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Technology Integration in Care Service Systems: The Required Actions of Technology Developers

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***Abstract*—Aging is a global phenomenon affecting the sustainability of national welfare systems. Care technologies are expected to improve the seniors' quality of life, remove the burden of the care personnel, and consequently, enhance the welfare systems' sustainability. The effective technological development and integration of care technology has been actively studied and discussed, focusing especially on user involvement. However, few empirical studies have been performed on the required actions of the care technology developers for technology integration. Therefore, we conducted a multiple case study of the care technology developers to clarify the required actions for promoting care technology integration in the care service systems. Through semi-structured interviews of six business cases in Japan and a qualitative thematic analysis of the individual ones, we obtained nine required actions for care technology integration that were categorized according to their major stakeholders and business phases. In addition, we carried out a cross-case analysis from the aspects of business types, firm sizes, and product types to examine the differences in the required actions. This study contributes to extending the research focus on care technology development and integration to its dissemination phase and the corresponding actions to offer an effective guidance for the care technology developers.**

***Index Terms*—Care service system, care technology, elderly care, implementation of new technologies, technology diffusion**

I. Introduction

AGING has been a global, long-term trend, not only in the developed countries, but also in the developing ones. The current welfare system relies on the younger generations, and its sustainability has been questioned [1]. Accordingly, in order to increase their sustainability, technological solutions for care services, such as robotics and artificial intelligence, have attracted attention [2-4]. For the effective use of such intelligent care technologies, scholars and practitioners have discussed how to integrate them into the care service system [5-9]. For example, previous studies have highly recommended user participation and co-creation in the care technology development and integration [6, 10]. In addition, a multi-actor consideration in the service systems, including the public sectors, has been emphasized [11, 12].

Interestingly, insufficient empirical studies have been conducted on the technology developers regarding integrating care technologies in the care service systems. Some exceptional studies have investigated the promoting factors and constraints of the care technology development and integration [13, 14]. However, limited research has specifically addressed the technology developers' required actions for the care technology integration.

Thus, this study aimed to examine the important actions for the care technology developers to develop and integrate technologies successfully in the care service systems. It was guided by the following research question: What kinds of actions do the technology developers need to take for promoting technology integration? Accordingly, we conducted a multiple case study of six technology developers with different technologies, business models, and sizes.

In the following sections, this paper primarily introduces the research on care technologies (especially care robotics) and integration. Then we explain the research methodology adopted for this study. After presenting the cases handled in this research. we illustrate the findings from both individual cases and the cross-comparison results. Finally, we discuss the findings and provide concluding remarks.

II. Care Technologies and Service Systems

A. Care Technology and its Role in Service Systems

In response to the global aging, research and development of the care technologies for seniors has been an attractive topic in the last few decades [15-18]. A major aim of these technologies is to improve the elderly's quality of life and sustain their independent living. For example, gerontechnology, defined as "a technology domain that links existing and developing technologies to the aspirations and needs of aging and aged adults" covers different types of "technologically-based products, services, and environments that improve the functioning and quality of life" [19]. As another example, ambient assisted living (active and assisted living) purports to develop "systems using ICT and socio-technical services in daily life and working environment to enable individuals to live an active, socially involved and independent life up to old age"

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For ethical considerations, the study was conducted based on the internal regulations, according to the determination of non-applicability by the Committee on Ergonomic Experiments of National Institute of Advanced Industrial Science and Technology (HF2020-1062, September 8, 2020).

[20]. Another expected role of the care technologies is to reduce the burden of and support caregivers. Devices such as exoskeletons are typical examples of such technologies [21]. Considering its high load, the technological support for the care work has been anticipated.

Care technology works as a resource of care service systems that include humans to create values [7, 22, 23]. New technologies have been integrated in its physical/technical environment that functions in coordination with other actors such as seniors, caregivers, and family members, which contributes to improving service quality and the seniors' quality of life [7]. The recent advancement of information technologies such as artificial intelligence and robotics has identified additional autonomous behavior, requiring further consideration regarding more active roles of technologies in the care service systems. For example, Čaić et al. [5] have introduced three functions of socially assistive robots in the care services: safeguarding, social contact, and cognitive support. As technologies take a more important and independent role in the service systems, how to integrate and operate them has become a serious issue, including its ethical consideration [24, 25]. Otherwise, the values in the care service systems are destructed among the actors [5].

