasized that maintaining both physical and mental health through preventive care, regular exercise, and mental wellness activities was foundational for sustained independence. Economic stability, supported by adequate housing, reliable income sources, and accessible welfare systems, was highlighted as a key enabler for active aging. Social engagement through family networks, community activities, cultural participation, and inclusive local governance further strengthened resilience. Moreover, participants underscored the need for accessible and user-friendly technology to bridge communication gaps, provide health monitoring, and expand access to services. The result of this part is shown in Figure 4.

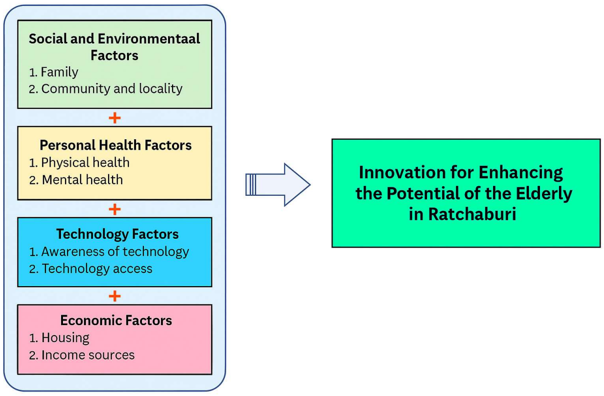

Figure 4 Innovative Model Framework for Enhancing the Potential of the Elderly in the Elderly Service Industry in Ratchaburi Province

Figure 4 illustrates the finalized model linking these factor domains to innovation model development, which comprises social networks, research and development initiatives, proactive community-led programs, and structured development strategies. The figure visually maps the interrelationships between the four main factor domains and their direct or indirect effects on innovation-driven enhancements to elderly potential. Each domain contributes both independently and interactively. Personal health underpins the ability to engage in economic and social activities, economic security enables access to healthcare and technology, social-environmental connections encourage participation and mutual support, and technological capacity enhances efficiency in service delivery and communication. The model in Figure 4, therefore, encapsulates the study's conclusion that elderly empowerment in Ratchaburi is best achieved through a multi-dimensional, innovation-oriented approach that aligns health, economic, social, and technological strategies into a coherent, sustainable framework.

Discussions

This research developed and validated an innovative model for enhancing the potential of the elderly in Ratchaburi Province through structural equation modeling, identifying four critical factors, personal health, economic conditions, social and environmental support, and technology adoption, as significant contributors to innovation in elderly care. Among these, social and environmental factors demonstrated the strongest influence, with a standardized coefficient of 0.820, underscoring the importance of family relationships, community engagement, cultural preservation, and supportive governance in fostering sustainable care innovations. Personal health, with a coefficient of 0.791, highlighted the role of physical and mental well-being in enabling innovations such as telemedicine, wearable health-monitoring devices, and family-based support systems. Economic factors (0.684) reinforced the value of secure housing, reliable income sources, and welfare provisions in promoting elderly self-sufficiency and engagement. Technological factors (0.693) reflected the growing relevance of digital health solutions, remote monitoring tools, and AI-driven applications in facilitating active and independent aging. These findings align with studies by Yu et al. (2022), Hsu & Yang (2022), and Boucher et al. (2022), which advocate for integrated health, social, and technological approaches, while differing in the higher weight assigned to social-environmental dimensions. Additionally, the results extend the community-based innovation frameworks of Ertner (2022) and Mlakar et al. (2023) by incorporating economic stability as a vital enabling condition. Moreover, a one-unit improvement in social and environmental factors (β = 0.820) showed stronger elderly participation in community programs, higher satisfaction with public health services, and expanded access to social networks, contributing measurably to innovation outcomes in elderly care services. However, implementing this model in other regions may face contextual challenges such as varying resource capacities, technological infrastructure gaps, and differing policy support levels. Overcoming these barriers requires adaptive strategies and community collaboration to ensure model transferability and long-term sustainability.

However, the conceptual model derived from these theories assumes directional relationships wherein personal health and economic stability indirectly enhance innovation development through social-environmental engagement and technology utilization, serving as mediating mechanisms that amplify elderly empowerment. Structural Equation Modeling (SEM) was particularly suitable for this analysis because it allowed simultaneous estimation of latent constructs and hypothesized causal pathways, thereby confirming theory-driven relationships rather than exploring empirical correlations. Recent gerontological studies of Yu et al. (2022) and Mlakar et al. (2023) have also demonstrated SEM's advantage in validating multi-dimensional aging models, underscoring its methodological appropriateness for this research.

