INTERNATIONAL DESIGN CONFERENCE - DESIGN 2014
Dubrovnik - Croatia, May 19 - 22, 2014.

PROPOSAL OF A DESIGN SUPPORT TOOL FOR EMPLOYEES TO REPRESENT SERVICES

K. Watanabe, S. Fujimitsu, Y. Harada, Y. Niino, M. Kobayakawa, K. Yamada, T. Sunaga, Y. Sakamoto, T. Nishimura and Y. Motomura

Keywords: service design, design support tool, UPAD

1. Introduction

Service design has become an important research topic among design research fields. Various methods and tools have been developed and introduced into actual service fields. Meanwhile, there are numerous service providers, most of which are small and medium-sized enterprises (SMEs). They do not necessarily have sufficient resources to organize a new design team using specialized design methods and tools or to receive a consultancy service for service design. It is preferred that the employees in service firms conduct design activities with less cost. More concretely, it is expected that employees in a service field would examine their work and present their design ideas independently. However, most employees in service fields are not trained to conduct such design activities. Therefore, it is necessary to motivate them to conduct design activities and to support them.
In this paper, the authors propose a design support tool to encourage employees to present their work and design ideas independently. The authors designated its prototype as "Zuzie Poetry." The authors explain the functionality and features of Zuzie Poetry and its trial results.

2. Service design and its support tools

2.1 Service design and the role of employees

Recently, service design has become a popular issue in the design research field. Various design methods, methodologies, and support systems have been developed and proposed based on several design disciplines such as engineering design [Tomiyama et al. 2002], user-centered design [Forlizzi and Zimmerman 2013] and design thinking [Stickdorn and Schneider 2012]. Especially in human-to-human services such as medical services, co-design with employees has become a common practice [Pilemalm and Timpka 2007], [Sunaga 2009], [Garde and van der Voort 2013] since the understanding of work practice in service fields is important for the design of such services.
Most service providers in such service industries are small and medium-sized enterprises (SMEs). The co-design project requires the active participation and facilitation of designers. This characteristic makes it difficult to implement the co-design approach widely to numerous service providers. To tackle this issue, a design approach drive by the employees' community designated as "User-driven Product/Activity Design (UPAD)" was proposed [Watanabe and Nishimura 2013]. Simply put, UPAD is an autonomous and continuous design approach of service processes and systems for use by a community of employees. This approach is aimed at realizing design activity using existing human resources. In this design approach, the employees are expected to represent the situation and problems in a service field [Watanabe and Nishimura 2013]. However, most service field employees are not trained to represent and assess their own work. Additionally, it would be difficult to adopt such an

activity if it costs too much time and effort for them. Therefore, some method or support tool that is easy to adopt in business is necessary for the representation of services by employees.

2.2 Design representation methods and tools

Various representation methods and tools exist for service and product design. In a broad sense, these methods and tools are classifiable into the following three categories. Figure 1 presents these categories and their related methods and tools.

- Modelling methods and tools

In general, modelling methods specifically examine a single or a few aspects and include strict notation to describe design ideas or observation results. These methods are superior in describing a certain aspect of design objects in a structured and exhaustive manner. Moreover, strict notation enables designers to use the mathematical analysis to evaluate design objects.

Most engineering design methods belong to this category. Various modelling methods for service design have been developed and proposed to date. For example, Shimomura and Tomiyama [2002] proposed a set of modelling methods representing the relation among stakeholders, detailed interaction between a pair of stakeholders, and the functional structure of a service. As another important design object, a service process has been studied by many researchers. Numerous modelling methods have been proposed [Shostack 1984], [Morelli 2002], [Hara et al. 2009]. In addition, multiple design support tools exist to describe models of services. Shimomura et al. [2004] developed a service computer-aided design (CAD) system designated as Service Explorer, which includes not only a modelling support function but also a simulation function based on the developed service models [Tateyama et al. 2011]. Several other CAD systems exist for services [Komoto and Tomiyama 2008], [Uhlmann and Bochnig 2012].

To describe the multiple and subjective aspects of services, various models have been proposed. However, employees who are not trained to use these models are not necessarily accustomed to describing their service and design ideas in a structural and formal manner. In addition, effective modelling methods depend on each service field and its characteristics [Watanabe et al. 2013]. The way in which one fits the suitable representation methods and tools to respective service fields is an important issue.

