ICT-Enabled Community-Based Social Support System Matrix for Elderly: A Social Support Perspective in Japan

Tingting Huang[a]

School of Business Administration, Women's University, 6-46 Ikebiraki, Nishinomiya, Hyogo, Japan

Abstract: Japan, as the leading country with the most significant percentage of elderly, has done a great job of improving the quality of the elderly' social life. This research adopts a qualitative approach with a multiple case design and the Social support theory to analyze four cases in Japan that use the deployed ICT to enhance community and support the elderly' social life. An ICT-enabled community-based social support system matrix is proposed with four types of elder communities. The findings delight the possibilities and the cautions for enhancing the elder community with ICT.

1 INTRODUCTION

In 2021, the proportion of people aged 65+ years in the total population in Japan is more than 28.8% (Statistics Bureau, 2021). The same survey back in 2009 gave the number as 23%, which already put Japan on the top of the list of the countries with the largest percentage of older adults (Muramatsu & Akiyama, 2011). The projections for 2050 show that considerable countries will face the similar population challenge soon (World Health Organization, 2015).

Today, various assistive technologies have been adopted to help the elderly improving their living quality (Khosravi & Ghapanchi, 2016). On the other hand, how to use assistive technology fulfilling mental needs of the elderly is another major research topic (Khosravi, Rezvani, & Wiewiora, 2016). There was little research focused on how to use the assistive technologies—appropriate design—effectively to ease the loneliness and social isolation. As a matter of fact, the experiences of Japan suggested that one of the solutions to loneliness and social isolation is to rebuilding community-based support systems (Muramatsu & Akiyama, 2011). Nevertheless, only a limited number of studies (Jia & Noda, 2011a; Kobayashi & Goto, 2016) in Japan have focused on this topic from a theoretical perspective, which

usually adopted survey methods and concluded from the users' perspective.

To address the above research gaps, the author aims to analyze the representative approaches to structuring ICT-enabled community-based support system in Japan. The two main dimensions of the framework are 1) social integration and 2) system structure. The author tries to answer the following question: How do various communities use ICT to support the social life of the elderly? Why these approaches to constructing ICT-enabled elderly support system are functional? By finding answers to these questions, the author wishes that this research might be able to prepare the super-aging societies-not only Japan-for the Future.

1.1 Eldertech and Social Isolation

The term of "eldertech" represents the technology for the elderly. The elderly are supposed to need the eldertech the most for remaining independent longer, but they also are approved to be the most disadvantaged group for technology adoption (Niehaves & Plattfaut, 2014). This research has little interest on physical assistive technology for the elderly living with chronic illness within the medical health, nursing, and gerontology literature (Khosravi & Ghapanchi, 2016; Magnusson, Hanson, & Borg, 2004). In fact, the author is more forcing on the research theme about the interactions between the

[a] https://orcid.org/0000-0001-6105-8554

usage of assistive technology and the mental needs fulfilling of the elderly (Chen & Schulz, 2016; Khosravi et al., 2016). Loneliness and social isolation (Sarason, 2013) is one of the most serious problems affecting the elderly, which is expressed in little participation in social activities, dissatisfaction with social lives, or even no contact with other people at all (Khosravi et al., 2016). The elderly also have a tendency to lose sight of their goals and sense of self (Bobillier Chaumon, Michel, Tarpin Bernard, & Croisile, 2014). Chen and Schulz (2016) find ICT to alleviate the elderly's social isolation through mechanisms as connecting to the outside world, gaining social support, engaging in activities of interests, and boosting self-confidence. According to the findings of Khosravi et al. (2016), within the studies on various technologies applied to alleviate social isolation, the commonly adopted technologies insist of the general ICT contained the computers and the internet (Lam & Lee, 2006; Niehaves & Plattfaut, 2014; Martina et al., 2020), social network services (Coelho & Duarte, 2016; Kim, Lee, & Preis, 2016; Spagnoletti, Resca, & Sæbø, 2015), robotics (L. M. Camarinha-Matos & Vieira, 1999; Wu et al., 2016), telecare systems (Marzano & Lubkina, 2017), interactive television/games (Silva et al., 2016; Wang & Sun, 2016), etc. However, the positive effect of these assistive technology use on social connectedness and social support seemed to be short-term and did not last for more than six months after the intervention (Chen & Schulz, 2016). There are even negative effects need to be concerned such as the assistive technology might reduce human contacts (Wu et al., 2016). All in all, more research is needed to unlock the relationship between ICT interventions and social isolation reduction (Chen & Schulz, 2016; Khosravi et al., 2016).