B. Development and Integration of Care Technologies in Service Systems

Various studies have discussed the care technologies' development and integration in services. A major approach in technology development has been user participation. Participatory design or co-design, a design approach to involve users in technology development, has been commonly adopted for healthcare technologies [6, 26]. For example, How et al. [6] have introduced a co-design project of telerehabilitation technologies with clinicians. More recently, a living lab, designed as "user-centred, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings" [27], has been adopted to foster user-led innovation of the care technologies [28-30].

For the care technologies' integration in the service systems, the actors' roles within them are crucial. Caregivers usually take a key role in this process. The technology integration does not work effectively merely with the top-down approach [31]. Accordingly, an employee-driven approach has been emphasized when innovating service processes through the care technologies [32]. In addition, seniors are also considered as important actors in the technology integration. They not only act as design informants of technologies, but also adapt to them and co-create values within the service systems [5]. Moreover, the care service systems function in collaboration with multiple actors [33]. Hence, the overall service system needs to be reconsidered for an enhanced technology integration [12]. Edvardsson et al. [34] highlight the key strategic factors for service system development including service development strategy, formalized development process, customer co-creation, and the use of integrated development teams.

While the care technologies' development and integration approaches for service systems have been discussed in the existing literature, there are few empirical studies on the care technology developers' business practices. Lanne et al. [13] interviewed the care technology business managers in Finland to investigate the promoting and hindering factors of the care technology integration from the service ecosystem perspective, emphasizing the importance of effective collaboration, demonstrating benefits, customer relationship, and societal and operational frameworks. Pekkarinen et al. [14] further examined the research and development (R&D) and service actors in Finland using a questionnaire survey to clarify the accelerating and hindering factors of technology integration, such as care culture and funding. These studies are beneficial; however, further empirical investigation on care technology developers with rich business experiences is desirable to clarify their required actions to promote technology integration corresponding to different types of businesses and the associated technologies.

III. Research Methodology

This research conducted a multiple case study of the care technology developers in Japan [35]. Japan has been actively promoting care technology development and commercialization [13, 16, 17]. Therefore, valuable insights could be expected from the companies. This research employed purposive sampling, aiming to maximize the sample's variety [36]. It selectively sampled cases with considerable experiences of the care technology businesses (at least five years), considering the diversity of their businesses and technologies. Furthermore, we received some recommendations from a care robotics research expert who was aware of the care technology industry.

We conducted in-depth, semi-structured interviews for six cases with eight interviewees in total. The interviewees included diverse individuals, ranging from junior managers to executives, who managed their care technology business. The interviews were held from November 2020 to September 2021. All the interviews were conducted through a web meeting system, each of which lasted for approximately 90 minutes. Table I presents detailed information on the cases and the interviewees. The main questions in the interviews comprised: the history of the company and the care technology development, technology features and the related services, the business models, how to engage with customers and collaborate with the other stakeholders, and the promoting factors of care technology integration. The interviews were voice-recorded and transcribed. The transcription data and the interview notes were employed as the main and supplementary sources, respectively. The specific information on the company and the technology profiles were obtained from the materials provided by the interviewees and the websites of the care technologies or companies.

The interview results' analysis was conducted using a qualitative thematic analysis [37] on the MAXQDA2020 software. Qualitative thematic analysis is "a method for identifying, analysing and reporting patterns (themes) within data" [37]. This analysis starts with getting familiar with data and putting codes to them. A code is "a word or short phrase that symbolically assigns

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a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data" [38]. We adopted the inductive coding strategy [37, 38] that is conducted without the prepared coding frame, while taking the research questions (the required actions for the technology developers) into account. The coding process was mostly conducted by one of the authors, while the others reviewed the coding results for assessing and confirming them [38]. After coding the data from the individual cases, we categorized the codes and structured a set of themes through revisions [37]. Thereafter, we compared the cases based on the themes [35].