- Expression methods and tools

In contrast to the modelling methods described previously, the expression methods and tools are for more free description of design objects. These methods are commonly used for creative purposes in idea generation.

Sketching is the most fundamental approach to describe a design object. Sketches enable designers to handle different levels of abstraction simultaneously and are important media for design communications [Ulrich and Eppinger 2008]. For the support of understanding sketches, support notation such as arrows among objects is also commonly used [Ullman et al. 1990]. In addition, a text description is a common approach to describing features of design objects [Cardoso et al. 2012]. Scenarios are commonly described to clarify the use case of design objects [Carroll 2000]. As a similar approach, storyboarding also describes and designs how customers behave in a certain context with visual and text representation [Madsen and Aiken 1993]. Support tools for designer expression and related activities such as memorization or communication of design ideas have also been developed [Gopsill et al. 2012].

These expression methods and tools can be widely applied to various cases. However, sketching for communication among employees requires a certain skill. In addition, a lack of uniformity in the design representation might lead to inconsistency in interpretation among employees.

- Intermediate methods and tools

In addition to the categories described previously, several intermediate approaches exist to combine the respective benefits of the categories. These approaches apply a common and simple structure to the representation of design objects to arrange design ideas with fewer constraints. For example, the mind map [Buzan and Buzan 1996] provides a framework to describe the ideas and concepts in a general tree structure not only with text but also with images. For the analysis of designed objects especially in a social context, the causal loop diagram that describes causal relations among design objects and their

environment and the system dynamics to simulate it are commonly applied [Akasaka et al. 2013], [Rannacher et al. 2012]. As another approach to the design purpose, the *n*-dim system provides an infrastructure for modelling that is adaptable for various design objects by engineering designers [Subrahmanian et al. 1997]. The characteristics of design tasks by engineering designers, which Subrahmanian et al. discussed [Subrahmanian et al. 1997] are similar to those in service fields with multiple cultures, languages, and areas of expertise. In this sense, the adaptive strategy to develop a support tool in the *n*-dim approach is adequate for service design by employees. The graph structure of information objects and the flat space concept, which allows the direct reference to any kind of model to it, is also general and versatile.
These intermediate approaches present variety in the description of design elements. A graph structure applied in the aforementioned methods is familiar to those who have scientific expertise, but not necessarily to employees in a service field. This could interrupt their free expression. Concerning this issue, Rich Picture in Soft Systems Methodology [Checkland and Scholes 1990] would be a good example which prevents restricting expression by not determing a concrete syntax. For the adequate design support for each service field, a general representation tool which is adaptable to various service fields and has less restriction in expression is necessary.