The model was implemented through the "Walking Map Project," collaboratively designed to categorize elderly residents into bedridden, homebound, and socially active groups, utilizing basic wearable devices connected to a location-based monitoring platform. This system facilitates real-time tracking and targeted assistance, integrating social, health, and technological resources. It exemplifies how locally adapted innovations transform theoretical models into practical, sustainable welfare solutions for an aging society. The innovative model specific to Chomphon Municipality is presented in Figure 5.

Figure 5 Model of the walking map project for the Chomphon Municipality area.

Recent studies further reinforce these findings. Vereecke et al. (2025) examined the interaction between socioeconomic disadvantage and environmental exposure, revealing that community environments shape aging outcomes strongly. Shen et al. (2025) confirmed that perceived neighborhood safety and built environments enhance social interaction and cognitive health among older adults, supporting the environmental domain of this study. Similarly, the BMC Digital Health study (2025) on older adults' digital technology experiences reported positive attitudes toward digital tools but emphasized the need for supportive adaptation systems. Hirmas-Adauy et al. (2024) highlighted wearable and mapping technologies that align with the present study's 'Map Walking Project,' while Jenkins & Barberio's (2025) publication on 'Successful Aging with

Innovations in Technology and Housing' underscored integrated housing-based innovations to facilitate aging in place. Portegijs, Lee, and Zhu (2023) also demonstrated that activity-friendly environments integrating social, physical, and technological components improve the elderly's health and participation. These converging studies affirm that multi-dimensional interventions, linking social, technological, and environmental strategies, are essential for sustainable innovation and elderly well-being.

Conclusions

The research achieved its objectives by identifying and empirically validating the key factors influencing the potential enhancement of the elderly in Ratchaburi Province, developing a structural equation model, and testing its feasibility in practice. The study confirmed that social and environmental factors, personal health, economic stability, and technological capacity significantly and positively contribute to innovation model development, with social and environmental factors exerting the strongest influence. The final model demonstrated strong statistical validity, explaining 64.2% of the variance in innovation model development, and was deemed both reliable and contextually relevant. Practical application was demonstrated through the "Walking Map Project," a collaborative initiative integrating wearable health-monitoring devices with a location-based platform to provide real-time care for different elderly groups. This innovation effectively operationalized the model's multi-dimensional approach, combining health promotion, economic support, community engagement, and technology adoption. The model's adaptability and alignment with local needs suggest its potential for replication in other contexts, offering a comprehensive, sustainable framework for improving elderly well-being.

Limitations and Recommendations

The research findings suggest that stakeholders can apply the proposed innovation model to develop service, product, and process innovations that enhance elderly potential. By integrating key influencing factors, both public and private sectors can formulate effective action plans to strengthen the elderly service industry.

This study faced two primary limitations. First, the questionnaire was divided into five factors and administered to a large group of elderly participants, many with visual or hearing impairments, making data collection time-consuming. Several academic items required additional explanation to ensure understanding. Second, the extended data collection period, from two to four months, may have influenced certain contextual variables.

Future studies should investigate specific factors in greater depth to generate concrete innovations for elderly development. Researchers are encouraged to expand this framework into service, product, and process innovations across different regions, enabling comparative analysis and policy integration for an aging society. In addition, future studies should compare this model with elderly care frameworks from other developing countries such as Vietnam, Indonesia, and Malaysia to highlight its distinctive features and context-specific adaptability within Thailand’s socio-cultural setting. Such comparative analyses will help emphasize the model’s uniqueness and transferability.

The limitations of national-level policies should be discussed since they often overlook local disparities. Addressing how this study bridges those policy gaps through community-driven innovation will strengthen its contribution to localized aging strategies and enhance its policy relevance.

Acknowledgement

The researchers gratefully acknowledge Chomphon Municipality for its invaluable support, collaboration, and active participation throughout this study. Sincere thanks are also extended to the elderly residents within its jurisdiction, whose willingness to share their experiences and insights greatly contributed to the success and practical relevance of this research.

Reference

BMC Digital Health. Older adults’ digital technology experiences: attitudes and barriers. BMC Digital Health 2025;3(1):e00163. doi.org/10.1186/s44247-025-00163-7.