IV. Case Description

As shown in Table I, this study analyzed the following six cases:

- Case A

Case A was about a start-up providing a medication information technology (IT) service for seniors. They developed their own application that was provided to the care service providers. Although their business has been in the launching phase, the executives interviewed had an extended experience in pharmaceutical industries and were knowledgeable about the characteristics of the elderly and the care service systems in Japan.

- Case B

Case B was regarding recreation services for seniors at care facilities. Service robots were applied to interact with them using registered programs. The interviewee engaged in this business.

- Case C

Case C was concerning the IT company that manages the care information systems. Its key feature was having a strong cooperative relationship with a care service provider as well as co-developing their systems and services involving the care facility employees. In addition, this company explored and sourced new technologies from other companies or start-ups. The interviewee was a junior manager for business development.

- Case D

Case D was about an organization dealing with various care equipment for seniors. They provided products by both developing and outsourcing. The interviewee's work included marketing and new product development.

- Case E

Case E was concerning a small and medium-sized enterprise, offering personal assistive devices for mobility. It separated from the parent company that developed the original product. The interviewees were two executives who had started the product and business development.

TABLE I
SUMMARY OF THE CASES

Case	A	B	C	D	E	F
Size	Start-up	Large	Large	Large	SME*1	Individual
Products	Medication information technology system	Service robot	Care information system	Care equipment	Personal assistive devices	Consumables, assistive devices
Main business type	B2B*2	B2B	B2B	B2C*3	B2C	B2C
Interviewees (number: position)	2: executives	1: junior manager	1: junior manager	1: junior manager	2: executives	1: expert of care technology business

*1: Small and medium sized enterprise, *2: Business-to-business *3: Business-to-consumer

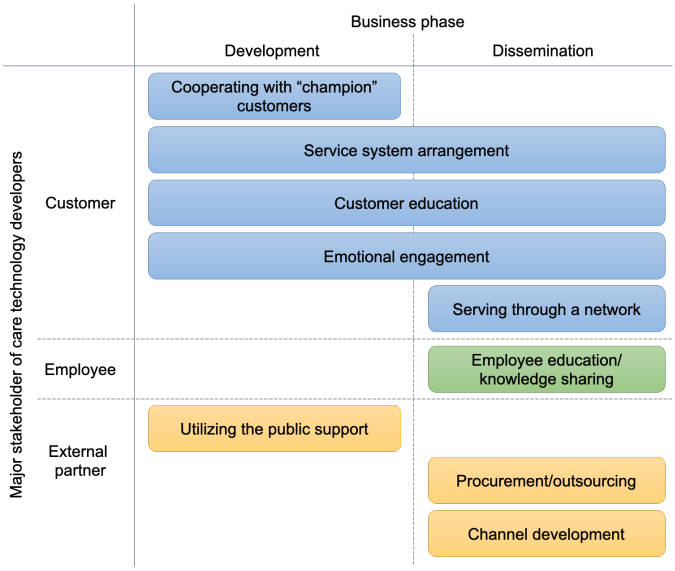

Fig. 1. Required actions for the care technology integration

- Case F

Case F was an expert of the care technology business, who previously worked for the care technology developers. This professional was knowledgeable about the care product business, specifically consumable items and assistive devices. In addition, the expert used to manage the user community for product testing.

V. Findings from Individual Cases

Through the analysis, we identified nine actions aiming to promote technology integration. They correlated with two types of categories: the main stakeholder for the technology developers including customer, employee, and external partner; and the business phase of the care technology, including development and dissemination phases (Fig.1). The development phase indicates that the target technology is still under development or testing toward commercialization. The dissemination phase means that the target technology has already been commercialized and is promoted to expand its use and the overall business. Table II shows the details of each action.

