Online Academic Event Interaction Platform: Case Studies in Three Japanese Domestic Conferences

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Abstract

Due to the COVID-19 crisis, many collaborative activities including academic events have been held online. The purpose of this study is to contribute to serviceology by summarizing the findings on online academic events and the online interaction platforms (OIPs) as their service encounters. In this paper, we first outline how each OIP, such as Zoom, oVice, and Slack, was chosen in three online academic events, which we actually operated, in terms of the interaction manner of each session. After reporting on the OIP log analysis and questionnaires, we discuss the comparison between on-site venues and the OIPs as well as the usage barriers and social acceptance of the OIPs. The findings include (1) the functions that OIPs should provide especially in peripheral states of interaction process, such as "seeping-out" of the lively atmosphere, "looking around and listening in" in poster sessions, and "spontaneous interaction among participants," have more than minor impacts on the evaluation of OIPs, (2) the degree of acceptance of OIPs depends on the balance of various factors such as usage barriers, maturity, familiarity, accessibility, and risks, in addition to the various values provided for synchronous and asynchronous interactions, etc.

Keywords

Online academic event, Online interaction platform, Post-COVID society, Case study

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1 INTRODUCTION.

The introduction of online interactive platforms (hereafter, OIP) for telework and online meeting has rapidly advanced due to the impact of the COVID-19 crisis, and the state of telework in the post-COVID society has been actively discussed [1]. A questionnaire survey has been conducted to understand the current status of telework and online meeting as a basis for such discussions [2]. The survey (4,343 respondents) showed that the frequency of telework and online meeting increased with the COVID-19 crisis and that satisfaction was generally high, while the following two issues were suggested regarding OIP.

(1) Compared to on-site (actual workplace), OIP does not provide enough functions and values for interaction (e.g., the agenda is narrowed down, chit-chat is not allowed, topics are not expanded, it is difficult to build new relationships, it is difficult to foster creativity that comes from human interaction, and it is difficult to grasp the overall atmosphere of the place).

(2) Although the use of OIP has been promoted by necessity, problems related to barriers to its use and social acceptance exist to a non-negligible degree (e.g., meetings do not proceed smoothly due to OIP malfunctions, preparation in advance and ingenuity are required while building up knowledge and skills related to OIPs, etc.).

On the OIP, interactions for collaboration take place. Here, collaboration is "the creation of new value through the collaboration of multiple people, which is impossible or extremely difficult for one person to achieve alone" [3]. In the general hierarchical model of collaboration shown in the upper left of Figure 1 [4], co-presence, which is "a state in which multiple people can recognize each other's state," is the basis of the model, and awareness regarding people and places/spaces (situations/atmospheres) is made possible through co-presence. Furthermore, co-presence and awareness enable and promote sharing and collaboration.

OIP supports co-presence and collaboration in synchronous/asynchronous distributed environments among the four types of environments as shown in the lower left of Figure 1 [4]. In this study, we assume that issues (1) and (2) related to OIP and the general hierarchical model of collaboration are related as shown in Figure 1. Based on that, we will proceed with each discussion under the assumption that issues (1) and (2) are common issues related to co-presence in collaboration in a synchronous/asynchronous distributed environment,

Table 1. OIPs used for each event and their purpose of use.

Event title, Event period, Participation fee			HARCS2020 (HARCS) 2020/11/20 (One day), Free		HCG Symposium 2020 (HCGS) 2020/12/15-17 (Three days), Paid			The 9th Annual Japanese Conference of Society for Serviceology (JCSFS) 2021/3/9-10 (Two days), Paid		
Interaction mode			One-to-Many	Many-to-Many	One-to-Many	Many-to-Many		One-to-Many	Many-to-Many	
Session category			Cat-T	Cat-I	Cat-T	Cat-I	Cat-S	Cat-T	Cat-I	Cat-S
Types and number of sessions			7 Invited lectures 1 Panel discussion [Single session]	46 Posters [Single session]	8 Invited lectures 55 Oral presentations 1 Panel discussion [Parallel session: Max 2]	69 Interactive presentations [Single session]	Social gathering	5 Invited lectures 32 Oral presentations [Parallel session: Max 3]	27 Posters [Single session]	Social gathering
Online interactive platform (OIP)	Synchronous distributed environment	Zoom	Invited lecture, Q&A, Panel discussion [Webinar]	Short video streaming [Webinar]	Invited lecture, Oral presentation, Q&A, Panel discussion, Award ceremony [Meeting]	N/A	N/A	Invited lecture, Oral presentation, Q&A, Award ceremony [Meeting]	Instruction, Q&A [Break-out room]	N/A
		oVice	N/A	Instruction, Q&A, Chit-chat [Four floors]	N/A	Instruction, Q&A, Chit-chat, Short video [One floor]	Pleasant chat, Award ceremony [One floor]	N/A	N/A	Pleasant chat [One floor]
	Asynchronous distributed environment	Slack	Instruction, Q&A (including after-session), Instant material provision, Announcement		Instruction, Q&A (including after-session), Instant material provision			N/A		
	Web site		Announcement, Material provision, Program publication, Registration		Announcement, Material provision, Program publication, Registration			Announcement, Material provision, Program publication, Registration		

awareness and sharing through that, and implementation of OIPs.

The authors of this paper have been involved in the planning and operation of any or all of the following three academic events, all of which were held online due to the COVID-19 crisis: "Symposium of Human Augmentation Research Center 2020 (HARCS)" [5], "HCG Symposium 2020 (HCGS) organized by the Human Communication Group of the IEICE" [6], and "The 9th Annual Japanese Conference of Society for Serviceology (JCSFS) " [7].

Thus, we treat academic events as specific cases of interaction for collaboration and compare OIPs with on-site events based on subjective and objective data obtained at each event and our experience. In addition, we practically discuss the issues related to the usage barriers and social acceptance of OIPs, respectively, and summarize our findings on OIPs as service encounter [8] for online academic events. In this way, we contribute to serviceology.

Section 2 describes the structure of the interaction process and outlines the process of OIP selection and adoption for each session category of each event; Section 3 reports the descriptive statistics of the usage log of each OIP; Section 4 reports the results of the questionnaire conducted with the participants and Cat-I presenters (Note: the usage log records and questionnaires for each OIP were conducted in HARCS and HCGS, but not in JCSFS, because JCSFS used only Zoom as the OIP for synchronous interaction and did not employ any OIP for asynchronous interaction for the reasons described later.) In sections 5 and 6, we compare on-site venues and OIPs, discuss usage barriers and social acceptance of OIPs, and finally summarize the findings in section 7.

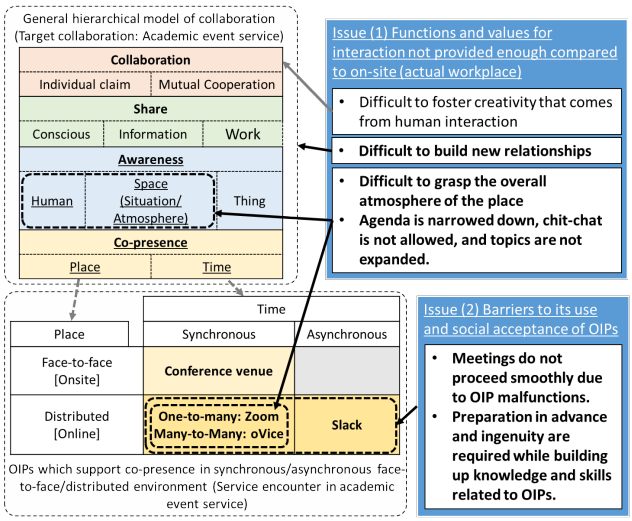

Figure 1. General hierarchical model of collaboration and issues of OIPs.