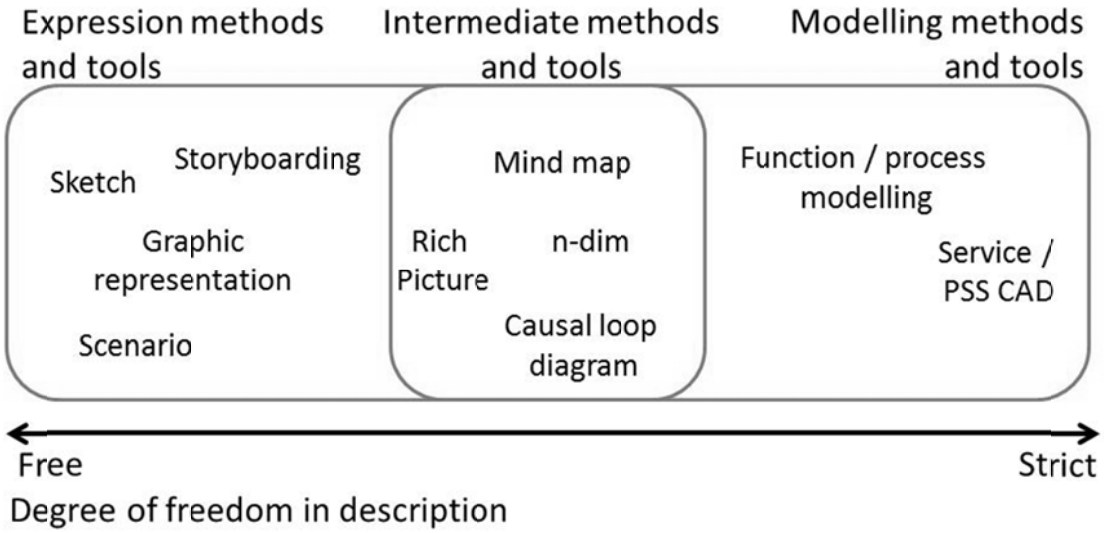


Figure 1. Categories of design representation methods and tools

3. Design representation prototype tool for service design

3.1 Concept

According to the problem setting described previously, the authors propose a concept of a design representation tool that can encourage design activities by service field employees. As a basis of the proposal, the authors examined an expression tool 'Zuzie', which is a participatory platform for the creation of spaces of expression [Kobayakawa and Sunaga 2013]. Zuzie was developed for learners in museums or classrooms to express themselves and to promote new learning through that expression. This application software arranges identical collections of image cards across the surfaces of multiple sheets and creates visual representations of those arrangements from different perspectives. Zuzie has been used by various users: from scientific professionals to elementary school students. At this point, Zuzie is accepted by many various users.
In succession to the practice of Zuzie, the authors set the following concepts to the design representation tool.

- Unstructured representation of relation among design elements

The modelling / intermediate methods and tools described previously represent design objects as design elements such as functions, actions, physical components, and concepts, in addition to their

structural relation. The proposed tool uses no structural representation scheme such as a graph structure to avoid limiting the variety of representation by users who are not accustomed to a certain representation scheme. Users can describe relations among elements and other pictorial representations in any form on the free-form sheet. In addition, the authors expect that the representation scheme would be concretized for a detailed description of design results after continuous use by users, as the *n*-dim approach is intended [Subrahmanian et al. 1997].

- Visual representation with the supplementation of text

In this design representation tool, the major elements are described with images to assist the quick perception of design representation [Cardoso et al. 2012]. To supplement the meaning of images and to add descriptive information, text descriptions are used in the tool.

- Representation for sharing subjective viewpoints among users

As mentioned above, multiple and subjective viewpoints exist in a service field. These viewpoints describe certain aspects of services. Their integration is important for better understanding of the current situation and its redesign. The proposed tool is designed for the sharing of such subjective viewpoints by multiple users.

3.2 Representation elements

For the representation of service fields, the authors determine the following elements of the proposed tool.

- Human

'Human' is an element to describe stakeholders in a service field. They include not only employees but also customers and other related people.

- Action

'Action' is an element showing action by a stakeholder in a service field. This action is usually related to humans with the description of relation.

- Feeling

'Feeling' is an element to describe feelings of stakeholders. This feeling is also described in relation to humans. The change of feeling and causal relation between an action and a feeling can also be described.

However, the description in the tool is not limited to the elements described previously. Users can draw images and add texts to represent situations in a service field and design ideas for them.

These elements are put on sheets which describe multiple situations or viewpoints. These are important to describe dynamism and diversity of services. By using sheets, users can describe the shift of the situations, different perspectives on the same issue and movement of elements. This is a different point from Rich Picture [Checkland and Scholes 1990].

3.3 Prototype tool "Zuzie Poetry"

Based on the concepts and representation elements described previously, the authors have developed a design representation prototype tool for service design. The authors call it "Zuzie Poetry." Zuzie Poetry was developed though the collaborative project with Saga University Hospital in Japan to improve the information device to support nursing care services. This tool, which was developed using the Squeak Etoys as a programming framework, was designed for use on touch panel devices and ordinary PCs (Windows and Mac). Figure 2 presents a screenshot of Zuzie Poetry.

Zuzie Poetry provides the following functions.

1. Create elements

Users can set the following design elements on Zuzie Poetry

- Human as an image

Human elements can be put on Zuzie Poetry using the drag-and-drop of image files. Users can use drawing images as shown in Figure 2 and photographs of stakeholders. Users can also change the image sizes.

