Innovation of service system by human-centered design and effectual evolution: Hypothesis development and case verification

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ABSTRACT

Purpose – In order to realize service innovation, it is very important to understand how new value is created in a company's innovation mechanism and how internal and external corporate resources are combined. This research focuses on human-centered design thinking and effectuation and forms hypotheses about value creation and execution of service innovation. Then, in the service innovation creation project, we will examine how the problem definition is made and how the configured project is evolving toward problem-solving.

Design/Methodology/approach – The case study method is chosen for this study.

Findings – In order to create new service innovations, a mechanism to connect actors (Actor Involvement), a mechanism to form a new team (Teaming), a mechanism to encourage new problems to be discovered (Problem DIscovery), and a mechanism to support the service system integrating social capital brought by evolving team members (Resource Integration) are effective.

Originality/value – These findings have two important implications. First of all, the design activity that enhances interactions both inside and outside the company seems to have an impact on the radical innovative capability. Innovation is basically a collaborative effort and successful incorporation of diversity plays a central role in creating radical innovation. Diversity, communication, fluid diffusion of information, sharing and assimilation of knowledge is an important element of innovative capabilities regardless of its kind. It is unlikely that radical innovation will be created only by processing route-dependent information in a way that is routinized in the enterprise. Investment in design activities that encourage interaction and co-creation of value inside and outside the company enables problem setting by a new perspective from various actors, encourages internal and external interactions and new associations of organizational capital and can be the basis for selectively using these capabilities to gain the flexibility to respond to market or competitive emergencies. Therefore, design activities open to the inside and outside of companies can be key to developing "dynamic ability" that is not only to create ideas from the discovery of new perspectives but also to enable organizations to change the focus of competition and achieve a new form of competitive advantage.
Secondly, in order to create discontinuous ideas from internal and external interactions, it is essential to invest continuously in design activities to encourage setting new problems, not only for the organizational capital to solve the given problem. However, it is suggested insufficient for radical innovation if the firm is biased toward strengthening only design activities or only organizational capital. In order to enhance the radical innovative capability of the organization, it is important to enhance the ability to realize potential enhancement obtained by interaction with the inside and outside of the company through the introduction of design thinking, without conflicting with the fundamental aspect of corporate organizational capital and intellectual capital for individual skill improvement.

Key words (max 5) Service Innovation, Service Design, Design Thinking, Resource Integration

Paper type – Research paper

Innovation of service system by human-centered design and effectual evolution: Hypothesis development and case verification

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Introduction

Innovation is becoming more and more important and a difficult task for companies against the backdrop of the service economy and the advancement of information technology accelerating the servitization of industries. In the background, it seems that the importance of the service system increases and the problem becomes complicated. As information technology advances, it connects industries as general purpose technology, and new business is rapidly born from outside the existing industry (Lipsey, Carlaw, & Bekhar, 2006).In North America, startups are born from different fields such as Uber and Airbnb. In other areas, for example, efforts to create new industries across the industry involving governments such as Industry 4.0 (Ganzarain, & Errasti, 2016) in Germany and Society 5.0 (Society 5.0, 2015) in Japan are also started and new businesses to embody these concepts are rapidly rising. The source of this competitiveness is spreading not only to the physical products produced by traditional technology-focused R & D, but also to the design of service systems including those of products, software, networks, services, processes and experiences (Maglio, & Spohrer, 2013; Ettlie, & Rosenthal, 2011). The service system is the configuration of elements (people, information, technology, organization, etc.) connected to other systems for value co-creation (Maglio, Vargo, Caswell, & Spohrer, 2009; Spohrer, & Maglio, 2010).

In other words, the subject of innovation has been expanded from traditional products only to service systems including value co-creation such as customers and providers. Innovation research advances not only innovation process by conventional R & D, but also user innovation (von Hippel, 1986, 1998, 2001) and open innovation research (Chesbrough, 2006; Gassmann, Enkel, & Chesbrough, 2010). In service research, the value co-creation between customers and providers and the importance of resource integration are pointed out as services dominant logic is suggested (Vargo & Lusch, 2004; Vargo, Maglio & Akaka, 2008). Innovation combines the organization's skills and knowledge with the implicit needs of customers and users outside or inside the organization in a novel way (Renko, Carsrud, & Brännback, 2009). Innovation activities are not only carried out within the company but also have spread to a mechanism of interaction utilizing open innovation and co-creating value with various actors. In other words, the society and the economic environment change from the 20th century where the stable supply of goods leads the market to the 21st century where the diverse values of users who seek experiences and empathy lead the market. The roles played by companies that are the source of innovation are reconsidered and a change in the mechanism of creation of innovation is required (Hobday, Boddington, & Grantham, 2012).