1.2 ICT-Enabled Community-Based Social Support System

ICT was found to alleviate the elderly's social isolation through four mechanisms: connecting to the outside world, gaining social support, engaging in activities of interests, and boosting self-confidence (Chen & Schulz, 2016). Close-knit community-based social networks enhanced provision and receipt of social support (Muramatsu & Akiyama, 2011), which is fundamental to ease the critical issue—how to provide appropriate support to the elderly who live alone (Obi et al., 2013). The pressure due to aging populations can be alleviated by focusing on community-based healthcare and empowering people to proactively manage their own general wellness

(Grace & Gleasure, 2015). By using the internet, mobile devices, and other technologies have shown great help on the design and development of virtual elderly support community environments (L. M. Camarinha-Matos & Afsarmanesh, 2001; Magnusson et al., 2004). However, these telehealth and telecare services are mainly for the elderly and their family carers for monitoring of some health parameters motivated by some alarm condition, specific help, reminding or advising to the elderly person, and supporting for electronic trading (L. M. Camarinha-Matos & Afsarmanesh, 2001). Since not all the elderly have family carers and most of the relatives with jobs have less flexibility on time and energy, it is hard to say that the above virtual elderly support community environments can be adopted practically.

With the proliferation and ubiquity of ICTs, in recent years, the usage of ICTs in rebuilding community-based support systems certainly brings more efficiency and variety (Obi et al., 2013). In Japan, under the promotion of the Japanese government, considerable regions have started various ICT-enabled regional activation projects (Takata, 2012) which include many community-based support models for the senior citizens. However, few of these cases can be found in academic database. ICT watching systems for the elderly in Japan (Jia & Noda, 2011b; Kobayashi & Goto, 2016; Mori et al, 2011; Miyazaki & Shoji, 2017; Naoi & Ogawa, 2015) is one main research trend which focus on keeping the elderly safe most and providing some supports in the daily life.

1.3 Theoretical Background: Social Support Theory

Social support as the most frequently studied psychosocial topic refers to the availability of interpersonal resources (Sarason, 2013; Thoits, 1995). The reason for choosing social support theory as the theoretical lens for this research is because that social support research has made important advances (Barrera, 1986) and kept an impressive accumulation of studies on the relationship between social support and physical and mental health (Barrera, 1986; Lakey & Cohen, 2000; Thoits, 1995), especially for the elderly (Cutrona, Russell, & Rose, 1986). Barrera (1986) conducts a thorough literature review from the considered beginning, the seminal works since 1976 (Caplan, 1974; Cobb, 1976), and points out some consistent criticisms of social support theory such as broad definitions and diversity of measurement. Considerable literature reviews of social support have been conducted (Barrera, 1986; Lakey & Cohen,

2000). For instance, Barrera (1986) summarizes various social support concepts and operationalizations into three categories, i.e., social embeddedness, perceived social support, and enacted support. Lakey and Cohen (2000) resort to the above three categories into five theoretical perspectives, i.e., supportive actions, appraisal, social cognition, symbolic interactionism, and relationships.

2 RESEARCH METHOD

A qualitative research approach with a multiple-case design is adopted to search for answers to the research questions. The case research method is considered to be suitable for addressing 'how' and 'why' questions (Shan L Pan & Tan, 2011). Using multiple cases aims to 1) seek the relationship between the community and the most suitable ICT-enabled elderly support system; 2) make comparisons among various communities to find the patterns of ICT adoption. The Social support theory as a theoretical lens guides the data collection and analysis, which provides three perspectives, i.e., social embeddedness (network size), perceived social support (support satisfaction), and enacted support (helping behavior) (Barrera, 1986).