- Activity, feeling and others as texts

Activity and feeling elements are described as texts on Zuzie Poetry. By tapping or clicking corresponding icons in the bottom / side bars, users can create text objects. For the activity elements and the feeling elements, a template of frequently used words is prepared. Figure 3 presents a list of activities and feelings. These lists were designed by nurses at Saga University Hospital for nursing care services. The activity list contains five categories: "medical practice," 'care,' 'movement,' 'communication' and "indirect task." The feeling list contains six categories: 'happy,' "in trouble," 'sad,' "happy and want to say," "in trouble and want to say" and "sad and want to say." By selecting a suitable word from a list, users can reduce the time necessary for typing text. For feeling elements, facial icons are added to the front of the texts, as shown in Figure 2. Users can also set text elements for other descriptive purposes such as describing contexts or situations. The size and color of texts can be changed to add meanings such as importance, emotion, and messages.

2. Describe relations / situations

Users can describe relations among elements or situations by drawing on a sheet on which elements are put. In Zuzie Poetry, functions such as drawing lines, erasing lines and changing line colors are prepared. Users can also change the line thickness and color.

3. Create / change / copy / manage sheets

Zuzie Poetry includes several sheets on Zuzie Poetry for describing multiple situations or viewpoints. By selecting a sheet on the top bar, users can change a sheet to be shown. Users can also create a new sheet and copy the existing sheet.

4. Create time stamps

The expression by this tool can be continued in parallel to changing circumstances in an actual service field. To describe when the expression on the tool was conducted, Zuzie Poetry has the time stamp function. By selecting the time watch icon on the bottom bar, a time stamp object is created.

5. Save and load

After finishing the representation, users can save sheets and load them later for additional representation. For the analysis of sequential change of the representation results, snapshot data are created at each time of saving. Users can see how the representation has been altered by viewing the snapshot data.