2 SESSION CATEGORY AND OIP

In this study, sessions of academic events are classified into the following three categories.

Session Category T [Cat-T] (Talk): Sessions in which a small number of speakers or presenters take the stage to give presentations, such as invited lectures, panel discussions, and oral presentations, and engage in interaction (one-to-many interaction) with a large audience in a question-and-answer session.

Session Category I [Cat-I] (Interaction): Sessions in which a large number of presenters and a large number of audience members are dispersed and engaged in interaction (many-to-many interaction), such as poster presentations and interactive presentations.

Session Category S [Cat-S] (Social): Similar to Cat-I, social sessions such as social gathering, reception, and banquets for many-to-many interaction

Table 1 summarizes the OIPs adopted for each session category of each event and their applications. The following subsections outline the process of OIP selection and adoption for each session category, based on the structure of the interaction process.

2.1 Interaction process at academic events

The interaction process at an on-site venue consists of several states. In this study, we categorize the interaction process into the states (a) through (f) shown in Table 2 and proceed with the discussion.

Table 2. Each state of interaction process and session category.

State of interaction process	Core state or Peripheral state?			Whose behavoir?	
	Cat-T One-to-Many	Cat-I Many-to-Many	Cat-S Many-to-Many	Participant	Presenter
(a) Grasping the degree of liveliness	Peripheral	Peripheral	Peripheral	✓	✓
(b) Look around and listen	Peripheral	Peripheral	Peripheral	✓	
(c) Calling out		Peripheral			✓
(d) Presentation/Explanation	Core	Core			✓
(e) Question and Answer	Core	Core		✓	✓
(f) Interaction among participants	Peripheral	Peripheral	Core	✓	

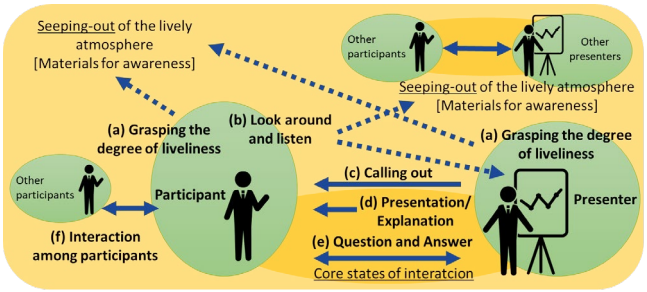

Figure 2. States of the interaction process in Cat-I

(a) "Grasping the degree of liveliness" is a state of perceiving the overall situation and atmosphere of a place. A crowded place may be easy to enter, while someone may feel more relaxed if the place is quiet.

(b) "Look around and listen" is a state in which participants collect information about presentations and discussions from a distance before deciding whether or not to start interacting with a presenter. In the case of Cat-T, it may be a case of deciding which room to choose in a parallel session. In the case of on-site Cat-I and Cat-S, the typical distance is the far phase of social distance (2 to 3.5 meters), according to the classification of interpersonal distance [9].

(c) "Calling out" is a state in which the presenter calls out to the participants as a trigger to start a presentation or explanation. These (a), (b) and (c) are called the peripheral states of interaction. In this study, the state in which materials for awareness of the number of people involved, the content of the interaction, and the atmosphere of excitement are obtained from outside the place where the interaction is in the core states described later, or these materials themselves are called "seeping-out". States (a) and (b) are also states in which the seeping-out is sensed and collected.

(d) "Presentation/Explanation" and (e) "Question and Answer" are literally the core states of the interaction, i.e., the state of presentation, explanation, or question and answer in Cat-T and Cat-I.

(f) "Interaction among participants" is a peripheral state in the Cat-T and Cat-I, but a core state in Cat-S. For example, there are cases in which participants discuss some presentation in Cat-T and Cat-I in the passage without the presenter. Figure 2 illustrates each state of the interaction process, using Cat-I as an example.

2.2 Session Category T and OIP

As an OIP to support co-presence in one-to-many synchronous interactions of Cat-T, we adopted "Zoom", which has become popular as an OIP and is expected to work stably, for all events [10].

HARCS selected the Zoom webinar because it is easy to control cameras and microphones even with a large number of participants. The program was organized as a single session, and the same webinar URL was used throughout the day. For questions and discussions, we asked participants to use the Q&A function of the Zoom webinar or to post their questions to each session channel on Slack, and the management staffs aggregated questions on Zoom into Slack, which is described later in section 2.5 [11]. In some cases, the chairperson selected a question and read it out, and the speaker answered it orally, while in other cases, the speaker or his/her representative wrote the answer in Slack at a later date.

For both HCGS and JCSFS, Zoom meetings were chosen because the number of participants was not as large as for HARCS, and it was assumed that many participants were familiar with online meeting. The program for both events consisted of single sessions for invited lectures and parallel sessions for oral presentations. Virtual meeting rooms were set up to simulate the on-site venue, such as Rooms A, B, and C, and the meeting URL for each room was used throughout the day. In HCGS, the URL of each room was not changed for three days. In JCSFS, the meeting URL was changed for each day because there was a one-day ticket.

The question-and-answer in HCGS was based on the same operation as in HARCS, but the actual operation was left to the discretion of each chairperson. In JCSFS, a combination of Zoom meeting chat, hand-raising, and microphone (oral statements) was used for question-and-answer at the discretion of each chairperson.

2.3 Session Category I and OIP

For HARCS and HCGS, we decided to use a 2-D virtual space dialog service as an OIP which supports co-presence for many-to-many synchronous interactions in Cat-I, focusing on reproducing functions and values in each of the states (a), (b), and (f) provided in the actual poster/interactive presentation venue, rather than on the degree of penetration and stability of the service.

We compared candidates such as "Remo," "SpatialChat," and "Gather," and adopted "oVice," which has just started service in August 2020 [12][13][14][15] because of the following reasons: freedom of spatial movement and placement of participants, conversation control by distance between users (e.g., conversation is possible just by approaching), high-quality audio and video, full support for participants in Japanese, and cost.

Accessibility for visually impaired people and participants who have difficulty with detailed 2D operations was another reason for adopting oVice. In the virtual space interaction service, each state of the interaction process shown in Table 2 and Figure 2 is realized based on the positional relationship and distance of participants and presenters.

This can be a cause of reduced accessibility. For example, operations such as spatial navigation tend to rely on visual information and require detailed operations such as pointing to a specific local area on the screen. oVice is no exception but provides an alternative method of issuing a URL containing coordinates (x, y) in the virtual space. This enables direct access to the destination, so we decided to post the URL including the coordinates in Slack and on the website.

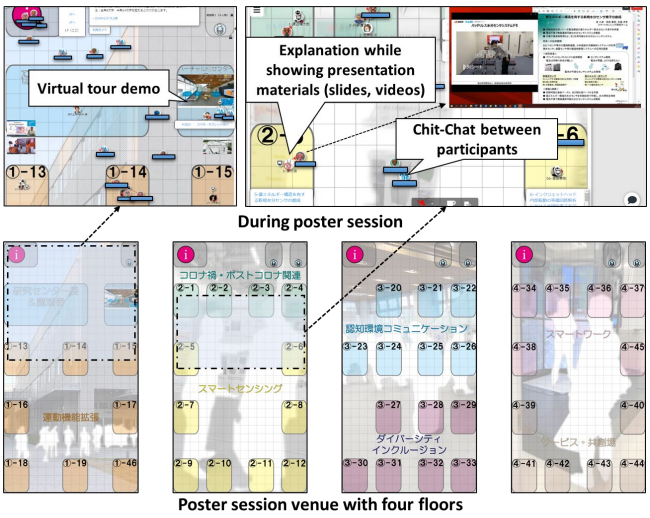

Figure 3. HARCS: Floor configuration with four floors in Cat-I (Max: 200 participants/floor, Comfortable: 35-50 participants/floor.)