A. Customer-related actions

The customers, seniors in the business-to-consumer (B2C) cases as well as care service providers and care personnel in the

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TABLE II
DETAILED ACTIONS FOR TECHNOLOGY INTEGRATION

Action	Details
Cooperating with the "champion" customers	- Co-creating solutions with customers - Cooperating with customers with "true motivation" - Collaborating with an intermediator in the customer organization - Having a long-term partnership
Service system arrangement	- Analyzing and redesigning service processes for integrating technologies - Involving customers and other stakeholders - Exploring new roles of technologies in care service systems and arranging the human-technology collaboration
Customer education	- Providing sufficient lectures and training - Controlling customer expectation toward technologies
Emotional engagement	- Developing positive attitudes and attachment to technologies - Obtaining support from the surrounding stakeholders
Serving through a network	- Providing digital services associated with the technology (e.g., software upgrading) - Utilizing remote communication with customers (e.g., remote training)
Employee education/knowledge sharing	- Arranging employee education for technology integration - Sharing knowledge on technologies and customers within a company
Utilizing the public support	- Receiving the public supports such as expert assistance for technology assessment and partner matching
Procurement/outsourcing	- Procuring technologies and outsourcing corporate processes to extend the business capability
Channel development	- Providing resources for the distributors to assist the product and service delivery - Promoting their products at the place for experience (e.g., exhibition) - Forming relationships with professional communities for collecting the market information

business-to-business (B2B) cases, were crucial actors in the care technologies' development and integration. The interviewees' firms conducted the following actions related to their customers.

- Cooperating with the "champion" customers

Cooperation with customers, specifically the "champion" ones (according to the Case A's interviewee) was considered as a significant success factor by most interviewees. Here, "champion" indicates the consumers with strong motivations to solve problems in care by adopting new approaches. Several interviewees described such customers as follows:

"(It is important to) proceed together with the champions, who want to improve the current quality of the dementia care." (Case A)

"It worked effectively to cooperate with customers in which the occupational therapists and the others wanted to do it, considered it fun, and were positive toward it if needed." (Case D)

"... not old-fashioned, conservative people to new things, but those who are willing to do something new and challenging are very grateful for us." (Case B)

With these customers, the interviewees could co-create the solutions. Regarding Case B, technological specifications and the required IT literacy were clarified through cooperation with customers. In such a collaboration, the role of the intermediator in the customer organizations was emphasized by several interviewees. The intermediator communicated with the care staff and the care organizations' management, translating the terms of the technology developers and the care organizations. They shared a good relationship with the company's stakeholders and possessed knowledge regarding the organizational structure and processes. Sufficient knowledge on care technologies was also an important skill for them. In Case C, the partner care provider had its own division of system development that led the project. According to its interviewee, an important requisite of intermediators is "know who" have ideas or issues rather than an actual experience in care.

Having a long-term partnership with such customers is valuable, however, somewhat controversial. In Case C, the developer and the care organization agreed for a longstanding collaboration, cooperating with each other at the daily operation level. The interviewee in Case E also mentioned the significance of continuous feedback from the champion customers for further sales. Additionally, Case F implied the importance of an individual monitor group for the development of the technologies. Meanwhile, the interviewee in Case D questioned the effectiveness of feedback from the easy-to-contact customers because their evaluation tended to be superficial and affected by a courtesy bias. Hence, the motivation of customers was important for supporting the technology development and integration. In addition, the champion customers were good sources of reputation for the other ones. Several interviewees expected them to disseminate good reputation.

The cooperation with the champion customers was especially crucial in the development phase of the care technology business to establish the technologies for disseminating them to others.

- Service system arrangement

Regarding the technology integration, the interviewees focused on how a service should be arranged including technologies. First, the analysis of the service processes at the care workplaces was mentioned as the starting point. While some types of services have fixed procedure, in which the care technology is easily adopted, the care workplaces with complex work procedures need a comprehensive analysis to clarify the requirements for technologies that align with the service processes within the care service systems. The cooperation with the care personnel is significant in arranging service systems. Several interviewees introduced the experiences of the co-development of the technologies and service processes with the care personnel, especially regarding the champion customers. Moreover, according to the interviewee in Case C, it was essential to specify the key performance indicators such as labor productivity and the available time for care when adopting technologies. They also requested the intermediator to promote the technology integration by informing the care staff of the technology adoption's direction as the managerial decision.