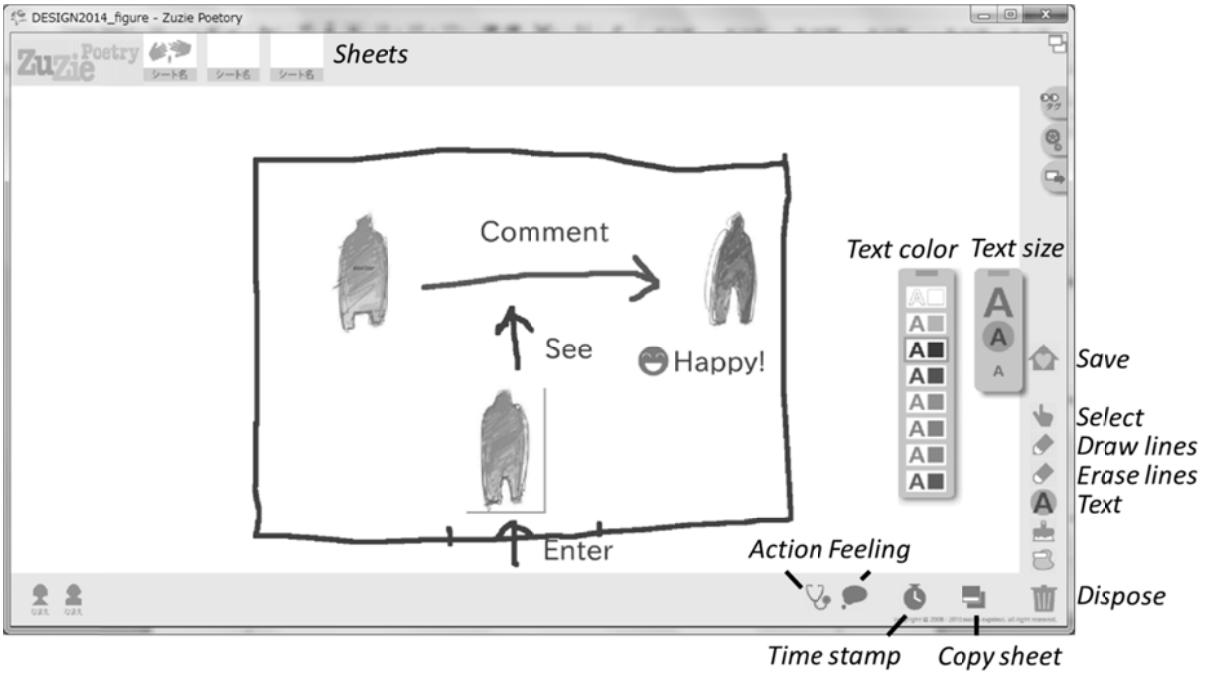


Figure 2. Screenshot of Zuzie Poetry

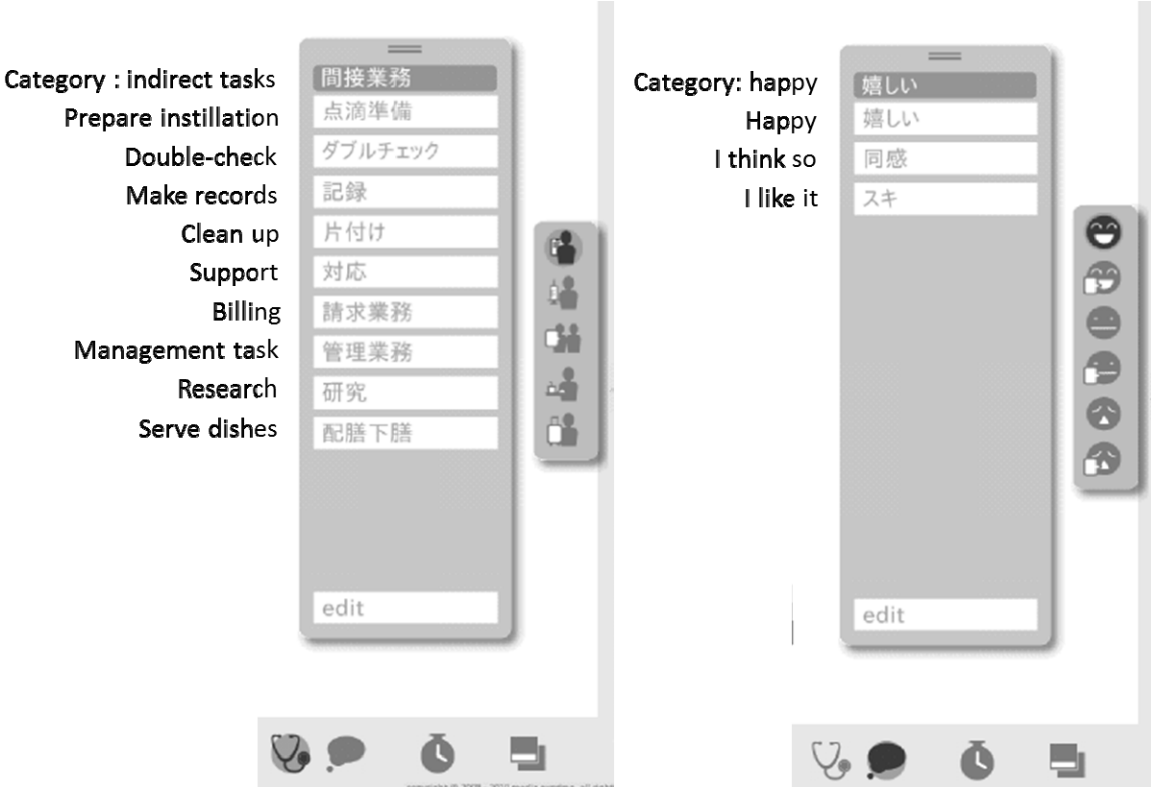


Figure 3. Lists of activities and feelings (for nursing care services)

4. Trial use

4.1 Method

The authors conducted trial use of Zuzie Poetry. This trial use is a preliminary study of the tool effectiveness by the research team including representative nurses before the field test. The trial use themes were selected from the project activities as follows.

1. Task management in research activities
2. Goal setting of the project
3. Meeting situation of the collaborative study
4. Issues in medical system design