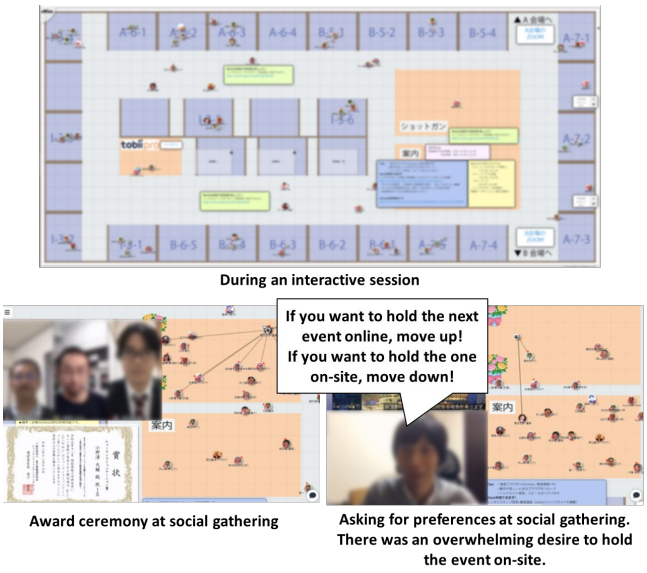

Figure 4. HCGS: Floor configuration with one floor.

Figure 5. JCSFS: Zoom's breakout rooms used in Cat-I.

For HARCS, oVice was configured with four floors, with the research themes divided into seven categories and poster presenters distributed among them (Figure 3), while HCGS was configured with one floor (Figure 4, top), according to the expected number of participants (Table 3). In both symposia, a short video of each presentation was provided to facilitate understanding of the contents of many presentations, and to make participants spend more time for synchronous discussions, as in a flipped classroom, rather than one-way explanations from the presenters.

For HARCS, the videos were distributed via Zoom webinar for participants who had difficulty using oVice. For HCGS, the videos were distributed via oVice and YouTube, and the URL of the videos was also announced on Slack [16].

JCSFS also considered adopting oVice or Remo, but we finally adopted Zoom's breakout room function. This function allows participants to interact with each other in multiple breakout rooms (in the example shown in Figure 5, each breakout room corresponds to each of 14 poster presentations). In the past, the host could only assign each participant to each breakout room or Zoom automatically assigned them in a random manner, but in September 2020, this function was updated to allow each participant to select breakout rooms of their choice. There were more than five months between this update and JCSFS (March 2021), so each participant was expected to have installed a breakout room-compatible version of the application. In addition, Cat-T and Cat-I can be held using only Zoom, which many JCSFS participants from academia and industry are accustomed to using. These are the reason why JCSFS adopted Zoom.

2.4 Session Category S and OIP

Cat-S, so-called "social events," were held in HCGS and JCSFS, and the social gatherings in HCGS are shown in Figure 4 below. At the on-site social gatherings, the participants repeatedly met and parted in a bottom-up manner, sometimes in one-on-one conversations, and sometimes in group discussions in a spontaneous, distributed, and cooperative manner. In order to naturally support such state transitions (a), (b), and (f), oVice is employed for Cat-S in HCGS and JCSFS.

2.5 OIP and website for asynchronous interaction

It was anticipated that it would be difficult to foster interaction networks among participants using only the current OIP-based synchronous interaction. Therefore, HARCS and HCGS employed the business chat tool "Slack" to support asynchronous interactions, which included posting of questions and answers during each session, aggregation of questions and answers posted on Zoom, questions and answers after the session and after the date of the event, immediate provision of materials (presentation slides, videos, etc.), and various announcements.

Websites were used for each event to provide information on the event, the venue (URL and how to use each OIP), and to distribute materials such as presentation slides and proceedings. In addition, for HCGS, "Peatix" was used for participation registration and an in-house system was used for presentation registration, while "Confit" was used for JCSFS to registration of both participation and presentation and to distribute materials [17][18].

Table 3. The number of participants.

		HARCS	HCGS	JCSFS
# of registrats		700	162	201
# of participants	Cat-T	518	150	No data
	Cat-I	214	125	No data
	Cat-S	N/A	25	31
# of max simultaneous participants	Cat-T	346	53	89
	Cat-I	139	61	No data
	Cat-S	N/A	25	31

Table 4. Participation rates.

		HARCS	HCGS	JCSFS
Ratio of # of participants to # of registrants (%)	Cat-T	74	93	No data
	Cat-I	31	77	No data
	Cat-S	N/A	15	15
Ratio of # of simultaneous participants to # of registrants (%)	Cat-T	49	33	44
	Cat-I	20	38	No data
	Cat-S	N/A	15	15
Ratio of # of participants to # of participants in Cat-T (%)	Cat-I	41	83	No data
	Cat-S	N/A	17	No data

3 DESCRIPTIVE STATISTICS OF OIP LOG

This section reports descriptive statistics on the usage log of each OIP recorded in HARCS and HCGS. The "number of registrants" and "number of participants" for each event, which were determined from registration information, usage log, and some visual observation, are shown in Table 3. Based on this table, "the ratio of the number of participants to the number of registrants," "the ratio of the number of simultaneous participants in a category to the number of registrants," and "the ratio of the number of participants in Cat-I and Cat-S respectively to the number of participants in Cat-T, which tends to attract many participants such as invited talks" were calculated (Table 4).

Figures 6 and 7 show the usage trends of Zoom and oVice. Figure 6 shows the time trend of the usage ratio from the beginning to the end of HARCS when the final number of registrants (700) is set as 100%. The results show a monotonic decrease in the number of users over time. Figure 7 shows the percentage of users during the three days of HCGS when the final number of registrants (162) was set as 100%.

In HARCS, since Zoom and oVice were used together in Cat-I, we also checked the usage status of each OIP. Although the accounts of each OIP were not linked, and the similarity of the account names was used to calculate the usage rate, 65% of the participants used oVice, and the remaining 35% used only Zoom webinars, which provided short videos of poster presentations (Note: The results of the questionnaire were 78% and 22%, respectively).

We graphically described Slack usage trends as in Figures 8 and 9. To do so, the ratio of the number of registered Slack users from the invitation URL to the final number of registrants, the ratio of the number of active users to the number of registered users on the date of the event, and the ratio of the number of posted messages to the number of messages posted on the date of the event were calculated respectively for each day.

Here, active users refer to users who viewed or posted messages in Slack on the relevant date. The display period for HARCS shown in Figure 8 was from November 9, 2020, the day before opening to the public, to December 18, 2020, when there was practically no more use of the system. Similarly, the display period for HCGS shown in Figure 9 was from November 30, 2020 to April 10, 2021.

