



# **The design of technological service system of long-term care institutions: A perspective of activity theory**

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## **Abstract**

*This study aims to explore the design of technological service system of long-term care institutes. The design is based on the integrated framework of activity theory and customer value perspective to suggest the critical considerations of system design. This study collected a total of 351 service events of 17 long-term care institutions located in Japan, Singapore, and China and a total of 75 equipment or facilities. In addition, this study conducted in-depth interviews with experts. The findings are described as follows. First, in the aspect of the services, provided by the subject for the objects, the study shows long-term care institutes place more emphasis on hedonic value and then functional value and contextual value of the objects. Moreover, ethical value and relationship value are neglected. Second, in the aspect of tool, the equipment or facilities of long-term care mostly emphasize functional value and contextual value. Third, in the aspect of community, the system design should consider sharing platform, sharing information and network between the focal institute and other institutes. Finally, in the initial stage of system design, related policies, rules, and operation procedures should be considered. Moreover, long-term care institutes can improve the service quality based on the five-dimension framework of customer value. Furthermore, the focal long-term care institute should collaborate with external institutes to reach a clear division of labor through the sharing platform to build a complete care ecosystem.*

**Keywords:** Long-term Care Institute; Activity Theory; Customer Value; Technological Service; System Design

## **1. Introduction**

The elderly population grows rapidly in advanced countries, and then the demand for medical service and long-term care also rises greatly (Chen et al., 2017; Hewitt, Nalabanda, & Cassell, 2015). Long-term care means to provide comprehensive and continuous service to people who need long-term care. It is estimated that the elderly population in Taiwan will account for 30% of its total population in 2050. Therefore, medical and health care policies have gotten a great deal of attention internationally (Hewitt et al., 2015; Robinson, 2005). The health care industry around the world has undergone a transformation from the traditional hospital bedside service to home care service for the chronically ill (Drageset, Haugan, & Tranvag, 2017). Telemedicine, information and communications technologies, and cross-disciplinary electronic medical equipment have made comprehensive and professional health care available to the elderly at home or patients in remote mountains. Furthermore, information and communications technologies combined has enabled cloud computing service to be widely used, so medical service on the cloud has become a topic of attention in recent years, offering another medical care option to the public (Sonehara, 2011). Building smart and green hospitals is a trend in future medical development in Taiwan. Because smart hospitals use electronic medical records, the integration of cross-platform medical systems, and mobile devices to improve their operating flows and give patients even higher quality medical care, the care industry in Taiwan will also gradually move toward smart applications and smart service. Against the complex, individualized backdrop, the elderly have diverse requirements for their health care service (Bandini et al., 2019). Consequently, it is very difficult for a single entity or a single operation to satisfy the need of the supply chain for the elderly care industry (Gbreil et al., 2018). Due to rapid population aging, the elderly care industry emphasizes wide-ranging and diverse service provision, besides

providing health and medical service (Drageset, Haugan, & Tranvag, 2017; Gbreil et al., 2018). Therefore, in devising a new care model, the industry should take institutional environment, facility, and equipment, internal service, and personnel professional skills into considerations (Hewitt et al., 2015; Siou et al., 2017). Most service systems nowadays emphasize safety, cater to the elderly, use sensors and photographing equipment to monitor and control, and, via the Internet, remotely control and maintain the at-home safety of the elderly. In sum, long-term care services had better consider not just the requirements for everyday functional care but also the multi-faceted demands of the elderly. Therefore, the objective of this study is, through theoretical viewpoints, to propose how to design a technological service system of long-term care institutions by integrating the viewpoints of institutional and strategic alliances. That is, this study aims to conduct a systematic and logical analysis and help the design of future systems.