Four representative cases (Table 1) selected from fifty ICT-enabled regional activation projects of Japanese government (Takata, 2012) is studied mainly through in-depth interviews, observations, and related documents.

Table 1: Detail information of the four selected cases.

Case No.	Geographic Location	ICT project	Organizations Involved	Period
Case IRO	Kamikatsu-Cho, Tokushima Prefecture	IRODORI VILLAGE KAMIKATSU	IRODORI.Co.,Ltd; and Kamikatsu Town Hall	1999~now
Case OTS	Otsuki City, Yamanashi Prefecture	HALLO NATURES OTSUKI	Otsuki City Hall	2013~2019
Case TOK	Tokushima City, Tokushima Prefecture	TOKUTTER	Specified non-profit corporation Tokushima Internet Citizen's School; and Tokushima University Regional Creation Center	2010~2015
Case KAT	Katsuragi City, Nara Prefecture	NEW ERA KATSURAGI CREATION PROMOTION PROJECT	Katsuragi City Hall, Toppan Printing Co., Ltd., Kintetsu Cable Network Co., Ltd., Aeon Tail Co., Ltd., OMRON HEALTHCARE Co., Ltd., and Kansai University	2013~2014

Participants in the study were users and managers in the four selected cases. Twenty-two individuals completed the interview. The average age of the sample was around 70 years (range = 60-88 years), and 73% of the participants are women. The duration of each interview is around half an hour. The observations of the involved organizations and other secondary data is collected.

Recursively iteration for data analysis between the relevant literature, the theoretical lens, and the empirical data is conducted in this research. Because of a qualitative, inductive, multi-case study seeks to build abstractions across cases (Merriam & Tisdell, 2015), hypothesis coding is considered to be appropriate for analytic induction of the qualitative data set, particularly the search for rules, causes, and explanations in the data (Saldaña, 2021). This research adopts the analytical induction method (Shan L. Pan, Pan, & Leidner, 2012) that has already been proved to be appropriate for case study in information systems (IS) field.

3 CASE ANALYSIS

3.1 Case IRO

In Kamikatsu-Cho (the smallest town in Tokushima Prefecture), the population in 2021 is less than 1500, and the elderly (over sixty-five years old) take up fifty-three percent of the local population. The Irodori business means cultivating, processing, and selling natural plants that are used as decorations for Japanese dishes. The plant products vary from flowers, leaves, and ears of rice to edible potherbs. Nowadays, with over 140 producers, the earnings of Irodori have increased to more than 200 million JPY per year, and seventy percent of the Irodori market share is kept steadily. Irodori business not only boosted the regional economy but also generated the elderly's passion.

Community Feature. This community in Kamikatsu-Cho is connected by the transaction in the Irodori business. The locals who have the land which produces the Irodori products can join the community with a small membership fee (only 3000 JPY per year). In 2021, the community has 150 members, of which the average age is over seventy, and sixty percent are women. The ranking of each product's sales volume in the town greatly encouraged the elderly to compete, and the local nursing home closed because few elderly chose to stay. According to one government-related staff, the competition strategy works might because most of the community members are relatives—they have a long time and close relationship and know each other very well.

System Structure. IRODORI CO., LTD founded in 2001 by the local government oversees promoting the information network of Kamikatsu-Cho. In 2001, the Ministry of Economy, Trade and Business of Japan allocated 160 million JPY to help build the information network of Kamikatsu-Cho. In fact, the

investment was not enough to build an average information network. Kamikatsu-Cho chose to make use of the existing communication line to build the local area network, and this could largely reduce the cost of hardware infrastructure. The most important feature of Kamikatsu-Cho's system is that the elderly, even those who have never used computers before, can accept and use this system. Information on this system including news and so on is updated every day, forming users' habit to use the system every day. Thirty years later, the producers can afford to buy their computers and tablets for the business. Customized software is still operating every day.