Involving other stakeholders, such as the family, was mentioned as another approach to develop new service systems. In Case A, the interviewee mentioned the importance of the family's motivation to a continuous use. Regarding Case C, a new function to send a letter to the senior's family about the day care services' activities was established based on the care recording system. This provided another value to the family.

The interviewee in Case B indicated that their products could adopt novel roles in the existing service practices. For example, their robot could promote communication with seniors; they mentioned the following:

"Our communication robots were expected to promote conversations, and actually the communication from them motivated the seniors to take actions, such as social participation and self-care.... We asked the care personnel how they started talking with seniors and implemented it in the robots. Consequently, and very interestingly, they listened to the robots, in some cases, rather than human personnel". (Case B)

However, they also highlighted the human role's importance in technology integration.

"By setting a role (of the robot) and arranging the human interventions on a case-by-case basis, I think that the robot could be utilized for a long time." (Case B)

The interviewee in Case C emphasized that customers need to be aware of the necessity of their service process change for technology adoption. According to them, customizing new technologies for each customer's process could be harmful for both the technology developer and the customers; it is significant to change their service process to also adapt it to the technology.

"... If we try to customize a new technology for a customer, their business process will only be limited to them. Although it might be good for the customer, it would be expensive; further, when they attempt to introduce a novel system, they need to take care of the legacy. Instead, if their business process is restructured when the new technology is installed, their payment will decrease. Thus, we basically work with the customers by analyzing and changing their processes." (Case C)

The service system arrangement is a crucial process to clarify the care technology's role not only in the care technology's development phase, but also in the dissemination one, where the technologies are accepted in different service systems.

- Customer education

Customer education is known to affect the perceived service quality and trust regarding services [39]. Many interviewees emphasized the importance of lectures and trainings for customers, especially in the B2B, for an enhanced utilization of the care technologies that are important for both development and dissemination phases. Since the research was conducted after the outbreak of COVID-19 pandemic, some interviewees introduced online lectures and provide the relevant information.

In addition, several interviewees stated the significance of controlling customer expectation. They intended to decrease the customers' over-expectation toward the care technologies' functionalities.

"...thus, when we enter the test facility, we always instruct the staff to have a one-week long training period and to understand what the technology can or cannot do; further, we request them to avoid misunderstanding that everything can be done using this technology in the early phase. If they do not comprehend it, it will be difficult for them to accept the technology." (Case B)

The interviewee of Case D also mentioned the importance of the test use's follow-up feedback.

"This is the development of a new product; hence, we cannot tell whether it is appropriate or not. Especially regarding the welfare products, it is impossible to tell to whom they will fit. Therefore, we basically have an interview with the test users and understand the aspect that is inappropriate... and we provide feedback to them when and how the product is commercialized, and how it has worked in different places." (Case D)

Moreover, according to Case B, it is meaningful to allow the service robot to make an excuse, which makes users feel empathy for it.

"In addition to understanding what the robot cannot do, we allowed it to communicate it. The robot can say, "I could not hear you properly" and "My ability is insufficient." Showing the weakness or imperfectness occasionally becomes an advantage of the product; thus, (it is important to) explain it to the customers to gain some understanding from them." (Case B)

- Emotional engagement

In addition to the technologies' functional aspects, obtaining emotional engagement from users was mentioned as a key success factor of technology integration. Many interviewees attempted to make their products more attractive and well-designed. Especially regarding the service robots in Case B, how to develop the attachment of the users to them was explored. To nurture the supporters in the customer organization and change the attitudes toward the robot is an effective approach for the technology development and dissemination.