## 2. Literature review

### 2.1 Activity theory

Vygotsky (1978) first raised the activity theory. It aims to provide a comprehensive framework with which to explain that people's activity is affected by the tools they use, whether tangible or intangible. If a social system is treated as a unit of analysis, the research will have difficulties to also consider human agency. If personal behavior is used as the basic unit of analysis, the researcher will omit the importance of contextual considerations (Kuutti, 1991). Therefore, research should take both units of analysis into consideration. Activity theory offers a solution to use both personal actions and contextual factors as units of analysis (Kuutti, 1996). The main idea behind the activity theory is that the subject of an action uses a tool to help conduct the action, which interacts with the object, whether concrete or abstract, and transforms the process into the final outcome. The subject of any activity may be an individual or a group. A group means a collection of specific interactive relationships. If the relationships are very strong, the collection becomes a community. Therefore, in order to explore how different doers coordinate, regulate, and share responsibility in a community, Engestrom (2000), based on Vygotsky's triangular framework, offered another triangular framework for basic activities, which added community, rules, and division of labor to subject, tool, and object for a total of six elements (Figure 1). Subject is the main character of an individual or group activity. The subject, through tools, such as language, hand gesture, number system, diagrams, materials, symbols, and types of human activities, gets close to the object (Ogawa et al., 2008). An object means something, observable or imagined, that is the target to be guided. Therefore, the tool acts as an intermediary between the subject and the object. Furthermore, the subject and the community are highly intertwined. Rules are principles, customs, and regulations that are needed to govern the actions of the activity systems in a "community" and the interactions among them (Minnis and Steiner, 2006). And the activity systems in a "community" need division of labor to achieve their objectives. Division of labor means the division of missions and the division of job responsibilities among members. Member's work is divided but members work cooperatively (Durkheim, 1947).

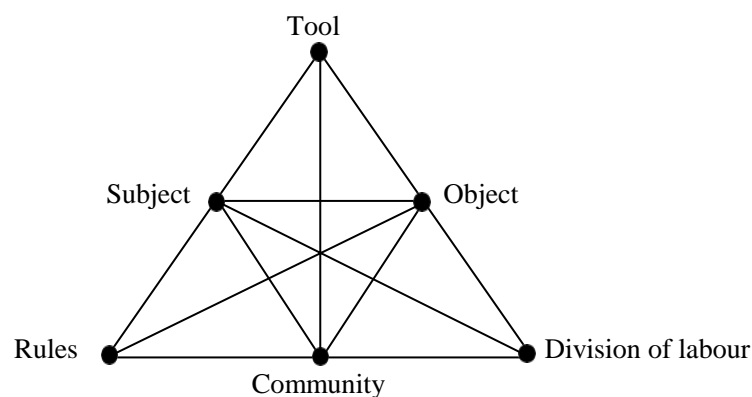


Figure 1 Activity theory

### 2.2 Customer value

After comparing with the products or services provided by competitors, customer value means the comprehensive assessment formed in the customer (Woodruff, 1997). The assessment is multi-dimensional, such as efficiency value, excellence value, status value, respect value, game value, aesthetics value, ethics value, and spirituality value (Gbreil et al., 2018; Holbrook, 1994). In addition, customer value is an experience, which does not exist in the chosen brand

and not in the products owned, but instead the value exists entirely in the consumer’s experience (Bandini et al., 2019; Holbrook & Hirschman, 1982). Therefore, customer value can be distinguished as two aspects, concerning functional value and hedonic value (Babin et al., 1994; Chandon et al., 2000; Holbrook, 2006; Rachel et al., 2019; Siou et al., 2017).

Furthermore, based on the customer relationship aspect, the weighing of emotions, perceptions, gains, and losses cannot be limited to a single situation, but instead it should be expanded to weighing the value of the sustained process of the whole relationship, which is called a relational value (Baker, Kleine & Bennion, 2003; Flint et al., 2002). That is, a product is consumed because the consumer has seen some symbolic meaning in the product, and consequently the consumer perceives some extra value from the product or the consumption of the product and forms human bonding with its manufacturer (Wei, 2008). Furthermore, the customer value that values the contextual aspect emphasizes even more the difference in customer values under different situations, which is called a contextual value (Sheth, Newman & Gross, 1991; Overby, 2000). Additionally, care service for the elderly is an integration of different services, and it is also a professional service to help others, encompassing two broad areas: medical service and social work. Therefore, care service personnel should possess relevant moral awareness in the process of doing the work in order to provide high-quality service (Bandini et al., 2019; Gbreil et al., 2018).

In sum, this study has divided the value of care of the elderly into five dimensions: ethical value, functional value, hedonic value, relational value, and contextual value.

### 3. Method

This study aims to explore the whole picture of the demand for elderly service, and use the activity theory to further explore the complex network relationships between information systems. Furthermore, the customer value aspect could take all the needs of institutional residents into considerations. This study proposed the theoretical framework by integrating the customer value aspect with activity theory. Customer value aspect is used in the analysis of the object in the activity theory. The analysis framework is shown as Figure 2.