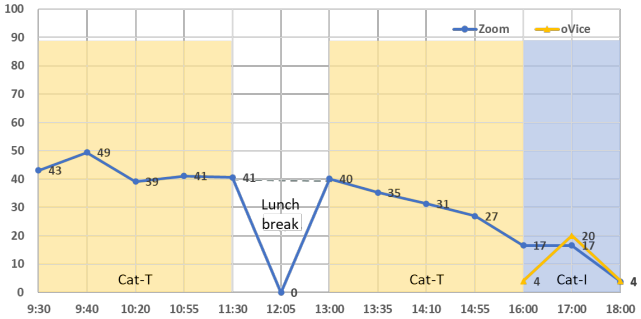

Figure 6. HARCS: Time trend of usage ratio from the beginning to the end when the final number of registrants (700) is set as 100%. (9:30-18:00)

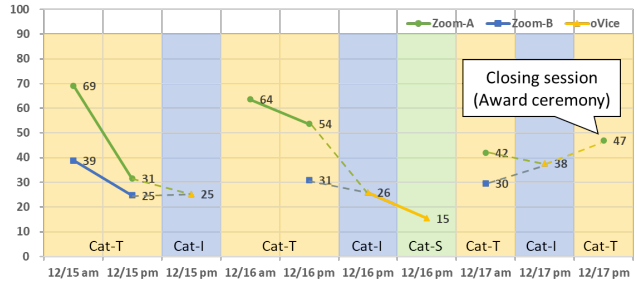

Figure 7. HCGS: Percentage of users for three days when the final number of registrants (162) was set as 100%. (2020/12/15-2020/12-17)

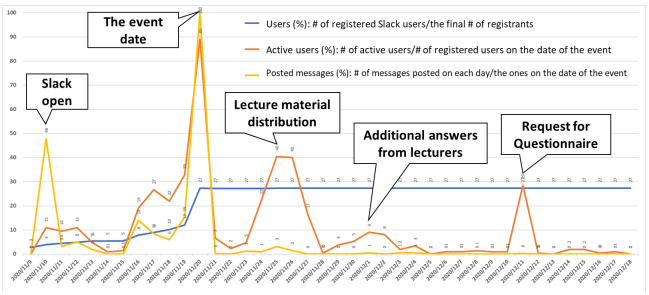

Figure 8. HARCS: Time trend of usage ratio (%) (2020/11/9-2020/12/18)

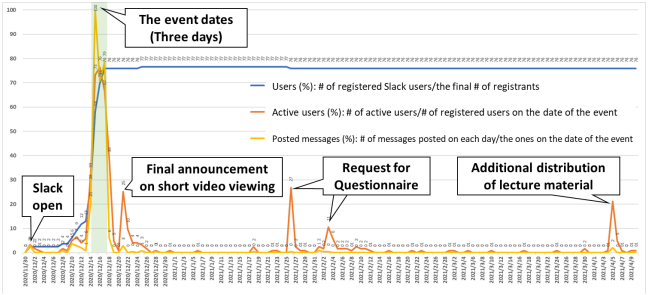

Figure 9. HCGS: Time trend of usage ratio (%) (2020/11/30-2021/4/10)

Table 5. The number of respondents and response rate.

Participants	HARCS	HCGS
Resistrants	700	162
# of respondents	130	40
Response rate (%)	19	25

Cat-I presenters	HARCS	HCGS
Presenters	45	68
# of respondents	28	31
Response rate (%)	62	46

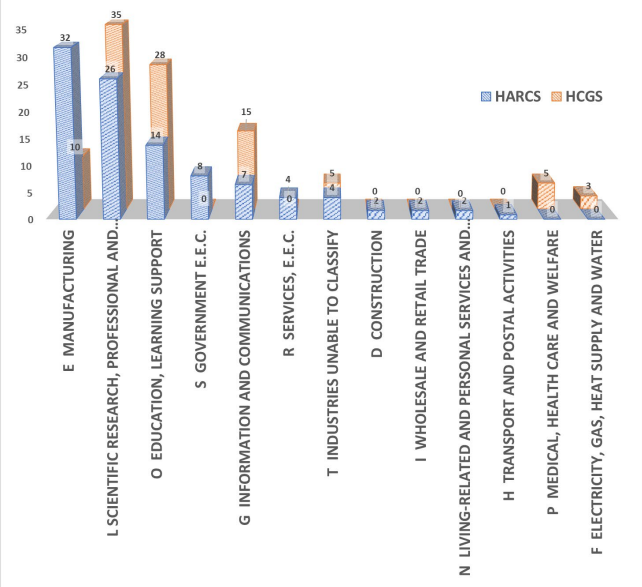

Figure 10. Industry distribution of the affiliations of respondents. (E.E.C.: Except Elsewhere Classified)

4 QUESTIONNAIRE

After each HARCS and HCGS meeting, a questionnaire was sent to the participants and to the presenters in Cat-I (Note: those questionnaires were subject to ethical review by AIST). The number of respondents and response rate are shown in Table 5, and only responses from respondents who gave their consent were regarded as valid ones. Google Forms was used to collect the questionnaires, but respondents who had difficulty using it were supported by e-mail [19].

Figure 10 shows the industry distribution of the affiliations of the participant respondents for each symposium according to the Japan Standard Industrial Classification [20]. 60% of the participants in HARCS came from the private sector, including manufacturing, service, and information and communications industries, especially with 32% from the manufacturing industry. The remaining 40% came from universities and research institutes. In HCGS, 63% were from universities and research institutes.

Figures 11 and 12 show the results of the participants' responses to the questions "Evaluation of each session" and "Barriers to using each OIP," respectively. Tables 6 and 7 summarize and categorize the open-ended comments from participants and Cat-I presenters, respectively. Figure 13 shows the participants' "behaviors related to question-and-answer in Cat-T."

In Cat-I, questionnaires were administered not only to participants but also to presenters. Figure 14 shows the participants' responses to the question-and-answer "Actions and evaluations during participation in Cat-I," and Figures 15 and 16 show the presenters' responses to the question-and-answer "Impression of presentation at oVice" and

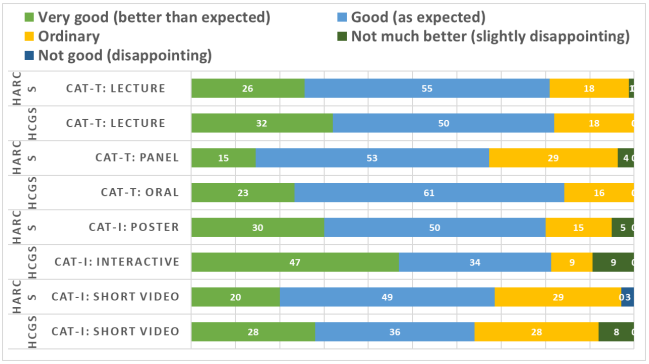

Figure 11. Participants: Evaluation of each session. (%)

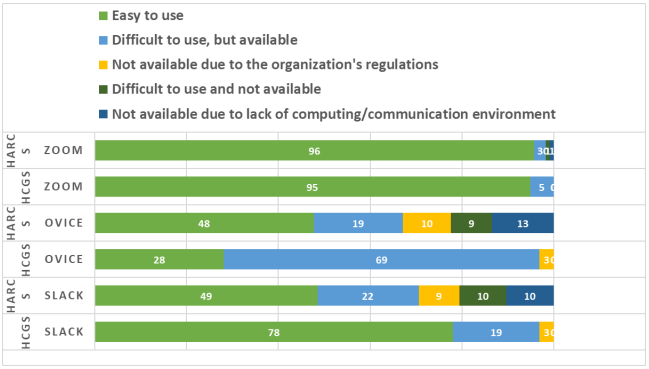

Figure 12. Participants: Barriers to using each OIP. (%) (Multiple responses allowed)

"Evaluation of oVice operation during presentation," respectively.

The presenters were also asked to respond to a questionnaire regarding their interaction experience, and the average number of participants per hour was calculated. In HARCS, the average number of participants who approached a presenter was about 2.9 persons/hour during a two-hour session. Out of these, presenters explained to 2.0 participants/hour and received questions from 1.8 participants/hour. In HCGS, during sessions lasting from 1 hour 15 minutes to 1 hour 40 minutes, the average number of participants who approached a presenter was about 4.2 persons/hour. Out of these, presenters explained to 3.6 participants/hour and received questions from 3.0 persons/hour (Note: The maximum of the answer options was "10 or more", and the average was calculated taking the maximum as 10, so the actual number is expected to be higher than the above.)