Social Integration. Before the thriving of the Irodori business, most of the elderly were drinking during the day or chatting to pass the time because of lacking hope for the future. By providing job opportunities, the elderly use their mind and their bodies every day and the feeling of being needed are keeping them joyful. The staff of IRODORI CO., LTD not only teach the elderly how to use computers in the first place but also hold assemblies to teach them how to use this system to understand and analyze transaction data. Solving technical issues in the community is still the routine of IRODORI CO., LTD. Meanwhile, IRODORI CO., LTD offers regular study tours and classes to the whole world. Many young urban dwellers are attracted by internships and learn from the elderly about the Irodori business, which also makes the elderly more vibrant.

3.2 Case OTS

In the OTS case, social media combined with the official website intends to draw citizens and travelers to engage in various events in Otsuki. Seniors in Otsuki can rent their farmland to visitors, manage it for them, and post the status of the plants regularly on the social media. In 2013, Otsuki City was entrusted with the "Otsuki Wellness Network" project in the general affairs document "Project to Promote the Creation of a Super-Aging Society". The "landing-type tourism product centered on communication" business using ICT was promoted within Otsuki City. This project continued as an independent business of the city after 2014 and ended in 2019.

Community Feature. Otsuki City in Yamanashi Prefecture is an area blessed with abundant nature, including the best viewpoint of Mt. Fuji in Japan. Although the access from Tokyo is less than one hour, Otsuki City has not been sufficiently recognized as a tourist destination. On the other hand, the population has been declining since the 1960s, and the aging of the population has led to a decline in the state of the

local community and a decline in the vitality of the area. The population aged 65 and over is the largest in the Otsuki district with an aging rate of 38.6% (in 2020). Another issue is the increase in idle farmland due to the declining agricultural population.

System Structure. The system of Otsuki Wellness Tourism mainly combined the SNS (Facebook), sensors, and the public cloud. By installing WIFI network equipment in the field of "Otsuki Eco-no-Sato" and transmitting the landscape with a network camera and the temperature and humidity from the field server installed in the greenhouse, the situation of the rented farm can be viewed on time by the city dwellers, and the local elderly can also interact with them through SNS, such as posting the status of plants. For the local elderly, tablets were distributed to active seniors who were responding to events to share information, and their health conditions were observed using network-compatible weight scales, body composition meters, and pedometers. Meantime, an ICT education course called "Learning Place" was set up from the beginning, where the active seniors can experience step-by-step how to operate tablets and how to use SNS.

Social Integration. According to the Chairman of NPO Otsuki Eco Village, the above event was organized seventy-eight times with around 754 participants from all over Japan; the ICT education course was organized thirty-one times with about 155 active seniors; more than 350 local elderly participated in the health measurements. Within the social activity domain of active seniors, the local events' participation and activities of hobby groups were promoted the most. Active seniors were seen more actively at the Silver Human Resources Center, and recreational activities and socializing activities with neighbors and relatives were rising as well.

3.3 Case TOK

"Tokuta" is a smartphone elderly watching system based on the side street function of the local shopping district. It was implemented as "ICT Furusato Genki Business" by the Ministry of Internal Affairs and Communications in 2010 and was proposed by the specified non-profit corporation Tokushima Internet Citizens' School and developed by the Tokushima University Regional Creation Center. Although the project and the application for support were withdrawn in 2015, the social support network through Twitter is still in operation.

Community Feature. In Tokushima's local community, nuclear families have become more

common, and the number of elderly living alone has increased, but the problem was that there was no mechanism for the local community to share information about those elderly. Therefore, using the time of the shop owners to have them watch over the elderly with ICT is considered to be doable. As of November 2011(one year after the start), there were thirty "Watched members" (thirteen men, seventeen women, average age seventy-three years old) and forty-two "Watching members" (thirteen men, nineteen women, average age fifty years old). The goal is for everyone to tweet about twice a day. The average number of tweets is 2,917 tweets per month (July-September 2013), ninety-seven tweets per day on average, and tweets 1.6 times per person per day.