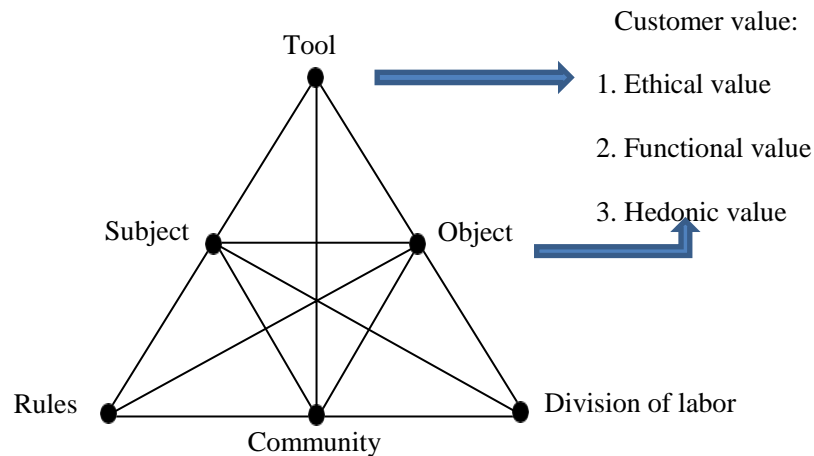


Figure 2 Analysis framework

As for data collection and analysis, this study based on the perspective of activity theory: subject (such as long-term care institutions and service personnel), object (such as residents and family members), community (such as medical institutions, religious groups, volunteers, and disaster response centers), tool (such as information and communications equipment and system, smart service), rule (such as principles, customs, and regulations), and division of labor (such as care division of labor, medical division of labor, and spiritual support).

First, about the service provider, for subjects (such as long-term care institutions and service personnel), this study had mainly collected data about service contents of nine, three, and five well-known long-term care institutions in Japan, Singapore, and China, respectively. This study compiled into 351 events about long-term care service. The contents of the data were used to gain knowledge about the ideals of service at each institution and collect the sources of secondary data, concerning the contents of their professional services from their official websites, other websites, flyers, and news reports. Moreover, for some long-term care institutions, we conducted in-depth interviews with experts. Furthermore, we conducted in-depth interviews with the elderly and their family members in the community so as to actually grasp the needs of the customers. Then, for data analysis, the content of each long-term care service was a unit of analysis. We used text analysis and method of content analysis, and we numbered and inducted each record according to its nature. Each record about the service of a long-term care institution may have multiple customer values, so each of the 351 events had been individually judged and analyzed to yield 412 service events of

the long-term care institutions. Finally, we conducted statistical procedures to count customer value types, percentages, and ranking of service events.

Second, for the element of tool, we collected information on community (medical institutions, religious groups, volunteers, and disaster response centers), including the service provided by the centers that supported the community care service for the elderly, including basic management, assistance in food service, assistance in household chores, 24-hour emergency assistance notification service, and medical shuttle bus, in order to understand the community's integration resources and the convenience of everyday living. The data of this study mainly concerned the long-term care smart equipment. The sources of information about the smart equipment from Japan were the Japanese long-term care institutions and International Home Care & Rehabilitation Exhibition. The sources of Taiwanese institutions were Elder Care Asia, 2020 Assistive Technology for Life, the Center for Assistive Technology Resources and Popularization portal, and the AI and smart health care categories of the top 100 new products. To further collect data relevant to smart equipment, we collected secondary data as the source of information, for example institutions of theses, dissertations, journals, and magazines that purchased smart equipment and the official websites of long-term care institutions. This study used four keywords to search: long-term care smart equipment, health care, smart wearables, smart assistive devices. Our search yielded 3,890 items. After induction, analysis, and deletions of duplicates and irrelevant items, we got 75 items, which we ensured to be specific and non-cross-dimensional, and then we inducted them to the customer value framework of this study. Finally, regarding long-term care smart equipment, we further compiled customer value types, frequency, proportions, and ranking.