"Interaction is extremely important. Unless users have the attachment to the robot and acquaint themselves with it, they cannot obtain its efficient use for the facility. The robot can remember the names and faces ...; thus, we primarily let it learn all the staff's faces and communicate with them. The staff notice, "Ah, it hears me talk," which motivates them. Letting them say, "Oh, it is lovely!" is our goal. When we achieve it, the staff learns how to use it by reading the manual or by asking us." (Case B)

The interviewee of Case B revealed that the robot's personalization is exceedingly important for maintaining the long-term attachment. In addition, the family's role was

highlighted for the technology integration. The interviewee of Case A mentioned, "The family is a driver, and with their support, the care facility will cooperate," and highlighted the feeling of fun for the surrounding people and the "positive aspects of carers" as the sales points.

- Serving through a network

The importance of digital services was mentioned by some interviewees. For example, Case B adopted the upgrade service for the service robots to add new contents. They expressed the difficulty in the traditional product selling business and the importance of a continuous service provision.

"We provide the upgrade service with some fee. It is our advantage that we provide both hardware and software... Overall, it is difficult for us to continue the technology development relying only on the product sales. We also need to offer maintenance and some additional development continuously... it is necessary to collect some amount of fee for it." (Case B)

Regarding the other types of network-based services, a remote training was mentioned in the interview. Especially under the impact of COVID-19, face-to-face contacts became impossible even with the care personnel. According to the interviewee of Case C, it was a new opportunity to provide an innovative type of service.

"… (remote training has been) accepted and our work has become more efficient…those who were absent from the session could access the recorded material." (Case C)

This digital service is especially effective in the dissemination phase of the care technology business to make the technology integration process more efficient and satisfactory.

B. Employee-related activity

The interviewees specifically mentioned the employees' knowledge in the care technology developers as a major capability for the care technology integration.

- Employee education/knowledge sharing

The employees of the care technology developers were required to have sufficient knowledge regarding aging, seniors' life, and care services. In the company of Case D, all the sales staff were certified welfare equipment consultants. The employees' education was highly encouraged. In addition, the importance of knowledge sharing about the technology use was also stated by the interviewee.

"I ask the sales staff about the good use cases of technologies. Additionally, I collect the information on the proper and creative use cases, and conversely, share it with them as a use case recommendation." (Case D)

These actions are crucial, especially when the technologies need to be disseminated, because more human resources with sufficient capabilities are required in that phase.

C. External partner-related activities

The interviewees also mentioned the needs for cooperation with external partners who support solution provision. Here, we extracted three major actions: utilizing the public support, outsourcing/procurement, and channel development.

- Utilizing the public support

Several interviewees considered the public support for the technology development as valuable. Regarding effective support for the developers, expert assistance for technology assessment and partner matching were mentioned.

"... care insurance department in the municipality supported us... group homes and care residents were picked up; we were able to extract the problems by renting our products for two weeks..." (Case B)

"Companies do not have a mechanism for the ethical review processes that were supported by..." (Case B)

These supports are preferable in the development phase when the care technology developers are unaware about the process of developing the care technology businesses.

- Procurement/outsourcing

Some interviewees mentioned the procurement of external technologies as part of their technology lineups. The company of Case C had the function of venture incubation and funding to explore care technologies within or outside Japan. It is worth mentioning that the procurement of technologies and outsourcing corporate processes could be an effective means to extend their capabilities to support seniors and care service providers, which is especially important in the dissemination phase.

- Channel development

In the dissemination phase, it is significant to establish channels to deliver information, resources, and products for external partners to provide products and services broadly. For example, many interviewees mentioned the difficulty in letting customers know their products and services; they attempted to perform various actions to utilize the external resources for this process. For instance, it is helpful to have the potential customers experience their products at exhibitions.

"It is easy for the customers to understand the benefit (of a product) by experiencing the demo at exhibitions." (Case E)

The interviewees indicated that the report of customers' experiences impacts other potential clients. They attempted to disseminate the story of experiences through the external media and partners. The relationship with the care professional communities were also effective in collecting the market information.