System Structure. "Tokuta" is a coined word that combines Tokushima and Twitter. "Tokuta" watches over the elderly using Twitter and smartphones (iPhone, Android devices) that send information in short sentences of 140 characters or less. The rented iPhone has an iPhone application "Tokuta" installed exclusively for watching. The system was developed mainly by students from Tokushima University. With Tokuta, you can tweet messages such as "I'm full of energy" and "I'm a little sick" with a simple operation. On the other hand, the watching team replies, "How are you feeling today" and "Is it okay?" And interacts on Twitter. Participants only need to have fun talking on Twitter for both the "watching party" and the "watched party", but as a function to support this, Tokutta analyzes Twitter's remarks with a computer and analyzes it. A "watching server" that automatically finds people who are not feeling well is in operation. The" watching server "extracts the elderly remarks such as" I'm sick "and contacts the watching team in charge, asks them to listen to the situation by e-mail or phone, and visits the house if necessary.

Social Integration. Tokuta's watching is not a conventional system for monitoring elderly people from the outside but is characterized by watching through daily greetings and conversations. If you say something trivial around you, someone will reply to your statement. Since it is only about daily conversations, the elderly are not managed or tied up and will enjoy participating. Also, there is almost no awareness or burden of watching over, and it seems that they are enjoying participating in the community purely. Not only the watched side uses Twitter, but the elderly watching side also uses Twitter to disseminate information, and the information of the elderly is shared by the local community. It is a method of watching over the entire region by creating a "loose community" through mutual voices through daily greetings and conversations, rather than just watching from the outside.

3.4 Case KAT

The new era Katsuragi Creation Promotion Project creates places and opportunities for self-help and mutual assistance-type local community regeneration at community bases such as public halls, and the local community manages their lives sustainably and autonomously. In the spring of 2013, it was adopted by the Ministry of Internal Affairs and Communications as an ICT town development promotion project, and the "New Era Katsuragi Creation Promotion Project" was launched through industry-government-academia collaboration. However, this project ended one year later.

Community Feature. Katsuragi City, Nara Prefecture, is located in the northwestern part of the prefecture and borders Osaka Prefecture with a population of about 37,000. The elderly ratio is 25%. In particular, there are many mountainous areas, and residents have said that shopping is difficult and that they are worried about their health. Initially, city hall staff were promoting a business to visit elderly people's homes, but it was too costly to continue. In order to find a business that would sustainably support living and health at no cost, the wisdom and power of not only the government but also citizens, universities, and private companies were gathered.

System Structure. In Katsuragi City, Nara Prefecture, the local government provided shopping support and health/life support services for the elderly using IC cards (NFC standard). Instead of staying at home, elderly people go to the "Otagaisama Support House" and access the personal portal by holding an IC card over the built-in tablet terminal to support shopping (from purchasing products at online supermarkets to paying charges) and to access Health support services (health guidance based on measured/accumulated blood pressure/body fat percentage, etc.)

Social Integration. The Otagaisama Support House utilizes a public hall and is operated by citizen volunteers, which is a community-based system that not only reduces the burden on the city but also encourages the elderly to go out and to communicate with each other. Citizen volunteers also support the operation of elderly people who are unfamiliar with the operation of smartphones and tablets.

3.5 Cross-Case Analysis

Based on the previous analysis, Table 2 and Table 3 summarize the key features of the four cases. SST focuses on the ways individuals are embedded in a social network through social connections, and how these connections are used to request or offer support (Maier, Laumer, Eckhardt, & Weitzel, 2015). Social support refers to the availability of interpersonal resources (Sarason, 2013). The term social interaction refers to the frequency and degree of involvement in social relationships. Social integration is a sense of belonging to a group of people who share common interests and recreational activities (Huang, 2018).

Table 2: A Summary of the Different Approaches to Information Flow Revealed in the Within Case Analyses.

Cases	social embeddedness（social network structure）	perceived social support（Users' believe）	enacted social support（actually do）
IRODORI	• Strengthen and expand the social network of community entities	• Social integration • Reassurance of worth • Work pride • Guidance	• Provide social participation • Inspire motivation
OTSUKI	• Expand virtual social network	• Social integration • Reassurance of worth • Guidance	• Provide social participation
TOKUTTER	• Reinforce the social network of community entities	• Reliable alliance • Guidance	• Provide online monitoring and immediate support
KATSURAGI	• Encourage the elderly to go out and to communicate with each other	• Reliable alliance • Guidance	• Provide opportunities for community exchange and inquiry • Provide self-help living support

Table 3: The Four Elderly Support Systems.