5 DISCUSSIONS FOR ON-SITE VENUES VS. OIP

In this and the next sections, based on the usage log and questionnaires, we discuss the comparison between on-site venues and OIPs, asynchronous participation, operational costs, usage barriers and social acceptance, accessibility, combined use of multiple OIPs, participation rates, and other issues. In addition, some discussions based on the knowledge obtained through the operation of JCSFS, which did not conduct detailed analysis of the usage log and questionnaire survey, are also included.

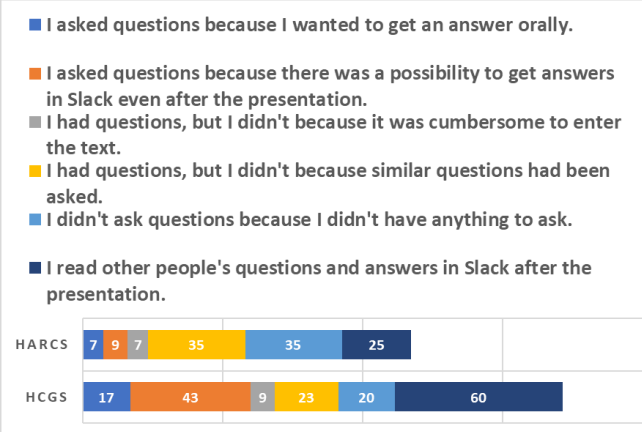

Figure 13. Participants: Behaviors related to question-and-answer in Cat-T. (%) (Multiple responses allowed)

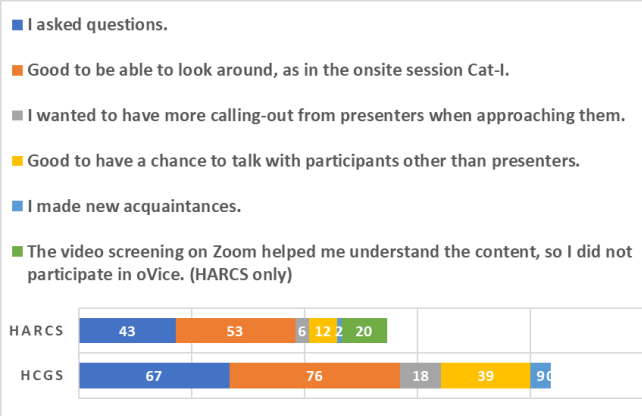

Figure 14. Participants: Behaviors and evaluations during participation in Cat-I. (%) (Multiple responses allowed)

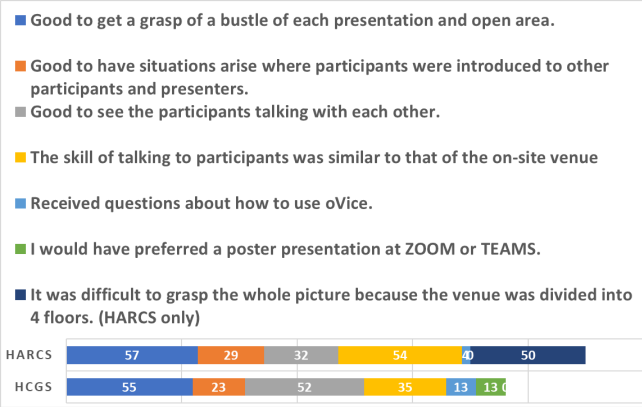

Figure 15. Cat-I presenters: Impressions of the Cat-I presentation with oVice. (%) (Multiple responses allowed)

5.1 Comparison of On-Site Venues and OIP in Cat-T

In the evaluation of each session by the participant respondents (Figure 11), Cat-T (Zoom) had the highest percentage of "normal" or higher in both HARCS and HCGS. Although it should be considered that the content of each lecture and oral presentation was evaluated primarily, it can also be considered that Zoom did not interfere with the evaluation of the content as an OIP with a high penetration rate and stability.

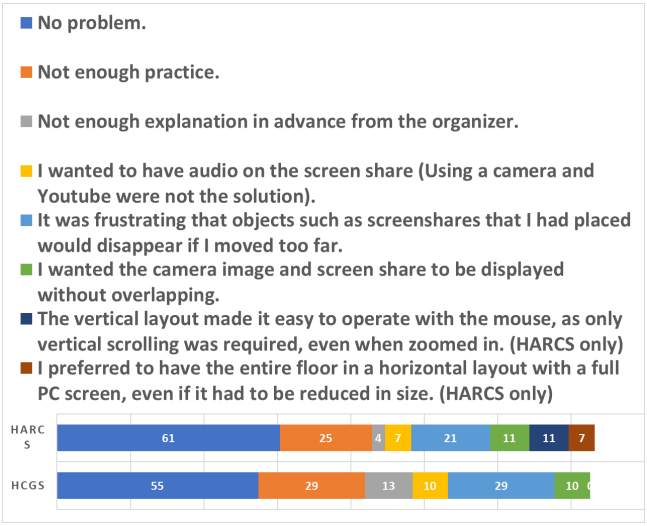

Figure 16. Cat-I presenters: Evaluation on oVice operation for presentation in Cat-I. (%) (Multiple responses allowed)

At a typical on-site venue, immediately after a lecture by an invited speaker (states (d) and (e), which are the core states of the interaction), participants may form a queue to exchange opinions and business cards with the speaker (a state similar to state (e) in Cat-I occurs). By being in the vicinity, i.e., in state (a), one may sense the "seeping-out" of the direction of each participant's interest (the atmosphere of excitement in each research field) and gain "awareness". Discussions were held at the beginning of the planning of HARCS to provide value through such "seeping-out" and to utilize OIPs for this purpose.

Interactions between speakers/presenters and participants in both HARCS and HCGS were conducted in Slack, but they were mainly questions and answers about the content of the lectures/presentations, and more general interactions such as greetings and self-introductions were not seen very often. It is possible that these conversations were conducted behind the scenes via direct messages (DM), in which case the "awareness" of "seeping-out" described above would not have occurred. However, because of the complex operations required to stand in a queue and interact with a speaker when one's turn comes, we gave up replicating such a process, which resulting in "seeping-out" could not be realized.

5.2 Comparison of on-site venues and oVice in Category I

The highest percentage of "very good (better than expected)" was found in Cat-I (oVice) for both HARCS and HCGS in the evaluations from the participant respondents for each session (Figure 11). One of the main reasons for this may be that oVice was able to provide a series of functions for each of the states (a) through (f) of the interaction process in Cat-I shown in Table 2 and Figure 2. Related to this, in the behaviors and evaluations during participation in Cat-I (Figure 14), the following evaluations were obtained: "It was good to be able to look around like in actual Cat-I" (HARCS: 53%, HCGS: 76%), and "It was good to talk with people other than presenters" (HARCS: 12%, HCGS: 39%). These evaluations corresponded to each of the states (a), (b), and (f).

In the impressions of the Cat-I presenters on their experience with oVice (Figure 15), the use of oVice seemed to be accepted since only 0% and 13% of HARCS and

Table 6. Comment summary from participants.

Category	Comment	# of comments	
		HARCS	HCGS
Held online	I didn't know how to register.	1	
	I didn't know how to participate.	1	
	Although the schedule was not convenient, I was able to participate partially.	2	
	Good to participate without travel time or travel expense restrictions.		4
	Difficulty in maintaining focus (not being able to feel the atmosphere at the vanue, being interrupted at work.)		4
Asynchronous participation	Request for distribution of missed presentations (Network connection was unstable, wishing to look back)	4	
	I could not attend the event and only checked the presentation materials.	2	
Multiple OIPs	I liked the use of multiple OIPs.	1	
	Use of multiple OIPs is cumbersome.		1
	Good decision to use the new OIPs (oVice, Slack).	1	
	I wanted opportunities to learn how to use each OIP.		1
	I couldn't use anything but Zoom because of the organization's rules.	1	
	Did not want to use Peatix because it was right after the information leak incident.		1
oVice	Glad I got to experience it for the first time.	4	1
	Easy to use.	1	
	It was fun.	1	
	Tools similar to real-world session Cat-I		1
	There were problems with microphones, network connections, etc.	1	1
Cat-I operation	I wanted the format of presentation materials to be consistent with poster format (some presenters presented in oral format)		1
	Announcements to the entire floor were annoying.		1

Table 7. Comment summary from Cat-I presenters.