## 4. Results and discussion

### 4.1 Subject-object

Firstly, we conducted a text analysis on the content events of the specific service of long-term care institutions (subject). We used inclusive reading, naming, numbering, and induction to analyze and yielded 412 long-term care service events. Then we used the five-dimension customer values of long-term care institutions residents (object) to induct. We further categorized the five dimensions into 15 subcategories and 42 detail subcategories (shown in Table 1). The five-dimension customer values are described below, where “【】” means coding alphabet and number. First, ethical value 【A】 means a moral thinking, judgment, and decision-making process to help care personnel, when they encounter care situations, make the most ethical care decisions and do things that are most beneficial to the service recipients. Second, functional value 【B】 means the attributes or effects of the service or product functions meet the needs of the case. Third, relational value 【C】 means the mutual understanding, mutual responding, mutual acceptance, and common understanding obtained through mutual interactions between two cases or between a case and a caregiver. Fourth, hedonic value 【D】 means a blissful psychological state and feelings after the case received good service. Fifth, contextual value 【E】 means a feeling of satisfaction that a case feels after he or she has explained or assessed a series of external environments. Furthermore, the top five dimensions incidence counts and proportions for the contents of long-term care institutions service are, in declining order, hedonic value (30.83%), functional value (25.24%), contextual value (20.39%), relational value (13.83%), and ethical value (9.22%). The top five subcategories incidence counts and proportions (at least 6.7%) are, in declining order, D2 LOHAS service, C1 social interaction, E1 safe lifestyle, and E2 healthy lifestyle (same ranking) and B4 rehabilitation training. The top 14 detail subcategories incidence counts and proportions (at least 2.4%) are, in declining order, D203 leisure activities, D202 art activities, E202 comfortable living, D201 parties, E102 safe facility, C101 interactive activities, C102 variety program, E101 safe environment, B402 morning training, B301 healthy diet, E201 comfortable space, B101 health checkup, B501 cognition and perception training, A101 help with eating, D101 health topics, and B401 joint training.

### 4.2 Tool

Based on the state of information and communications equipment systems on the market, we obtained 75 pieces of smart equipment for long-term care. We also categorized into five-dimension customer value, shown in Table 2: functional value (44%), contextual value (37%), hedonic value (7%), relational value (7%), and ethical value (5%). Furthermore, observing Table 4-2, the incidence counts in the five dimensions and proportions for long-term care equipment and facility are, in declining order, functional value (44.0%), contextual value (37.4%), relational value (6.7%), hedonic value (6.7%), and ethical value (5.2%). Of the 14 subcategories, the top three subcategories incidence counts are, in declining order, E1 safe lifestyle, B1 health care, B2 daily living care. Of the 18 detail subcategories, the top three subcategories incidence counts are, in declining order, B101 health tests, E101 safe facility, and E102 safe environment.

Customer value	Frequency	Proportion %	Ranking	Customer-value service category	Frequency	Proportion %	Ranking	Customer-value service sub-category	Frequency	Proportion %	Ranking
A-ethical value	38	9.22	5	A1 Protecting life	22	5.34	6	A101 help with eating	12	2.91	14
				A2 dignity maintenance	16	3.88	12	A102 accompany to the doctors	10	2.43	16
							A201 human waste nursing service	7	1.7	20	
							A202 shower nursing service	9	2.18	18	
B-functional value	104	25.24	2	B1 health care	19	4.61	8	B101 health tests	13	3.16	12
								B102 traditional Chinese medicine treatment	2	0.49	36
								B103 disease treatment	3	0.73	32
								B104 disease prevention	1	0.24	39
				B2 daily living care	11	2.67	14	B201 mouth nursing	2	0.49	36
								B202 manicure	2	0.49	36
								B203 clean things and tests	4	0.97	28
								B204 sun bath	1	0.24	39
								B205 turning in bed	1	0.24	39
								B206 medication reminder	1	0.24	39
				B3 nutrition and health	21	5.1	7	B301 healthy diet	16	3.88	10
								B302 meal delivery service	5	1.21	23
				B4 rehabilitation training	34	8.25	5	B401 joint and body rehabilitation	10	2.43	16
								B402 morning training	18	4.37	9
				B5 Occupational therapy	19	4.61	8	B403 balance and gait training	6	1.46	22
								B501 cognition and perception training	13	3.16	12
B502 regain peace of mind	3	0.73	32								
B503 complications prevention	3	0.73	32								
C-relational value	59	14.32	4	C1 social interaction	47	11.41	2	C101 Interactive activities	22	5.34	6
								C102 variety program	21	5.1	7
								C103 social interactions and exchanges	4	0.97	28
				C2 attachment relationship	12	2.91	13	C201 conversation exchange	4	0.97	28
								C202 companionship on walks	8	1.94	19
D-hedonic value	127	30.83	1	D1 Counseling service	18	4.37	11	D101 health topics	11	2.67	15
								D102 support introduction	7	1.7	20
				D2 LOHAS service	82	19.9	1	D201 parties	25	6.07	4
								D202 art activities	28	6.8	2
								D203 leisure activities	29	7.04	1
				D3 Spiritual service	8	1.94	15	D301 spiritual comfort	3	0.73	32
								D302 emotions management	5	1.21	23
				D4 self-help service	19	4.61	8	D401 rides and transport	5	1.21	23
								D402 running errands for residents	5	1.21	23
								D403 conveniences for living	5	1.21	23
D404 making doctor's appointments	4	0.97	28								
E-contextual value	84	20.39	3	E1 safe lifestyle	42	10.19	3	E101 safe environment	19	4.61	8
								E102 safe facility	23	5.58	5
				E2 LOHAS friendly environment	42	10.19	3	E201 comfortable space	15	3.64	11
								E202 comfortable living	27	6.55	3
<b>Total</b>	<b>412</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>412</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>412</b>	<b>100</b>	<b>-</b>