Under these circumstances, enterprises should increase their innovation skills, design service systems by finding problems from an expanded perspective beyond their own activity areas, and transform themselves while changing with the environment (Siltaloppi, Koskela-Huotari, & Vargo, 2016). Firms with the capacity to innovate can respond to environmental challenges faster and better than non-innovative firms can (Brown & Eisenhard, 1995). Companies are required to raise organization learning capabilities that are open to outside the organization (Wetter-Edman, Vink, & Blomkvist, 2018). Recently the design management that integrates design and management has attracted attention by introducing design thinking into corporate management (Martin, 2009; Brown, 2009; Johansson, et al., 2013; Liedtka, 2015; Gruber et al., 2015). By doing so, it is expected to create not only existing ongoing activities but also a new business that brings value to society by recombining corporate intellectual capital. In order to realize design management, it is extremely important to understand how the firm resources inside and outside are combined to create new value in the innovation mechanism.

In order to realize service innovation, it is very important to understand how new value is created in a company's innovation mechanism and how internal and external corporate resources are combined. This research focuses on human-centered design thinking and effectuation and forms hypotheses about value creation and execution of service innovation. Then, based on the case studies, we will examine how the problem innovation is made in the service innovation creation project and how the configured project is evolving toward problem-solving.

Conceptual Background

Innovation is intrinsically about identifying and using opportunities to create new products, services, or work practices (Van de Ven, 1986). Intellectual capital is an important resource of management strategy and contributes to the creation of new social value and economic value by being incorporated into the mechanism of value creation of enterprise (Hargadon & Sutton, 1997). An important part of the knowledge and skills necessary for innovation exists with individuals and is used by individuals. The organization accumulates, organizes and stores individual knowledge in manuals, databases, and corporate rules and establishes robust structures, systems, and processes for present and future collective use (Garud & Nayyar, 1994). Organizations also assimilate and integrate knowledge by facilitating communication, sharing, transferring between individuals and promoting interactions in groups and networks (Allen, 1970, 1977; Wei, Yi, & Guo, 2014).

On the other hand, for the innovation of service systems consisting of diverse actors, companies that introduce design thinking which is a method of innovation by human-centered design (Brown, 2008) have increased. Activities based on design thinking, design activities are carried out by highly diverse groups. Knowledge accumulated in an organization based on human capital and individual knowledge may be newly combined by activities based on design thinking. The group plays an important role in developing knowledge within the organization (Nonaka, 1994). Group activities and quality of members will improve not only how to utilize the organization's organized knowledge of patents, databases, and licenses but also how these sources of knowledge are updated and strengthened.

Resource integration in companies

Focusing on intellectual capital utilized by companies for competitive advantage, individuals, organizations (structures, processes, and systems), or design activities that integrate them are discussed. Human capital is defined as knowledge, skills, and ability to be present and used in individuals (Schultz, 1961; Romer, 1990; Snell & Dean, 1992). Meanwhile, organizational capital is inherent in databases, patents, manuals, structures, systems and processes, and organized knowledge and systematized experience to be used (Walsh & Ungson, 1991; Davenport & Prusak, 1998).

Individual knowledge (human capital) is often systematized, institutionalized (organizational capital), and utilized through transferred to groups and networks. Organizational capital is organized, and its creation, preservation, and strengthening are done through structured and repeated activities (Nelson & Winter, 1982; Walsh & Ungson, 1991). Such systematization is manifested in various manuals, databases, and rules within the company for organizations to use to accumulate and retain knowledge. Information exchange conducted as part of these established structures and processes tends to follow well established and systematized guidelines. As a result, knowledge specific to organizational capital tends to be limited within the set tolerance, coded, accumulated and used in established ways (Brown & Duguid, 1991). In new product development (NPD), which focuses on physical product development, organizational knowledge conservation activities which are improved, expanded, and integrated into knowledge within the organization are compatible with the object of technology development. Likewise, structured processes in new product development projects that exploit and strengthen organization knowledge clearly benefit from abundant information exchange and collaboration among project team members (Subramaram & Venkatraman, 2001).