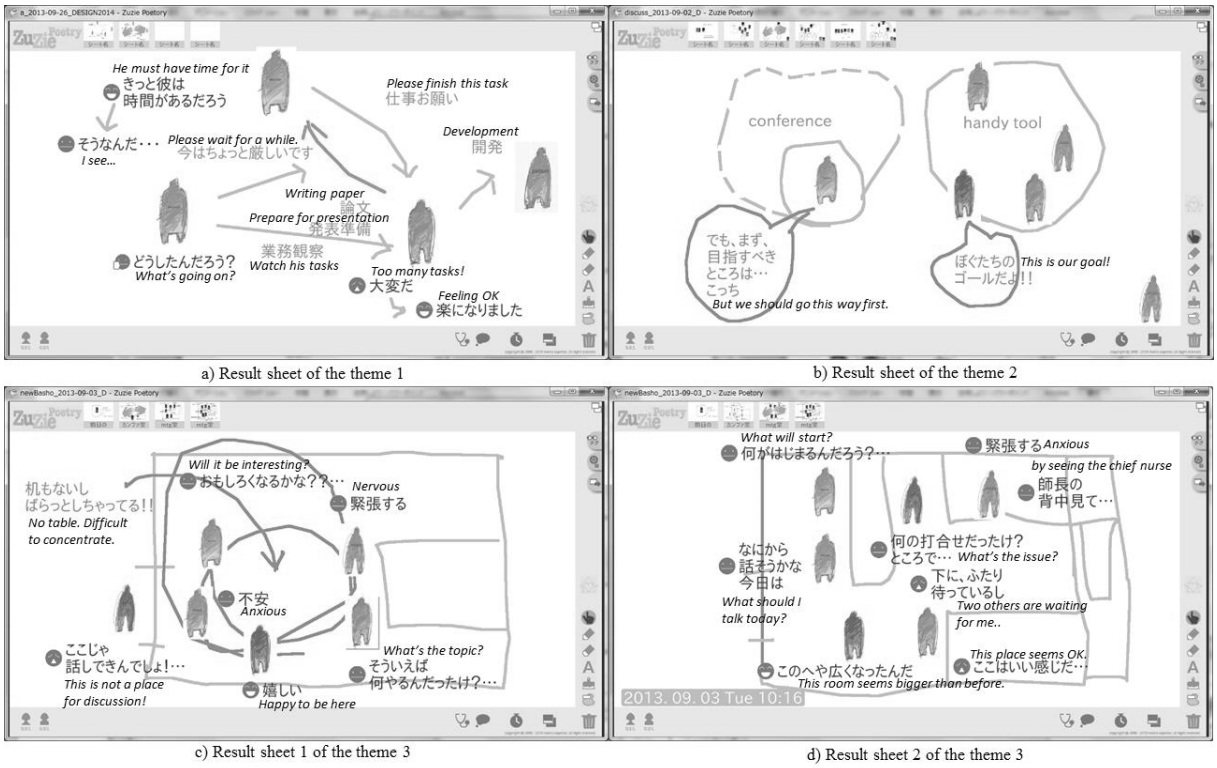
The trial use was performed with a group of 3–4 people from the research team gathering in front of a touch panel PC. The period of each trial use case was 20–30 min. After the trial use, the authors observed and analysed the representation results.

4.2 Result

Figure 4 presents some results obtained from trial use. By analysing these results, the following characteristics were observed.

- Numbers of humans in the representation results were various (from 3 to more than 10).
- Types of relation descriptions were the following.
    - Arrows (causal relation, direction of activity, change of feelings, movement of element, etc.)
    - Connection (human and feeling)
    - Location (drawing a room)
    - Category (in the same situation, with the same opinions)
    - Verbal expression (speech balloon)
    - Emotion (heart, etc.)

- Sheet change was used for describing
  - The time shift.
  - The current (problematic) situation, a solution to it, and its result
- Created sheets were 2–6.
- Template lists of activities and feelings were not frequently used.



a) Result sheet of the theme 1

b) Result sheet of the theme 2

c) Result sheet 1 of the theme 3

d) Result sheet 2 of the theme 3

Figure 4. Results of the trial use

5. Discussion

This section presents discussion of the effectiveness, limitations, and future expansion of the proposed tool.

First, Zuzie Poetry was able to represent various situations according to multiple themes. Especially, the descriptions of relations varied among cases. Compared to an ordinary graph representation, Zuzie Poetry enabled users to represent situations and relations more freely. The designed lists of activities and feelings were not used frequently. One of the reasons is that the required representation with this tool was much more detailed and complex. How to support user input should be reconsidered.

The authors assumed that the representation patterns of relations and situations would be fixed after several times of use. According to these results, the authors might be able to provide certain templates to describe relations and situations as models suitable to each service field. The authors consider that such a 'pre-modelling' process is necessary for the implementation of design activities in a service field. By applying such a modelling template, the represented data can be used for additional computational analyses. The manner in which one balances the flexibility of representation and the applicability for analysis remains as a subject for future studies.