Cases	ICT Literacy Support	Main Platform	Main Terminal Devices
IRODORI	Seminar	Home-made system	Smartphone/Tablet/Computer
OTSUKI	Seminar	Mainstream SNS	Smartphone/Tablet/Computer/Sensor
TOKUTTER	Seminar	Mainstream SNS/Customized application	iPhone/iPad
KATSURAGI	Citizen volunteers	Home-made system	IC card reader/Tablet

4 DISCUSSIONS

Based on the results of the case analysis, a 2×2 matrix with four dimensions: Social embeddedness, Perceived social support, Enacted social support, and Support system (Figure 1) is proposed. The first three dimensions are from the theory lens of Social support theory. The last dimension represents the physical structure of the support system. The four directing arrows with the same pattern that covers from simple to complex. Four cases in this research are placed in the matrix as an example for explaining the features of each type. One of the findings is that Social embeddedness is positively relevant to the Perceived social support and the Enacted social support is positively relevant to the Support system. Four types

of ICT-enabled community-based social support systems are derived from the cross-case analysis. The first type is the L4S type, in which "L" is a shortened form of the word "low" and "4S" represent the four dimensions above. This type has a relatively simple system infrastructure, the enacted social support is limited, and the perceived social support and the social embeddedness are also limited. In contrast, the H4S type means "high" in all four dimensions. The L2S type represents low in the dimensions of Enacted social support and Support system and high in the dimensions of Perceived social support and Social embeddedness. The H2S type represents high in the dimensions of Enacted social support and Support system and low in the dimensions of Perceived social support and Social embeddedness.
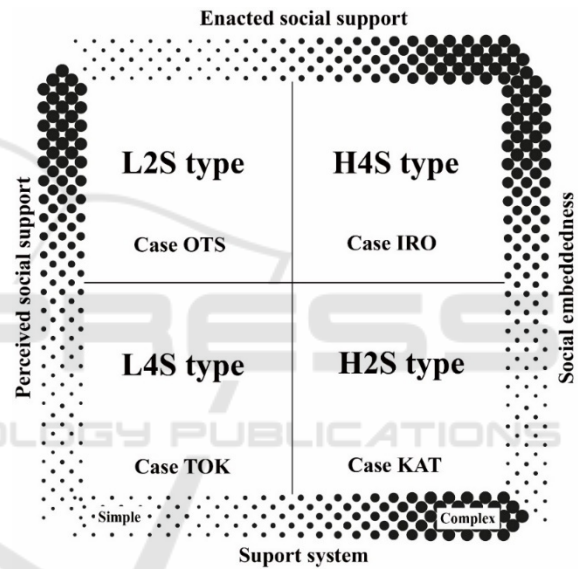

Figure 1: ICT-enabled community-based social support system matrix.

All four types contain a social welfare nature. Besides the case IRO, all other three cases relate to the ICT promotion project by the Japanese Ministry of Internal Affairs and Communications. Multiple organizations, such as telecommunications companies, universities, non-profit organizations, local government, etc., were involved in maintaining the social support communities. The elderly in the communities have participated and received supports for free. The founder of IRODORI CO., LTD was from Japan Agricultural Cooperatives and the leaf business has been supported continuing by the local government from the beginning. All the communities require ongoing funding support and manpower for promotion and maintenance.

Three differences are observed during the analysis. First, sufficient input on the support system and enacted social support rely on stable funding. In the case IRO, the leaf business has been able to keep annual sales of 260 million JPY. In the case OTS, with the withdrawal of the promotion company, the lack of manpower became apparent, making it difficult to promote the event. In the case TOK, the upgrade and maintenance of the application caused the closure of the project. Because the L2S type and the L4S type have relatively low costs, the case OTS and the case TOK all lasted for more than five years. By contrast, the case KAT as the H2S type only lasts for one year. Second, the main difference between the case IRO and the case KAT might be the incentive mechanism. In the case IRO, the leaf business provides the elderly with income, famous, self-affirmation, and common topics. However, in the case KAT, only self-help living supports, and communication spots were provided. The main difference between case TOK and case OTS might be the same. The case TOK only provides online communication spots and monitoring services. In the case OTS, the knowledge of the elderly was utilized, and the elderly spontaneously tried to learn new knowledge as same as the case IRO. Third, the difference between the case TOK and the case KAT might be the form of the provided communication spots. In the case KAT, the elderly needed to go to the community center for accessing support services. The appearances raised the opportunity for social interaction. On the other hand, compared to the online communication spot, the chance of communication is lower, and the accessible period is shorter. Some of the elderly in the case TOK are still communicating with each other on Twitter and helping each other in real life.