On the other hand, individual expertise and related human capital may or may not stay within the organization. Also, design activities utilizing the human and organizational capital in a group tend

to have flexible means for sharing and exchanging knowledge without following the prescribed rules and procedures for accessing sharing, or trading information. As a result, the uncoded knowledge is accumulated and used as a relation in the network and as a relation between the interaction and the context including it. As such, design activities done by a group serves as a facilitator to strengthen how human capital and organizational capital are utilized within an organization. In the service system, it is necessary to consider various actors such as customer employees as well as suppliers, and not only the function of the product, but also the interaction with related actors, the individual customer experience and the comprehensive experience of multiple touch points. In other words, in order to utilize intellectual capital in service system innovation, it is indispensable to develop norms to promote understanding of situations based on interaction among various actors, their relationships, understanding of situation based on empathy, promotion of collaborative work and value co-creation (Wetter-Edman, Vink, & Blomkvist, 2018). As one solution, many companies have introduced design thinking as a method of innovation based on human-centered design (Brown, 2008).

Design activities in companies

The origin of design thinking is "designer thinking" based on several academic researches focusing on specific skills and abilities of professional designers such as architects and regarded as a simplified version of "designer thinking" (Johansson, Woodilla & Cetinkaya, 2013). Several studies on designer thinking have already started in the 1960s. Simon (1969) defined the design as "to change the existing situation to a favorable one" and explains the design structure and framework based on the idea that it means artifacts created by human intentional processes. Design activities first recognize the situation and are implemented nonlinearly, interacting with the situation (Schön, 1983). Buchanan (1992) refers to the characteristics of the nonlinear design process and claims that the design process is a way of thinking to tackle "evil problems". Compared with designers thinking, the thinking of design thinking is focused on people incorporating design into organizations other than designers, especially for those who are interested in organizational management and business. Design thinking has not been studied as much as designer thinking but has expanded widely and rapidly in the organizational management field as intended (Johansson, Woodilla & Cetinkaya, 2013). A typical example is a design consulting company called IDEO and Tim Brown, the current CEO, describes design thinking as a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity (Brown, 2009). The concept of "design thinking" was spread especially to the industry by the design consulting company (Liedtka, 2015).

The design is a concept and plan of artifacts in a broad sense (Simon 1969; Bruce & Bessant, 2002). In product development, design management is discussed as a series of organizational and administrative skills or practices required to introduce design to the product development process and achieve it (Gorb & Dumas 1987; Bruce & Cooper, 1997; Dumas & Mintzberg, 1989; Chiv & Alegre, 2009). On the other hand, the design of service systems is becoming more important in addition to physical products, and service design has attracted attention as a design method of service systems recently (Marger, 2004; Wetter-Edman, Sangiorgi, Edvardsson, Holmlid, Grönroos, & Mattelmäki, 2014). Service design adapts design thinking to the creation of service systems, and service design cases and methods are discussed in enterprises and public services. The research area of service design has been extended from interface to interaction design since 1990. In interaction design and Human Centered Design (HCD), the overall design is targeted for designing the user experience based on product user interface and its use. In the service science and product service system (PSS) research community, the human-centered design was also discussed, and research subjects have been expanded to service systems and service life cycles.

The reason why companies introduce design thinking differs depending on the purpose, such as, human-centered design methodology of innovation (Brown, 2008), management skills or theory (Dunne & Martin, 2006; Boland & Collopy, 2004) to solve organizational problems, effective

Learning process for knowledge creation (Beckman & Barry, 2007) etc.. When dealing with very complex service systems including rapidly changing and interacting components, conventional analytic approaches alone do not work very well. Analytical approaches work well when the product under development is fairly well understood or dealing with clearly defined problems. Design thinking has been drawing attention as an approach to deal with complex problems (Buchanan, 1992). In order to create discontinuous trajectories, problem discovery and problem setting are important as their starting point. In design thinking, new insights are found based on behaviors of people with high diversity such as extreme users focusing on scenes that cause discomfort and unexpected situations (Wetter-Edman, Vink, and Blomkvist, 2018). A new viewpoint is recognized and understood by the interaction of actors with a wide variety of practices based on value creation (Brown, Colville & Pye, 2015; Weick, 1995; Melton, & Hartline, 2012). The design thinking has high commonality with the feature of sensemaking and seeks generalization about patterns and motivation of social behavior through an abstract process with insight from observational facts (Cross, 2011; Dorst, 2011). Activities based on design thinking are carried out by highly diverse groups, and these group activities play an important role in developing knowledge within the organization (Nonaka, 1994). Implementation of design activities (sympathy, problem setting, idea creation, prototype, verification, etc.) by various actors deepens the understanding of the situation, enables problem setting by a new viewpoint, encourages new interconnection of internal and external companies and internal capital, and creates radical ideas through value co-creation.