"A study group of future technologies for community-based integrated care was launched and various care reports on the communication robots were conducted. We participated in such occasions actively and collected various opinions... We have

been keenly attempting to disseminate our cases to the others." (Case B)

"There is an association that the welfare equipment providers belong to. Furthermore, there is another group of welfare equipment consultants. All technology developers are the supporting members of such an organization, wherein several information exchanges are conducted." (Case F)

Technology and service distribution has also been an important issue. The companies have developed a supply chain network and provided the required resources to distributors.

"It was difficult to develop the nation-wide support network from scratch considering our company's size; thus, we made agency agreements with the welfare equipment distributors and allowed them to sell products and provide support to the rental service workers across the country..." (Case E)

"We provided supply parts for maintenance to the rental service providers. In addition, we offered lectures and manuals for maintenance to form a support system with them." (Case E)

VI. Findings from Cross-Comparison among Cases

This section compared the cases from the recommended actions' aspect introduced in the previous section. Table III shows the comparative result. The cases were compared using several aspects, which have been described as follows:

- Generally required actions

In every case, cooperating with the "champion" customers was found to be effective for technology integration. This collaboration provided an improved fit to the customer needs and generated confidence in their solutions. In addition, every case adopted customer education. These actions seemed essential for the technology developers to promote technology integration.

- Business types

For the technology developers of the B2B businesses (Cases A-C), the service system arrangement was an essential process in their work. Their direct customers were care service providers. Hence, they needed to integrate technologies in the customers' service processes. In addition, serving through a network was also stated in the interviews of two B2B cases. An action specifically mentioned by the B2C cases (Cases D-F) was channel development. In many cases, their products or services were sold by their distributors that may have caused higher needs for the channel development.

- Company sizes

The large companies (Cases B-D) referred employee education/knowledge sharing and procurement/outsourcing as the promoting actions regarding technology integration. The companies in Cases C and D not only develop technologies for themselves but also procure ones from other companies. These acquired technologies were also a part of their solutions that could require more knowledge on care and technologies for providing well-fitted solutions. The interviewees of larger companies also mentioned serving through a network and channel development.

TABLE III
COMPARISON AMONG THE CASES

	A	B	C	D	E	F
Cooperating with the "champion" customers	✓	✓	✓	✓	✓	✓
Service system arrangement	✓	✓	✓			
Customer education	✓	✓	✓	✓	✓	✓
Emotional engagement	✓	✓			✓	
Serving through a network		✓	✓			
Employee education / knowledge sharing			✓	✓		
Utilizing the public support		✓			✓	
Procurement / outsourcing			✓	✓		
Channel development		✓		✓	✓	✓

- Product types

Among the technologies in this study's cases, the ones requiring in-depth interactions with seniors seemed to require an emotional engagement; its targets not only comprised seniors, but also their surrounding people, including their family and the care personnel. In the interviewees of Cases A and B, their technologies were difficult to assess their values; hence, an emotional acceptance was essential.

VII. Discussion

A. Required actions for the technology integration

This study aimed at clarifying technology developers' required actions for technology integration in care services. First, this study illustrated the importance of cooperation with the customers for technology integration. The interviewees' views were consistent with the existing studies on care technology integration [5, 12]. The detailed elements mentioned in the customer cooperation, such as motivations, knowledge on customers, and long-term relationships have been known as important factors for co-creating values with the customers [39, 40]. It was also notable that the interviewees of the B2B businesses emphasized the service system arrangement that should be more highlighted in the care technology businesses. Another interesting finding of this study was the intermediator's role to interpret the discourse about technology and care practices. This has been insufficiently discussed in the existing studies on the care technology development.

The technology developers' strategy to control over-expectation toward technologies is another example that aligns with the existing research outcomes. The theoretical model of service quality includes prior expectations toward a service, thus affecting the overall service quality [41]. The interviewed developers had exercised this principle regardless of their knowledge on service quality. Overall, the service quality's research could help the technology integration process as a practical implication.