5 CONCLUSIONS

This study adopts a qualitative research approach with a multiple-case design for constructing an ICT-enabled community-based social support system matrix model with three dimensions from the social support theory and one ICT dimension. Four representative cases in Japan are chosen and well analyze within and across all the cases. Findings show that ICT adoption and community design can solve the social isolation issues of the elderly, the effects of which also vary from the deployed system and the community design. The funding issue is the most striking issue for keeping the community functional continually. Incentive mechanism is proven to be

essential for the elderly to get long-term social support, especially for their mental needs. Four types of support systems from the proposed matrix model are considered to be able to cover and explain most of the current ICT-enabled community-based social support systems.

REFERENCES

Barrera, M. (1986). Distinctions between social support concepts, measures, and models. *American journal of community psychology, 14*(4), 413-445.

Bobillier Chaumon, M.-E., Michel, C., Tarpin Bernard, F., & Croisile, B. (2014). Can ICT improve the quality of life of elderly adults living in residential home care units? From actual impacts to hidden artefacts. *Behaviour & Information Technology, 33*(6), 574-590.

Caplan, G. (1974). *Support systems and community mental health: Lectures on concept development*: Behavioral Publications.

Chen, Y.-R. R., & Schulz, P. J. (2016). The Effect of Information Communication Technology Interventions on Reducing Social Isolation in the Elderly: A Systematic Review. *J Med Internet Res, 18*(1), e18.

Cobb, S. (1976). Social support as a moderator of life stress. *Psychosomatic medicine, 38*(5), 300-314.

Coelho, J., & Duarte, C. (2016). A literature survey on older adults' use of social network services and social applications. *Computers in Human Behavior, 58*, 187-205.

Cohen, S., Underwood, L. G., & Gottlieb, B. H. (2000). *Social support measurement and intervention: A guide for health and social scientists*: Oxford University Press.

Cutrona, C., Russell, D., & Rose, J. (1986). Social support and adaptation to stress by the elderly. *Psychology and aging, 1*(1), 47.

Jia, C., & Noda, T. (2011a). Investigation on the Effect of Services for Aged Persons by Using Information and Communication Technology in Okuizumo-Cho. *San'in Research, 4*, 23-36.

Jia, C., & Noda, T. (2011b). Possibility of ICT Application and Life Support for Senior Citizens in Intermediate and Mountainous Area by Using Video Conferencing Telephone and Call Center. *Proceedings of The Society of Socio-Informatics, 26*, 183-186.

Khosravi, P., & Ghapanchi, A. H. (2016). Investigating the effectiveness of technologies applied to assist seniors: A systematic literature review. *International Journal of Medical Informatics, 85*(1), 17-26.

Khosravi, P., Rezvani, A., & Wiewiora, A. (2016). The impact of technology on older adults' social isolation. *Computers in Human Behavior, 63*, 594-603.

Kim, M. J., Lee, C.-K., & Preis, M. W. (2016). Seniors' loyalty to social network sites: Effects of social capital and attachment. *International Journal of Information Management, 36*(6), 1020-1032.

Kobayashi, K., & Goto, K. (2016). Development, Present State and New Initiatives of the "Elderly Person Watching System": Case Studies on FUKUYAMA and FUKUOKA. *Journal of Nagoya Gakuin University, 52*(4), 23-38.

Lakey, B., & Cohen, S. (2000). Social Support Theory and Measurement *Social support measurement and intervention: A guide for health and social scientists* (pp. 29-52).