Table 1 The frequency analysis of the long-term care services based on customer value perspective

Customer value	Frequency	Proportion %	Ranking	Customer-value service category	Frequency	Proportion %	Ranking	Customer-value service sub-category	Frequency	Proportion %	Ranking
A-ethical value	4	5.2	5	A1 Protecting life	1	1.33	12	A101 accompany to the doctors	1	1.33	15
				A2 dignity maintenance	3	4.00	4	A201 human waste nursing	3	4.00	5
B-functional value	33	44.0	1	B1 health care	18	24.0	2	B101 health tests	18	24.0	1
				B2 daily living care	10	13.3	3	B201 medication reminder	3	4.00	5
								B202 home service	4	5.33	4
								B203 assistive devices	3	4.00	5
				B3 nutrition and health	2	2.67	7	B301 meal delivery service	2	2.67	9
				B4 occupational therapy	3	4.00	4	B401 regain peace of mind	2	2.67	9
B402 cognition and perception training	1	1.33	15								
C-relational value	5	6.7	3	C1 social interaction	2	2.67	7	C101 interactive activities	2	2.67	9
				C2 attachment relationship	3	4.00	4	C201 conversation exchange	3	4.00	5
D-hedonic value	5	6.7	3	D1 LOHAS service	2	2.67	7	D101 leisure activities	2	2.67	9
				D2 spiritual service	2	2.67	7	D201 spiritual comfort	2	2.67	9
				D3 self-help service	1	1.33	12	D301 accompany to the doctors	1	1.33	15
E-contextual value	28	37.4	2	E1 safe lifestyle	25	33.3	1	E101 safe facility	13	17.3	2
								E102 safe environment	12	16.0	3
				E2 healthy lifestyle	2	2.67	7	E201 bodily training	2	2.67	9
E3 interactive lifestyle	1	1.33	12	E301 social interaction	1	1.33	15				
Total	75	100	-	-	75	100	-	-	75	100	-

Table 2 Frequency analysis of long-term care tools based on customer value perspective

4.3 Community

A community is formed by groups of common values, interests, professions, or lifestyle. People are free to join any open community. Restrictive membership qualifications will limit members in specific groups. The community provides instantaneous communications, contact, and information sharing with its members. Through the community conduit, physicians and nurses can handle patients or residents of long-term care institutions, prescribe medications, or share residents’ experiences. We found through in-depth interviews with experts that communities can be divided into intra-institutional and between institution and community. For intra-institutional communities, technological service systems should be designed to meet the needs of administrative management of the institution, frontline professionals, frontline care personnel, and residents and their family members. First, the systems must help support the administrative tasks of the whole institution, such as institution accreditation. Furthermore, the system needs to help hospital administrators schedule, manage, and control their staff, such as monitoring the attendance of foreign care providers. The superintendent of an institution pointed out that “we have found some foreign care providers AWOL (absence without leave).” Second, the system needs to help frontline professionals do their work. For example, physicians and nurses can get information from the system to monitor the condition and nursing care information of their patients.