Entrepreneur activities

So far, researchers have traditionally studied entrepreneurship from the following perspectives. (1) A set of personality traits that describe the success or failure of a company created by an entrepreneur, (2) An environment that includes a set of situations or attributes that give rise to an opportunity, the success or failure of a venture. In the former case, the entrepreneurial candidate either has or does not have the right characteristics. If not, we will be prompted to foster them. In the latter, potential entrepreneurs are required to develop strategies and skills to recognize, identify and exploit high potential opportunities.

Recently, however, a new focus has been placed on entrepreneurial expertise (Sarasvathy, 2001). Expertise is implicit, consists of aspects of learnable and teachable experiences and is associated with high performance in a particular domain. Instead of trying to account for performance variations based on human characteristics or circumstances as input, the lens of expertise assumes a high level of performance and understands the commonalities of different professionals within a single domain Focus on what to do. As a result of in-depth research on how professional entrepreneurs act, think and decide in the early stages of creating a new business, the elements of the effective logic they use are beginning to be revealed. It has become clear that these factors also apply to the early days of new companies, new markets, and new industries.

Research Framework

In this paper, we aim to understand how new value is created in a company's innovation mechanism, and how internal and external corporate resources are combined to realize service innovation. In the following, we focus on human-centered design thinking and effectuation to form hypotheses about value creation and execution of service innovation.

With the spread of the Internet, as seen by Uber and Airbnb, who have created new value through service systems and platforms rather than a single product, entry from discontinuing and disparate industries are noteworthy. R & D, the source of product innovation in the enterprise, has collaborated with the marketing organization to create a team with the necessary expertise for new technology development and to carry out experimental effective activities. On the other hand, for service innovation that impacts on the customer experience and process, the previous activities can not sufficiently define the problem. Therefore, companies are thinking about new innovation mechanisms. This research focuses not only on problem-solving but also on the design activities of

companies that are thought to influence problem discovery/problem setting. This understands the relationship the company's intellectual capital has on innovation and the integration of them to the effect of design activities that create value.

Source of ideas for Service Innovation

Radical innovation leads to discontinuous trajectories. Ideas for radical innovation are often found through interaction with individuals and outside the organization. The important opportunity to create new knowledge, not on the extension of the knowledge of the organization is most likely to be caused by interactions with external actors derived from design activities, not necessarily within the company. As a result of interaction on the network, new connections are encouraged by accessing many knowledge and capital accumulated inside and outside the organization in order to solve problems. In radical innovation, the process of "mediating" and combining ideas that have not been relevant until now is important (Hargadon, & Sutton, 1997). In various studies, social network emphasizes how to support the acceptance of extreme ideas of individuals within a wide organization and industry environment (Schön, 1963; Tushman & Murmann, 1998; Schilling, 1998). Ties and connections that encourage a wide range of individuals to share information and know-how are important characteristics of design activities. Human capital and organizational capital provide organizations a platform for diverse ideas and ideas but design activities help to combine them and create unexpected and unusual combinations for radical breakthroughs. In addition, design activities also promote collaboration within and between organizations. Design activities allow individuals not only to establish legitimacy for revolutionary ideas within an organization but also to link resources that are widely organized (Sarasvathy, 2001).

Hypothesis 1 Actor Involvement: Access to new actors through non-existing channels is effective for creating new value for new technologies.