Category	Comment	# of comments	
		HARCS	HCGS
oVice	Good because it was close to reality. (Better than Zoom, etc., Not as complicated as VR, Could see how participants were moving around)	5	1
	The room was divided into 4 floors and the participants were dispersed. One large floor would have been better. It might have been different if other floors could have been monitored.	3	
	Need to get used to it. (Maybe we should have had a pre-event to get used to it)	1	2
Differences from onsite	Wanted to explain to participants while looking at their faces (Many people left the camera off because they needed to turn it off to move around; it was more important to be able to understand their reactions in Cat-I than in Cat-T).	1	1
	Need more appealing content and presentation, as participants are more likely to do "nibbling-like" participation (if they are not interested, they will leave quickly).	1	1
Cat-I operation	Making the short video in advance was a hassle.		1
	Announcements to the entire floor were annoying.		1

HCGS respondents, respectively, said that they preferred conventional teleconferencing systems such as Zoom. The following results may also contribute to the acceptance of oVice: "Being able to grasp how crowded each presentation was" (HARCS: 57%, HCGS: 55%), "Being able to grasp the interaction among participants" (HARCS: 32%, HCGS: 52%), and "Being able to introduce participants to others (expanding the circle of communication)" (HARCS: 29%, HCGS: 23%) also contributed to the acceptance of oVice. In addition, many respondents answered that "the skill of talking to participants was similar to that of the on-site venue," (HARCS: 54%, HCGS: 35%), indicating that the interaction process at oVice was similar to that at on-site venues.

Thus, oVice (2-D virtual space interaction service) provided functions for each state that constituted the interaction process on the participant and presenter sides, and these functions were well received. However, the feedback obtained from each event also mentioned some side effects, such as " since a bird's-eye view is provided instead of a first-person perspective, the popularity or unpopularity of each presentation is emphasized too much compared to the on-site venue.

The short video of each presentation in Cat-I received a certain level of evaluation, as shown in Figure 11. On the other hand, 20% of HARCS participants responded that they did not participate in oVice because they were able to grasp the contents through the short video streaming at Zoom (Figure 14), which can be interpreted as "I was able to grasp the contents through the short video streaming, so I did not participate in the interaction in Cat-I." The provision of short videos to facilitate time for synchronous interaction may have ironically created a segment of participants who did not engage in synchronous interaction.

In a study of face-to-face interaction in software development projects, which is a type of collaboration [21], the authors succeeded in quantitatively showing that managers and developers with high performance (intellectual productivity) have more interaction, that the amount of interaction increases when unplanned events occur, and that changing discussion partners within a short period of time strengthens the unity of the interaction network.

At on-site venues in Cat-I and Cat-S, unscheduled events are likely to occur depending on the interaction partners and surrounding circumstances, and often function to facilitate changing the discussion partners in a short period of time. If each participant's intellectual productivity is enhanced by such a function, it is suggested that the OIP for Cat-I or Cat-S should also provide a function that comprehensively supports each of the states (a) through (f), as oVice does.

5.3 Comparison of On-site Venues and Zoom in Cat-I

In JCSFS, Zoom's breakout room function was selected as for Cat-I, partly from the viewpoint of usage barriers, including "familiarity" as described in section 2.3. States (a), (d), and (e) are provided as breakout room functions. State (b) is also possible, but it is necessary to clearly enter each breakout room (small room). As for the state (f), it is possible to prepare many small rooms for chatting, but it is necessary to find a small room available for chatting and then build a consensus to enter the room, making the original casual chatting practically impossible. Although JCSFS did not conducted a questionnaire survey, the feedbacks such as "It takes courage to enter a breakout room when there is no one in the room except the presenter" and "It is difficult for participants to chat with each other" were actually obtained at the reception held at oVice.

In another online academic event, "Interaction 2020" (March 9-11, 2020), where many Zoom meetings were prepared and used just as breakout rooms, the same feedback as in HARCS/HCGS/JCSFS was obtained from

the participants: (1) it took courage to enter a room with no one but the presenter, (2) it was difficult to introduce one person to another person they knew, and (3) a segment of participants watched only the "introduction of the compiled presentations" and did not interact with individual presenters [22].

As mentioned in the previous subsection, oVice, a spatial OIP, was able to support each of the states (a) through (f) of the interaction process, so (1) was not a major problem for HARCS and HCGS, and (2) was not necessarily the case for HARCS and HCGS since there were participants who expanded the circle of interaction.

Regarding (3), although Interaction 2020 broadcasted each presentation live, while HARCS and HCGS distributed short videos, they were similar in that such a "compiled introduction of presentations" was conducted simultaneously at the time when many-to-many synchronous interaction should have taken place. In HCGS, short video streaming and each interactive presentation were made on the same oVice, allowing the participants to move back-and-forth between them instantly in the virtual space. In addition, the video distribution was also available on Slack even before the start of Cat-I. This difference may have made the problem (3) less noticeable in HCGS.

5.4 Category S and OIP

In online academic events, Cat-S, which includes receptions, is also a category with as many or more problems as Cat-I. In other online academic events, such as Robomech 2020 (May 27-30, 2020), the reception was cancelled in the first place [23]. In Interaction 2020, a reception was held via Zoom, but it was reported that the reception was not developed in a distributed and cooperative manner because it was not possible to handle meeting and parting in a continuous manner like oVice.

HCGS and JCSFS held a reception at oVice. Although we did not conduct a questionnaire survey on Cat-S, we have the impression that it was generally well received. In HCGS, a unique spatial interaction trial was conducted in which participants expressed their intentions by moving around, as shown in the lower right of Figure 4, which warmed up the atmosphere. In the first author's subjective view, the sense of participation and belonging to the place was augmented. At the JCSFS reception, the participants were naturally divided into several groups, and some participants called out to those who had no one to talk to. Some participants even said, "The organizers should have used oVice for Cat-I.

Compared to HARCS, which was the earliest of the three events that we were involved in organizing, Robomech 2020 was held about six months earlier and Interaction 2020 about eight months earlier. The OIPs themselves and their functionality options increased during that time due to the COVID-19 crisis, and the degree of familiarity of each participant with online academic events also increased rapidly. Each of the events that we managed benefited from these developments.

5.5 Asynchronous interaction, asynchronous participation and OIP

As shown in Table 1, Zoom and oVice were employed for synchronous interaction, while Slack was employed as an OIP to support asynchronous interaction. Regarding the behaviors related to question-and-answer in Cat-T (Figure 13), we obtained answers as follows: "I asked questions because there was a possibility to get answers in Slack even after the presentation" (HARCS: 9%, HCGS: 43%) and "I read other people's questions and answers in Slack after the presentation" (HARCS: 25%, HCGS: 60%). In fact, the usage log (Figures 8 and 9) confirms that active users responded to each posting after the event date such as provision of materials, answers to questions at a later date, and posting of the survey request for this paper, suggesting that Slack's asynchronous interaction support functioned effectively.

From the comments obtained from the participant questionnaire (Table 6) and inquiries to JCSFS, it was confirmed that there are requests for the distribution of missed lectures and oral presentations in Cat-T. The first thing that should be done by the organizer side for such post-event distribution is to organize the rights related to copyrights and portrait rights. For this purpose, it is necessary to proceed with the transfer of rights and licensing of use, as well as to clarify which side is responsible for each right, the organizer or the presenter [24]. In HARCS/HCGS/JCSFS, it was not possible to realize the post-event distribution due to the lack of time to prepare for the above legal issues.