Lam, J. C. Y., & Lee, M. K. O. (2006). Digital Inclusiveness--Longitudinal Study of Internet Adoption by Older Adults. *Journal of Management Information Systems, 22*(4), 177-206.

Magnusson, L., Hanson, E., & Borg, M. (2004). A literature review study of information and communication technology as a support for frail older people living at home and their family carers. *Technology and Disability, 16*(4), 223-235.

Maier, C., Laumer, S., Eckhardt, A., & Weitzel, T. (2015). Giving too much social support: social overload on social networking sites. *European Journal of Information Systems, 24*(5), 447-464.

Marzano, G., & Lubkina, V. (2017). Usability in social telerehabilitation systems for elderly users. *Public Health, 144*, 1-3.

Martina B., Sara G., Elvis M., Pietro C., Elisa P., and Giuseppe R. (2020). The Relevance of Online Social Relationships Among the Elderly: How Using the Web Could Enhance Quality of Life? *Front. Psychol.*, 11, 1-10.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*: John Wiley & Sons.

Niehaves, B., & Plattfaut, R. (2014). Internet adoption by the elderly: employing IS technology acceptance theories for understanding the age-related digital divide. *European Journal of Information Systems, 23*(6), 708-726.

Pan, S. L., Pan, G., & Leidner, D. E. (2012). Crisis Response Information Networks. *Journal of the Association for Information Systems,, 13*(1), 518-555.

Pan, S. L., & Tan, B. (2011). Demystifying case research: A structured–pragmatic–situational (SPS) approach to conducting case studies. *Information and Organization, 21*(3), 161-176.

Saldaña, J. (2021). *The coding manual for qualitative researchers*: sage.

Sarason, I. G. (2013). *Social support: Theory, research and applications* (Vol. 24): Springer Science & Business Media.

Silva, T., Abreu, J., Antunes, M., Almeida, P., Silva, V., & Santinha, G. (2016). +TV4E: Interactive Television as a Support to Push Information About Social Services to the Elderly. *Procedia Computer Science, 100*, 580-585.

Spagnoletti, P., Resca, A., & Sæbø, Ø. (2015). Design for social media engagement: Insights from elderly care assistance. *The Journal of Strategic Information Systems, 24*(2), 128-145.

Statistics Bureau. (2021). Population density (Portal site of official statistics of Japan). Retrieved from https://www.stat.go.jp/data/jinsui/index2.html

Takata, Y. (2012). Transition of the poligy on ICT promotion in regional community. *Media ・ Communication, 62*, 135-147.

Thoits, P. A. (1995). Stress, coping, and social support processes: Where are we? What next? *Journal of health and social behavior*, 53-79.

Huang, T. (2018). *Enacting Eldertech in Senior Citizens' Communities of Japan A Social Support Perspective*. Paper presented at the Proceedings of the Third International Conference on Informatics and Assistive Technologies for Health-Care, Medical Support and Wellbeing, Nice, France, October 14-18.

Wang, Q., & Sun, X. (2016). Investigating gameplay intention of the elderly using an Extended Technology Acceptance Model (ETAM). *Technological Forecasting and Social Change, 107*, 59-68.

World Health Organization. (2015). *World report on ageing and health*: World Health Organization.

Wu, Y.-H., Cristancho-Lacroix, V., Fassert, C., Faucounau, V., de Rotrou, J., & Rigaud, A.-S. (2016). The attitudes and perceptions of older adults with mild cognitive impairment toward an assistive robot. *Journal of Applied Gerontology, 35*(1), 3-17.

Mori, Y., Sodei, T., Arai, H., Sawaoka, S., & Suzuki, A. (2011). An Attempt to Prevent Isolation of the Elderly by Using ICT—Construction of a Model and Social Experiment—. *Proceedings of The Society of Socio-Informatics, 26*, 179-182.

Miyazaki, T., & Shoji, H. (2017). Life support services for the elderly using going out/coming home sensors. *The Institute of Electronics, Information and Communication Engineers Communication Society Magazine,* 11(1), 6-11.

Naoi, M., & Ogawa, A. (2015). Community Building Using ICT. *Academic Trends*, 20(1), 1_70-71_74.