While the existing studies mainly discussed the service system development in collaboration with the customers, this research's findings extend its focus to the organization's actions for disseminating their businesses, which is an important contribution of this study. More concretely, the results

demonstrated the technology developers' intention to make the technology integration process more efficient. For example, the interviewee in Case C highlighted the top-down initiative's role to integrate technology, while a sufficient understanding of the care practices is considered essential. The comment that an excessive customization of the care technologies could become harmful for both technology developers and care service providers is noteworthy. Through the collaborative development of the care technologies and the associated processes to provide services, the developed service offerings are productized and delivered to the other customers, thus contributing to both the technology developers and the customers [42]. Watanabe et al. [43] also emphasized the importance of packaging a technology with the associated activity guideline and application process for disseminating the impacts to other service systems. This study's implication covered the external partners within the care technology development and integration activities. Although the collaboration with the external actors seemed evident in business development, it has been insufficiently stated in the context of the care technology development and integration. The future research needs to investigate this broader ecosystem perspective further.

It was also notable that the remote service received greater acceptance under the COVID-19 situation. This digital shift driven by the reaction toward the pandemic has already been reported in the recent studies [44, 45]; nevertheless, this research provided new evidence of this shift. In addition to it, the digital servitization strategy [46], aiming at increasing the diversity of the business models of manufacturers through digitalization, could be an effective approach for the long-term utilization of technology; this has also been exemplified in the case of the remote software update. The research connecting digital servitization and care technology is still emerging [47], and this study has indicated the future research potential of this domain.

The care technologies are expected to provide functional values in the care services; however, this study highlighted the emotional engagement that is also an interesting finding and corresponds appropriately to the existing literature on the service robots in general [11]. While there is a discussion on the robot behavior to attract customers emotionally from the ethical perspective [48], it has helped them accept the technology in the care work, thus contributing to the sustainability of care.

B. Differences in the required actions for the technology integration

This study also revealed the differences in the actions performed for the technology integration depending on the business models, firm sizes, and product types. Although the findings have been based on limited sample cases, they have provided new insights for the technology developers.

The cooperation with the champion customers and the customer education were mentioned in all the cases, indicating that these actions nurturing mutual understanding and contribution between the technology developers and customers would be the general success factors for the care technology businesses. The required actions for different business types would indicate the difference in the challenges for the technology integration. While the arrangement of the service processes and organizations has been emphasized in the technology integration in the B2B settings, the channel development would be the main concern for the B2C technology developers. The employee education/knowledge sharing and procurement/outsourcing required for the cases of large firms have implied that the capability development would be specifically crucial for such companies that need to expand their business scales. Finally, emotional engagement has been highlighted for products mainly interacting with individuals. Emotion is known as a resource for creating values [39]; hence, this action is considered to promote the technology integration. These differences provide meaningful implications for the technology developers arranging their technology integration process of the care technologies.

C. Limitation

This study was based on a limited number of cases; thus, further case studies need to be considered, especially for an enhanced understanding of the differences in the required actions taken for different customers and products. In addition, studies focusing on other stakeholders, such as care service providers, seniors, and their families will provide multifaceted views to the result of this study. Local care policies, regulations and cultures also affect the business of the care technologies. Although the impact of these institutions has been addressed in the existing studies [5, 7], further research is required.

VIII. Conclusion

This study investigated the required actions for the technology developers to integrate the care technologies in the care services for the welfare systems' sustainability. Through the multiple case studies of the technology developers, we identified nine required actions for technology integration that were related to the main stakeholders (customer, employee, and external partner) and business phases (development and dissemination).

The action items listed in this study are practical contributions to the business managers of the care technology businesses for the actual technology integration processes. This research also extended the care technology integration's focus to the required actions to disseminate the care technology businesses. In addition, some differences in actions were observed for different types of customers, products, and firm sizes, which is also a novel insight.

Regarding the future research, further studies on care technology developers are warranted to generalize and diversify this study's results. A multi-stakeholder analysis for assessing the impacts of the action items from the different viewpoints would also be an important research topic. In addition, cross-national and cross-cultural studies would promote the international technology transfer to broaden business opportunities and moreover to make the global welfare system more sustainable.

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