In the case of YouTube, there are menus to set the visibility and period of publication, and a legal-tech mechanism to automatically check copyrights and portrait rights. If OIP recording and streaming functions such as Zoom are equipped with these features, it will be easier to introduce post-event distribution services.

One of the invited speakers was unable to be available at short notice, and the talk was pre-recorded and streamed via Zoom during the session, and the post-event distribution was available on Slack until the day after the session. In addition, a spontaneous question-and-answer session was seen to continue on Slack for about a week after that session. Considering such actual cases of asynchronous participation and the aforementioned requests for post-event distribution, as well as the ephemeral nature of Zoom chats, it is highly worthwhile to further develop a mechanism to support asynchronous participation, including asynchronous interactions.

5.6 On-site/online hosting operating costs

The human and financial costs of on-site and online events for HARCS and HCGS were compared with those of the previous year's on-site events. Note that the scale of events (number of days, number of participants, and number of presentations) for both HARCS and HCGS in FY 2019 and FY 2020 were similar, and preparations for FY 2020 were made with reference to the previous year, so no normalization was performed for comparison purposes.

First, a comparison of the number of operating staffs on the days of the event shows that HARCS was able to hold the event online with about 41% of the number of staffs in the previous year, and HCGS was able to hold the event online with about 71% of the number of staffs. Next, a comparison of expenditures shows that HARCS and HCGS were able to reduce their expenditures to about 19% and 25% of the previous year's on-site costs, respectively.

In the case of online events, duties of the registration desk on the days of the event are eliminated, and there is neither physical preparation of handouts nor venue organization. Moreover, OIPs are much less expensive than on-site venue fees.

Table 8. HARCS: (3) they were unable to use oVice and Slack because of their organization's rules and regulations.

Industrial Classification	Rate within the respondents who selected Item (3) (%)		(cf.) Rate in the whole respondants (%)
	oVice	Slack	
E MANUFACTURING	71	83	32
G INFORMATION AND COMMUNICATIONS	14	17	7
S GOVERNMENT E.E.C.	14	0	8

6 DISCUSSIONS OF USAGE BARRIERS AND SOCIAL ACCEPTANCE OF OIPS

6.1 Usage barriers of OIPs

In the case of online events, unlike on-site events, usage barriers at each OIP create problems that prevent participation. As shown in Figure 12, there were few problems with Zoom, as it is quite widely used (however, many organizations prohibited Zoom use in the first half of 2020, mainly for IT security issues). On the other hand, the number of participant respondents who were unable to use oVice and Slack amounted to around 30% in HARCS (In the case of HCGS, it was 3%). In addition to Item (1) usability and Item (2) computing/communication environment, about 10% of the respondents selected Item (3) “unable to use oVice and Slack because of their organization's rules and regulations.”

Noting that the industry composition of the participant respondents differed between HARCS and HCGS as shown in Figure 10, we checked the industry of the respondents who selected Item (3) (Table 8). As a result, we found that the manufacturing and information and communication industries accounted for 70-80% and 14-17%, respectively, of the respondents who selected Item (3), while the manufacturing and information and communication industries accounted for 32% and 7%, respectively, of the total HARCS respondents,

No respondents selected Item (3), even though the manufacturing and information and telecommunications industries accounted for 10% and 15%, respectively, of the total HCGS respondents. Therefore, it is difficult to make a generalization, but it is likely that organizations in these industries have strict IT security management based on the past OIP use. In fact, in JCSFS held three months after HCGS, it was confirmed that some participants could not use oVice or Slack due to their organization's rules, and it should be considered that the barrier as in Item (3) will not be resolved in the short term. This may be seen as a factor of barriers to entry for new service businesses with little operational history, not limited to oVice and Slack.

For example, standardization of authentication for communication and data management, etc., according to the confidentiality level of synchronous and asynchronous interactions, would at least facilitate lowering the new entry and usage barriers for IT security. In addition, by making the participation fee free of charge and adding holidays to the dates of the conference, it may be possible to lower the barrier as in Item (3) by making it easier to participate from an individual standpoint without being bound by the organization to which one belongs.

HARCS and HCGS have considered the use of a 3-D spatial interaction (VR: Virtual Reality) service, but decided against it due to concerns that the usage barriers would become too high. Based on the above discussion, this was the right decision at this moment.

6.2 Social acceptance of OIP

Regarding the oVice operation for presentation in Cat-I (Figure 16), many respondents answered that there were no problems (HARCS: 61%, HCGS: 55%), but there were also many who answered that they "lacked practice" (HARCS: 25%, HCGS: 29%) or "had some dissatisfaction with the functions. Insufficient practice is generally a matter of "familiarity," but in this case, many of the problems were attributable to the "maturity of the system." Specifically, even in cases where the system could not be used well due to "lack of maturity of the system" such as problems with oVice or Web browsers or inconsistencies in UI (user interface), the presenters regarded it as a problem of "familiarity". This was often observed through rehearsals and technical support during the events.

In any case, responses such as "there was not enough explanation in advance from the organizer" (Figure 16) and "I wanted opportunities to learn how to use each OIP" (Tables 6 and 7) suggested the need for rehearsals and tutorial sessions. However, since these were actually conducted at each event, the content and quantity of these sessions need to be reconsidered.

Not only oVice, but many of the new spatial OIPs are provided as Web apps, which often have limited functionality and operability compared to stand-alone apps. Although this may be a reason for dissatisfaction with the functionality (lack of system maturity), Web applications are easier to control than stand-alone applications from the perspective of the standardization of IT security authentication mentioned above, and the application development itself is also easier with Web applications. It is difficult to say which solution is the best.

If the only criteria for selecting OIPs are whether the participants are familiar with using them and whether they are mature and has sufficient operational history against IT security risks, it may cause giving up thinking about the various issues mentioned so far. In addition to familiarity, maturity, and various risks, the balance of each factor such as the value of the provided functions discussed in section 5 influences the degree of social acceptance [25], or at least the degree of acceptance by the participants of each event, which may affect the degree of satisfaction and convincingness. The balance of the above factors can change rapidly when triggered by a major incident or an epidemic, so the organizers of online academic events are required to have a comprehensive view. Note that the ages of the participants of the reception held at oVice in HCGS and JCSFS ranged from 20s to 70s, and each generation accepted it. This was impressive to the authors.

6.3 Accessibility of OIP

As described in section 2.3, oVice was adopted in consideration of accessibility for participants such as the visually impaired. This enabled a blind presenter who participated in Cat-I of HARCS and HCGS respectively to appear at the assigned location, and in HCGS, the presenter also participated in the reception.

The international conference Electroceramics XVII, where Gather was adopted, reported that it worked well in Cat-I,

although there were some system and service maturity issues [26]. However, accessibility was not mentioned. On the other hand, the international conference Ubicomp/ISWC 2020, which also adopted Gather, reported to AccessSIGCH and SIGCHI that "accessibility for people with audiovisual disabilities is poor and we recommend not using Gather until that problem is resolved" [27].

From the perspective of social acceptance described in the previous section, accessibility of OIPs must be emphasized more and more in the future. Technologically, it is expected that it will become easier to adopt not only 2-D spatial interaction services but also 3-D VR spatial interaction services, which will increase the degree of freedom in spatial design and the complexity of operations. Although this might make it more difficult to ensure accessibility, such future services are expected to enable virtual spatial mobility support such as automated driving and fine-grained accessibility support through multimodal interfaces.