In the trial use, Zuzie Poetry was used for describing the sequential change of a certain situation and for determining a solution to a certain problem. The latter case is clearly for design use, but the former case would also be important for the actual use in a service field (e.g. observing a long-term effect of a design solution to a certain issue). The authors assume that the usage of this tool would be determined gradually by employees in each service field. For that purpose, a workshop program to implement this system in a service field is necessary. This point should also be examined in future studies.

In each trial use case, the representation was finished within the predetermined period. The authors expect that this period is moderate considering the use in a conference in a service field though the empirical study to confirm it is still required. Through continuous use, the usage of this tool in a service field would be more sophisticated. The further study in an actual service field is necessary.
In addition, the pictorial representation of design results or current situation is expected to be useful for communication with other employees. It would also be applicable to explain the current service process to external system vendors for making information systems fit the service process. This point should be discussed as a service design methodology.

6. Conclusion

In this paper, the authors explored the requirements of a design representation tool that is useful for employees in a service field. The authors first investigated the existing design representation methods and tools which belong to three categories: modelling, expression and intermediate. Then, the authors proposed the concepts of the design representation tool that are "unstructured representation of relation among design elements," "visual representation with the supplementation of text" and "representation for sharing subjective viewpoints among users." According to these concepts, the authors designed the representation elements for the tool and developed a prototype tool "Zuzie Poetry" based on an expression tool 'Zuzie.' By introducing the trial use cases, the authors could confirm the effectiveness of the prototype tool and discussed further issues for its implementation in a service field.
As future studies, the authors plan to develop concrete programs of workshops using Zuzie Poetry. In addition, the authors will explore how employees can determine its usage and additional specifications for their purposes. Furthermore, the authors expect that service field employees will use the representation results as knowledge for the redesign of their services. For this purpose, the authors intend to investigate how the representation results can be assessed as knowledge.

Acknowledgement

We appreciate great effort and sincere support for this study by Ms. Mayumi Yamaguchi, Ms. Kumiko Kabashima, Ms. Satomi Miyanoshita, Ms. Miki Nanri, Ms. Tomomi Higuchi and Mr. Masashi Hasegawa at Saga University Hospital.

References

Akasaka, F., Nemoto, Y., Shimomura, Y., "Product-Service Systems Design focusing on System Aspect: Total Value Creation for Various Stakeholders", Proceedings of CIRP IPS2 Conference 2013, Bochum, Germany, 2013, pp. 371-382.

Buzan, T., Buzan, B., "The Mind Map Book: How to Use Radiant Thinking to Maximize Your Brain's Untapped Potential", Plume, New York, 1996.

Cardoso, C., Gonçalves, M., Badke-Schaub, P., "Searching for inspiration during idea generation: pictures or words? ", Proceedings of International Design Conference – DESIGN 2012, Dubrovnik, Croatia, 2012, pp. 1831-1840.

Carroll, J. M., "Five reasons for scenario-based design", Interacting with Computers, Vol. 13, 2000, pp. 43-60.

Checkland, P. B., Scholes, J., "Soft Systems Methodology in Action", John Wiley & Sons, Hoboken, NJ, 1990.

Forlizzi, J., Zimmerman, J., "Promoting Service Design as a Core Practice in Interaction Design", Proceedings of the Fifth International Congress of International Association of Societies of Design Research (IASDR2013), Tokyo Japan, 2013.

Garde, J. A., van der Voort, M. C., "The Activity-Flow Co-Design Game: Designing for scheduled and unscheduled use situations", Proceedings of the Fifth International Congress of International Association of Societies of Design Research (IASDR2013), Tokyo, Japan, 2013.

Gopsill, J. A., McAlpine, H. C., Hicks, B. J., "Partbook – a social media approach for capturing informal product knowledge", Proceedings of International Design Conference – DESIGN 2012, Dubrovnik, Croatia, 2012, pp. 1435-1444.

Hara, T., Arai, T., Shimomura, Y., "A CAD system for service innovation: integrated representation of function, service activity, and product behavior", Journal of Engineering Design, Vol. 20, No. 4, 2009, pp. 367-388.

Kobayakawa, M., Sunaga, T., "Two Types of Co-Creation in Designing a Tool and an Activity program for people's expression", Proceedings of the Fifth International Congress of International Association of Societies of Design Research (IASDR2013), Tokyo Japan, 2013.