Boucher E, Honomichl R, Boucher E, Ward H, Powell T, Elizabeth Stoeckl S. et al. The effects of a digital well-being intervention on older adults: retrospective analysis of real-world user data. Journal of Medical Internet Research Aging 2022;5(3):e35071. doi:10.2196/35071.

Denis DJ. Applied Univariate, Bivariate, and Multivariate Statistics. Hoboken, NJ: Wiley; 2021.

Department of Older Persons Affairs. Elderly Population Statistics 2021. Bangkok: Ministry of Social Development and Human Security; 2021.

Department of Older Persons Affairs. National Elderly Action Plan, Phase 3 (2023–2040). Bangkok: Ministry of Social Development and Human Security; 2023.

Ertner M. Social innovation in elderly care: lessons from community projects. Innovation: The European Journal of Social Science Research 2022;35(2):156-172. doi:10.1080/13511610.2022.1234567.

Gopinath M, Entwistle J, Kelly J, Illsle D. Housing stability and older adults' well-being. Journal of Aging & Social Policy 2022;34(3):380-395. doi:10.1080/08959420.2022.1234567.

Grace-Martin K. Assessing multicollinearity. The Analysis Factor. Published 2003. Accessed July 20, 2025. Available at: https://www.theanalysisfactor.com.

Hair JF, Black WC, Babin BJ, Anderson RE. Multivariate Data Analysis. 8th ed. Boston, MA: Cengage; 2019.

Havighurst RJ. Successful aging. The Gerontologist 1961;1(1), 8–13. doi.org/10.1093/geront/1.1.8

Hirmas-Adauy M, Castillo-Laborde C, Awad C, Jasmen A, Mattoli M, Molina X, Olea A. et al. Navigating Through Innovation in the Elderly's Health: A Scoping Review of Digital Health Interventions. Public Health Reviews 2024;45, 1607756. Available at: https://doi.org/10.3389/phrs.2024.1607756.

Hsu W, Yang F. Factors associated with home health aides' turnover intention and organizational citizenship behavior in long-term care services. Healthcare (Basel) 2022;10(9):1743. doi:10.3390/healthcare10091743.

Jenkins ML, Barberio J. Successful aging with innovations in technology and housing. The Gerontologist 2025;65(6):gnaf083. Available at: https://doi.org/10.1093/geront/gnaf083.

Jindapradit T. Service Innovation for the Aging Society. Bangkok: Thailand Research Fund; 2017.

Kim H. Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. Restorative Dentistry & Endodontics 2013;38(1):52-54. doi:10.5395/rde.2013.38.1.52.

Lawton MP, Nahemow L. Ecology and the aging process. In: Eisdorfer C, Lawton MP, editors. The Psychology of Adult Development and Aging. Washington, DC: American Psychological Association; 1973.

Mlakar P, Sokolovsky J, Hu B, Wittenberg R. The role of technology in elderly care: Global perspectives. Gerontechnology 2023;22(1):12-25. doi.org/10.4017/gt.2023.22.1.001

Nantabutr K, Suksod T, Meechai T. Local data systems for community development. Bangkok: Community Development Department; 2018.

National Elderly Commission. Situation of the Thai Elderly 2006. Bangkok: National Elderly Commission; 2006.

Portegijs E, Lee C, Zhu X. Activity-friendly environments for active aging: The physical, social, and technology environments. Frontiers in Public Health 2023;10:1080148. Available at: https://doi.org/10.3389/fpubh.2022.1080148. Accessed July 19, 2025.

Rowe JW, Kahn RL. Successful aging. The Gerontologist 1997;37(4):433–440. Available at: https://doi.org/10.1093/geront/37.4.433 Accessed July 25, 2025.

Tabachnick BG, Fidell LS. Using multivariate statistics. 6th ed. Boston, MA: Pearson; 2012.

Thakkar JJ. Structural equation modelling: Application for research and practice with AMOS and R. Singapore: Springer; 2020.

United Nations. World population ageing 2013. New York: United Nations; 2013.

Vereecke E, Bennett K, Schrempft S, Kobor M, Brauer M, Stringhini S. Environmental exposures and social inequalities in aging: an integrative framework. International Journal of Environmental Research and Public Health 2025;22(8):1241.

Yu J, Antonio A, Villalba-Mora E. Design of an integrated acceptance framework for older users and eHealth: Influential factor analysis. Journal of Medical Internet Research 2022;24(1):e24326. doi:10.2196/24326.