6.4 Multiple OIP use

As shown in Table 1, in the three events in which we were involved in the operation, multiple OIPs were combined to support one-to-many and many-to-many interactions in both synchronous and asynchronous ways. As shown in the comments in Table 6 and Figure 12, while we received constructive evaluations, we also received evaluations that it was troublesome to use, that it was usable although there were problems, and that it was unusable due to problems. In Robomech 2020, Zoom webinars were used in Cat-T, Facebook in Cat-I [28], and other different OIPs were also used together. Just as in our events, it was evaluated that it was cumbersome to use and that there were problems in using the system.

In exchange for the cumbersome use, Robomech 2020 made the decision to "use multiple OIPs in anticipation of private companies that do not allow the employees to use some specific OIPs". From Figure 12 and Table 8, it is fair to assume that the use of multiple OIPs was a reasonable decision in HARCS from this perspective. However, the probability that no problem occurs in the multiple OIP case is the product of the probability that no problem occurs in each OIP, so the probability of no problem occurring is lower in the multiple OIP case than in the single OIP case. Responses that there were problems using OIPs may also be related to this aspect.

At Robomech 2020, some participants were reluctant to provide their personal information to Facebook. In addition, some participants hesitated to use Peatix, which was used for registration in HCGS, due to an information leakage incident that occurred before the event (Note: no problem occurred in HCGS) (Table 6). Needless to cite these cases, special consideration should be given to how personal information is handled at each OIP.

6.5 Participation rates for online academic events

Finally, although not directly related to the OIP itself, we discuss the participation rate of online academic events. First, as for the ratio of the number of participants to the number of registrants shown in Table 4, it was higher at HCGS, where the registration fee was charged, than at HARCS, where the registration fee was free, for both Cat-T and Cat-I. This ratio is expected to be higher in proportion to the fee.

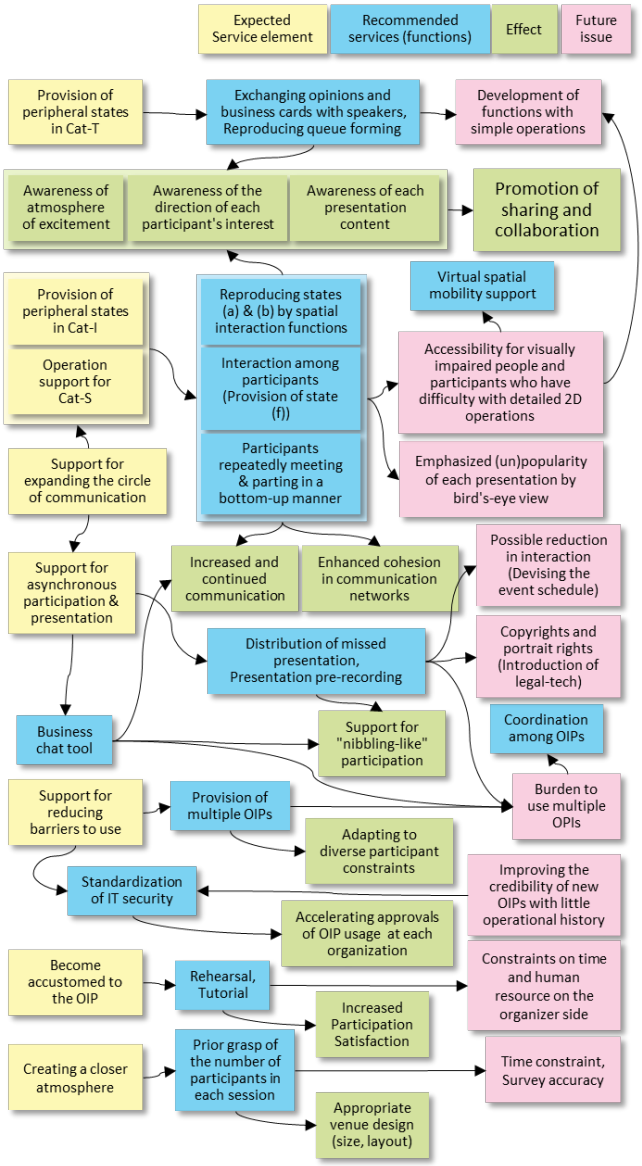

Figure 17. Summary of relationship between recommended services (functions), effects, and issues for the service elements expected in online academic events and the OIPs.

The above trend is likely to be observed regardless of whether the event is online or not. On the other hand, we confirmed, as a phenomenon peculiar to online events, that the "ratio of the largest number of simultaneous participants to the number of registrants" is low despite the fact that HCGS required the registration fee. It means that many participants attended only some of specific sessions. Since participants can participate without having to spend money for transportation, lodging, and travel time, the total cost of participation can be kept low even if they pay for the registration. This could be a factor in not raising awareness of the "wastefulness" or "Mottai-nai" of the participation fee, even if they do not participate.

In Cat-T, the "ratio of the largest number of simultaneous participants to the number of registrants" was lower at HCGS than at HARCS. If there is a relationship between the length of the event and the dispersion of participants in Cat-T, the program structure should take this into account.

In any case, the ratios on simultaneous participants described above were not high in both events, and it is fair to say that there was "nibbling-like" participation, which is

often seen in other online events. Several respondents commented that it was difficult for them to maintain their concentration, including being interrupted at work (Table 6), suggesting that there are two types of nibbling-like participation: intentional and unavoidable.

As shown in Figure 6, the number of HARCS participants peaked in the morning and monotonically declined, and it was not possible to retain the participants until Cat-I in the evening. In spite of the fact that oVice was set up with four floors in consideration of the large number of pre-registrants, the atmosphere was quiet depending on the floor and time because of the small number of participants in Cat-I.

In the virtual space, it would have been possible to create a "closer atmosphere" that was not possible in the real space during the COVID-19 crisis, but it was regrettable that it was not possible to do so. The number of participants should have been more accurately estimated at the time of pre-registration by asking the number of participants in each session category, so that the spatial configuration could be considered without relying solely on experience and intuition.

The phenomenon of fewer participants in the afternoon than in the morning was also observed in HCGS on both the first and second days (Figure 7). On the other hand, the closing session had the largest number of participants on the final day. This may be because the award ceremony was held in the closing session, where the winners were announced for the first time. It is obvious that such “superior content" increases the willingness to participate, but it was reconfirmed that it is indeed an important factor.

6.6 Contributions to Serviceology

The contribution of this study to serviceology is the findings organized in the previous section and the discussion in this section. Figure 17 summarizes the findings as a diagram of the relationship between recommended services (functions), effects, and issues for the service elements which are expected in online academic events and the OIPs as their service encounters. It is difficult to prove that the assumption made in section 1 are valid. However, the fact that this summary is based on discussions of online academic events with respect to each of the issues identified in teleworking and online meetings surveys demonstrates the validity of this assumption.

7 CONCLUSION

In this paper, firstly, the history of adoption of OIPs that support co-presence and collaboration in synchronous/asynchronous distributed environments in academic events, a kind of collaboration (Figure 1), is outlined for each session category. Next, descriptive statistics of the usage log of each OIP for HARCS and HCGS, and the results of the questionnaire for participants and Cat-I presenters were reported. Then, the comparison between on-site venues and OIPs, and the usage barriers and social acceptance of OIPs were discussed, including the experience of JCSFS management. In particular, the state classification of the interaction process (Table 2) was used for discussion in each session category (T, I, S).

The findings summarized in Figure 17 in this study may be applicable to collaboration in synchronous/asynchronous distributed environments different from academic events. For example, it may be assumed to be telework and online meetings (virtual offices), including remote group work in software development projects as described in section 5.2, university laboratories (virtual labs), group training, exhibitions, and remote local community activities. Future issues include verification of their feasibility, elaboration of findings, and design of OIPs based on the findings. Although remote international conferences are also academic events, it is necessary to further investigate how to overcome time differences in terms of interaction and collaboration in synchronous/asynchronous distributed environments.

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