Third, when residents or their family members have any questions about the care or when they need to view the records, the system can present the care flow of the frontline nurses and care personnel on the system. Additionally, the system also provides online counselling. Family members can use the system to get a good picture of the life of their loved ones as residents of the institution. Fourth, the system needs to help frontline care personnel with their job responsibilities. For example, when a frontline care worker is performing some invasive procedure for a resident, such as phlegm suction, if something comes up that requires immediate attention, the system can immediately inform a medical care worker and immediately takes emergency action. The system also allows care personnel to inquire about the condition of residents that day, items of note, patting the back, or medication reminders. Also, the system allows frontline care personnel to enter residents’ condition or information and make the information available on the platform. Furthermore, the system platform of the institution should be designed so that its information as well as the information on the systems of other long-term care institutions, hospitals, pharmacies, rehabilitation equipment manufacturers, schools, governments, social welfare institutions, and volunteer groups can

be mutually shared. This system of networks can cultivate an ecosystem of resources integration and a better network for care.

#### **4.4 Rules**

To nurture the sound development of long-term care service systems, their service quality, and resources development so as to protect the rights of the disadvantaged to receive long-term care service, the Taiwanese Long-Term Care Services Act was promulgated in 2015. This law has become an important piece of legislation for the development of long-term care in Taiwan. It integrates the multitudes of long-term care resources for the more than 700,000 families with disabilities. It helps make resources more comprehensive, improve the quality of services, and ensure that the demented can get proper care. Relevant laws and regulations include the Long-Term Care Services Act, standards for long-term care service institutions, standards tables for residential long-term care institutions, rules for the accreditation of long-term care service institutions, and guidelines for the security of personal data in remote care settings.

#### **4.5 Division of labor**

Elderly care is a service that requires division of labor among many jobs and service organizations. In an aging society, hospitals and such institutions should cross professional service lines to get involved with long-term care institutions and communicate, coordinate, and collaborate effectively in order to improve the quality of services of long-term care institutions. Long-term care institutions use their existing facilities and equipment, including buildings and vehicles, to house and transport the elderly. They also put their human resources to good use. For example, care service personnel, social workers, nurses, rehabilitation therapists, nutritionists take care of residents' everyday needs, health service, and even services of psychological dimension. In other words, subject, object, and community must carry out specific but effective division of labor. Long-term care institutions, based on the five-dimension customer values, improve the quality of service for their residents in order to raise the recognition and satisfaction of the residents and their family members toward the institution. As for hospitals, their collaborative partnership with long-term care institutions should be built on the needs of long-term care institutions. At the same time, hospitals should integrate the resources of their departments to collaborate with long-term care institutions seamlessly. When a resident becomes ill and needs to see a doctor, the long-term care institution should check with the family or emergency contact of the resident before contacting the medical institution to send a vehicle and accompanying personnel to get the resident to the hospital. While the vehicle is on the way to the hospital, detailed and complete medical treatment records must be kept. The condition of the resident and relevant health information should be transmitted to the hospital through the platform. While the resident is hospitalized, the long-term care institution and the hospital must stay in real-time contact in order to keep tabs on the condition of the resident. After the resident is discharged from the hospital and returned to the long-term care institution, the latter must assume the care completely. It must be fully prepared, keep abreast of the assessment, and understand the specifics and key suggestions in order to provide subsequent, more comfortable, safer care services to the resident.

To sum up, for long-term care institutions, the main purpose of division of labor is to achieve effective medical care, lower risks, and give their residents more appropriate care. How to effectively delineate the boundaries for responsibility and judgment among different medical care professionals, establish standards by which to judge medical errors, devise the workflow of long-term care institutions sending their residents to hospitals or care service are the keys to division of labor. Long-term care puts people at the center of its mission and has its foundation in communities so as to achieve the core value and ultimate goal of multifaceted, integrated, and continuous service.

## **5. Conclusions**

This study aims to explore the design of technological service systems for long-term care institutions. It combined activity theory and the five-dimension customer values to form its analytical framework, upon which it submitted important considerations for system design. The results are concluded as follows. For the contents of service that subject provides for object, this study collected and analyzed 351 events of service contents from nine, three, and five long-term care institutions in Japan, Singapore, and China, respectively. Long-term care encompasses a series of care services, such as housing service, medical care service, rehabilitation service, diet service, daily living care service, emergency transport to hospital service, social activities service, education of family members service, and other relevant institutional services. The event frequency and proportion in the five dimensions are, in declining order: hedonic value (30.83%), functional value (25.24%), contextual value (20.39%), relational value (13.83%), and ethical value (9.22%), indicating presently long-term care institutions have emphasized the most on residents' psychological dimension of hedonic value. It is followed by functional and contextual values, such as health care-the physical layer of residents. Ethical and relational values are less. Therefore, the design of technological service systems should take into account not only residents' hedonic value, functional value, and contextual value, but also their ethical and relational values. Secondly, regarding tools, long-term care equipment and facility were categorized and analyzed into five dimensions of customer value, the event proportions are functional value (44.0%), contextual value (37.4%), relational value (6.7%), hedonic value (6.7%), and ethical value (5.2%). This indicates that presently