Komoto, H., Tomiyama, T., "Integration of a service CAD and a life cycle simulator", CIRP Annals-Manufacturing Technology, Vol. 57, Issue 1, 2008, pp. 9-12.

Madsen, K. H., Aiken, P. H., "Experiences Using Cooperative Interactive Storyboard Prototyping", communications of the ACM, Vol. 36, No. 4, 1993, pp. 57-66.

Morelli, N., "Designing Product/Service Systems: A methodological exploration", Design Issues, Vol. 18, No. 3, 2002, pp. 3-17.

Pilemalm, S., Timpka, T., "Third generation participatory design in health informatics -Making user participation applicable to large-scale information system projects", Journal of Biomedical Informatics, Vol. 41, 2007, pp. 327–339.

Rannacher, A., Stranzenbach, R., Sturm, F., Mütze-Niewöhner, S., "Developing a system dynamics model of the influencing factors on the productivity of knowledge-intensive services", Proceedings of the XXII RESER International Conference, Bucharest, Romania, 2012.

Shimomura, Y., Sakao, T., Hara, T., Arai T., Tomiyama, T., "Service Explorer – A Tool for Service Design –", Proceedings of International Conference on Machine Automation 2004 – ICMA2004-, Osaka, Japan, 2004, pp. 381-386.

Shimomura, Y., Tomiyama T., "Service Modeling for Service Engineering", Proceedings of the Fifth International Conference on Design of Information Infrastructure Systems for Manufacturing 2002 –DIISM2002 –, Osaka, Japan, 2002, pp. 309-316.

Shostack, G. L., "Designing Services That Deliver", Harvard Business Review, Vol. 62, No. 1,1984, pp. 133-139.

Stickdorn, M., Schneider, J., "This is Service Design Thinking: Basics, Tools, Cases", Wiley, 2012.

Subrahmanian, E., Reich, Y., Konda, S. L., Dutoit, A., Cunningham, D., Patrick, R., Thomas, M., Westerberg, A. W., "The N-Dim approach to creating design support systems", Proceedings of 1997 ASME Design Engineering Technical Conference, Sacramento, CA, USA, 1997.

Sunaga, T., "Information Design Theories, Methodologies and Practices: A Project on a Platform Design for People Art", Proceedings of International Conference on Interaction Design 2008, Beijing, China, 2009.

Tateyama, T., Kawata, S., Shimomura, Y., Watanabe, K., Chiba, R., "Scene Transition Nets Simulator for Multi-aspect Modeling of Discrete-continuous Hybrid Systems", Proceedings of Eighth International Conference on Informatics in Control, Automation and Robotics (ICINCO 2011), Vol. 2, Noordwijkerhout, The Netherlands, 2011, pp. 467-474.

Tomiyama, T., Shimomura, Y., Watanabe, K., "A Note on Service Design Methodology", Proceedings of Design Theory and Methodology - DTM'04 -, The American Society for Mechanical Engineering (ASME), 2004.

Uhlmann, E., Bochnig, H., "PSS-CAD: An Approach to the Integrated Product and Service Development", Proceedings of the Fourth CIRP International Conference on Industrial Product-Service Systems, Tokyo, Japan, 2012, pp. 61-66.

Ullman, D. G., Wood, S., Craig, D., "The importance of drawing in the mechanical design process", Computers and Graphics, Vol. 14, No. 2, 1990, pp. 263-274.

Ulrich, K. T., Eppinger, S. S., "Product design and development", McGraw-Hill, New York, 2008.

Watanabe, K., Nishimura, T., "A unified approach for systematic and participatory design", Proceedings of the 19th International Conference on Engineering Design (ICED2013), Seoul, Korea, 2013.

Watanabe, K., Nishimura, T., Mochimaru, M., "A Meta-Methodology for Service Process Design", Proceedings of the First International Conference on Serviceology (ICServ2013), Tokyo, Japan, 2013.

Kentaro Watanabe, Dr., Research scientist
The National Institute of Advanced Industrial Science and Technology, Center for Service Research
2-3-26, Aomi, Koto-ku, Tokyo, 135-0064, Japan
Telephone: +81-3-3599-8875
Email: kentaro.watanabe@aist.go.jp
URL: http://unit.aist.go.jp/cfsr
https://sites.google.com/site/kentarowatanabe2012