long-term care information and communications technologies have focused more on the R&D of equipment and facility for health care (functional value) and environmental safety (contextual value), while there has been less demand for relational value, hedonic value, and ethical value. Therefore, in their R&D and applications development efforts, information and communications industries should further emphasize relational value, hedonic value, and ethical value. Moreover, communities can be divided into intra-institutional and between institution and community. An intra-institutional community includes the superintendent and administrative personnel, frontline professionals, frontline care personnel, residents, and their family members. Furthermore, policies, rules, work flows, and other relevant rules should be taken into consideration in the beginning stages of designing technological service systems. Long-term care institutions must improve the quality of their services based on the five dimensions of customer value. The institution and its external collaboration community (i.e., subject, object, and community) should execute specific division of labor through the above-mentioned shared platform and form a complete ecosystem of care.

This study emphasized that subjects (long-term care institutions) had better meet the requirements of the object (residents) when designing technological service systems. Based on the above results, firstly, ethical value means a moral thinking, judgment, and decision-making process to help care personnel, when they encounter care situations, make the most ethical care decisions. As technologies advance, many technological applications are available to solve ethical issues in the support of daily lives and care of the elderly. Secondly, about functional value, care service is labor intensive, high pressure, and emotionally draining. With the population aging, the shortage in caregivers in long-term care will be shocking. Therefore, the introduction of technological service systems can help institutions conduct case management, diet management, health management, daily living care management, and other similar everyday care services. Furthermore, cloud management centers can analyze data, follow up, and provide services of better quality. For example, through voice-controlled systems, residents may make VoIP calls to their family members or, when necessary, interact directly with care personnel. Furthermore, care personnel can use an automated process to electronically record the vital sign measurements that they have taken--without the trouble of manually copying, reading, and interpreting. This will lower residents' risks of accidents. Moreover, regarding relational value, technological service systems can improve the efficiency of institutional care services, but it reduces the frequency of face-to-face visits to residents. This leads to lowering social interaction and companionship of residents. Care service should meet both residents' physiological and bodily requirements. Care focuses not only on care relationships but even more on important internal qualities of care, such as the maintenance of interpersonal relationships, of emotional support, of friendship support, and of interpersonal communication. Furthermore, the elderly need the hedonic value with companionship and psychological support. Therefore, institutions should encourage the elderly to actively participate and interact. Finally, the institutions infuse technology into service systems in order to raise the degree of health and comfort for care situations to promote the contextual value. Physical environments, such as lighting, temperature, air, together with health care management environments, such as health prevention and rehabilitation, are both important.

In addition, this study suggests that the technological service system should help with institution-wide administrative tasks, the work of frontline professionals, and the work of frontline care personnel. The system can present the care flow of the frontline nurses and care personnel on the system. Additionally, the system also provides online counseling. Family members can use the system to get a good picture of the life of their loved ones as residents of the institution. Furthermore, the system also allows care personnel to inquire about the condition of residents that day, items of note, patting the back, or medication reminders. Also, the system allows frontline care personnel to enter residents' condition or information and make the information available on the platform.

Furthermore, the system platform of the institution should be designed so that its information as well as the information on the systems of external strategic alliance institutions can be mutually shared.

Accurate and complete recording of the information about everyday care, nursing activities, and the tracking of the health of the elderly can not only improve the quality of institutional care but also protect the life and safety of the elderly. Therefore, to computerize and infuse intelligence into long-term care systems and to fully automated storage, analysis, and recording will require the integration of information across multiple disciplines. Linking the health information of residents on the platform, such as health data, medication, and medical visits, will help caregivers know the elderly more clearly. Only when one has a better knowledge about the condition of the elderly will one be able to provide service of a better quality and to take the most appropriate action in the case of an emergency. This not only lowers the burden of the institution but also shortens the time needed to carry out the work. In this way, technological service systems will form the foundation of developing long-term care. In the face of upcoming and ever maturing development of big data and artificial intelligence technologies, the design of smart technological service systems at long-term care institutions is an important topic for future studies. The "rules" and "division of labor" in the activity theory will be key elements in finely-tuned smart service systems.



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