Problem Discovery

The process of radical innovation is initiated by finding new problems and setting up problems. Problems found by observation and interaction of actors inside and outside the company are considered from various perspectives and serve as a starting point for obtaining new insights. For problem discovery, design thinking uses empathy and focuses on extreme users. New insights are discovered based on behaviors of people with high diversity such as extreme users, are obtained from those observations and sympathy focused on unexpected scenes and unexpected situations (Wetter-Edman, Vink, & Blomkvist, 2018). There are various methods for sensemaking to obtain a common understanding among actors with high diversity. Sensemaking is related to new viewpoint recognition, insight based on deepening understanding, social practice of ideas (Brown, Colville & Pye, 2015; Weick, 1995). Design thinking seeks generalization about patterns and motivation of social behavior through an abstract process with insight from observational facts and has high commonality with the feature of sensemaking (Cross, 2011; Dorst, 2011). In the interaction on the network based on diverse social capital, design activities utilizing design thinking are deepened to understand the situation and problems are set from a new perspective (Cooney, Stewart, Vanka, & Haslem, 2017). Then the insights and problem setups obtained by interaction and value co-creation inside and outside the company create radial ideas for solving them.

Hypothesis 2-1 Problem Discovery: When design thinking from the human-centered viewpoint is used for problem discovery, problems are recognized from various viewpoints and deep insight is obtained.

Problem setting found by interaction with actors inside and outside the enterprise educates organizations about new ways to solve existing problems through access to diverse knowledge areas (Rosenkopf & Nerkar, 2001). New problem discovery triggers and organizations access and touch various new and alternative knowledge areas affect the tendency to transform knowledge.

Knowledge transformation requires questioning general rules from various perspectives and looking for fundamentally different solutions to existing problems (Tushman & Anderson, 1986). As a result, new connections are encouraged by accessing many knowledge and organizational capital accumulated inside and outside the organization to solve problems(Sarasvathy, 2001). Due to the diverse interactions encouraged by design activities, the knowledge possessed by the organization is utilized to solve the problem of discontinuous innovation. In other words, design activities enable setting up problems from a new perspective as a "mechanism to promote new combinations of intellectual capital" and lead to innovative problem solving by promoting a new combination of knowledge transformation accumulated in the organization.

Hypothesis 2-2 Teaming: A team consisting of various members that transcend the boundaries of existing organizations is effective in creating ideas for a solution.

Resource Integration for Innovation

Knowledge stored in the organization affects the tendency to strengthen that knowledge. Saved knowledge tends to be used for structured repetitive activities and is generally considered to be more reliable and robust than other knowledge (Katila, 2002; Lyles & Mitroff, 1980; Martin & Mitchell, 1998). Established processes and routines that utilize the knowledge that is generally stored in an organization often leads to the evolution of knowledge in a way that the organization feels difficult to preserve and exploit (Nelson & Winter, 1982). By improving the interactions, relationships and the quality of collaboration between individual groups acting with saved knowledge, eventually, path-dependent trajectories of knowledge are created (Cohen & Levinthal, 1990; Daneels, 2002). Notable features of the organizational capital include manuals, databases, structures, processes, and routines to organize and preserve knowledge and encourage the use of this knowledge (Hansen, Nohria, & Tierney, 1999). It is therefore expected that organizational capital will strengthen general knowledge enhancement, thereby affecting the organization's additional innovative capabilities.

The problems of existing products and services are solved by finding the possibility of new technologies and systems (Chiva, & Alegre, 2009). However, the more organizations have the infrastructure of strong organizational capital, the more knowledge change for problem-solving matches the existing direction, and the range of change is limited. The problem to be solved is linked to existing products and services, so the solution for that is highly sustainable (Baker, & Sinkula, 2007; Costa, et al., 2018). Even in that case design activities are said to be effective for enhancing customer experience (Andreassen, Kristensson, Lervik-Olsen, Parasuraman, McColl-Kennedy, Edvardsson, & Colurcio, 2016).

Hypothesis 3 Resource Integration: Human-centered decision-making is important for changing the boundaries and resource composition of existing organizations and creating new value.

From the point of view of the provider (Provider) and user (User) of the created value, the generated hypotheses can be positioned in a framework in which each current activity and a new activity are plotted on the horizontal axis(Sawatani & Fujigaki, 2014). One of the vertical axes is the present condition and novelty of technology for the provider, and the other one is the present condition and novelty of the process for the user.

R & D, the source of product innovation in the enterprise, has collaborated with the marketing organization to create a team with the necessary expertise for new technology development and to carry out experimental effective activities. On the other hand, it is said that resource integration for value co-creation and solution with customers is important for service innovation that impacts on customer experience and processes (). Actor Involvement (H1), Problem Discovery (H2-1), Teaming (H2-2), Resource Integration (H3) generated in this paper are positioned in the figure1.

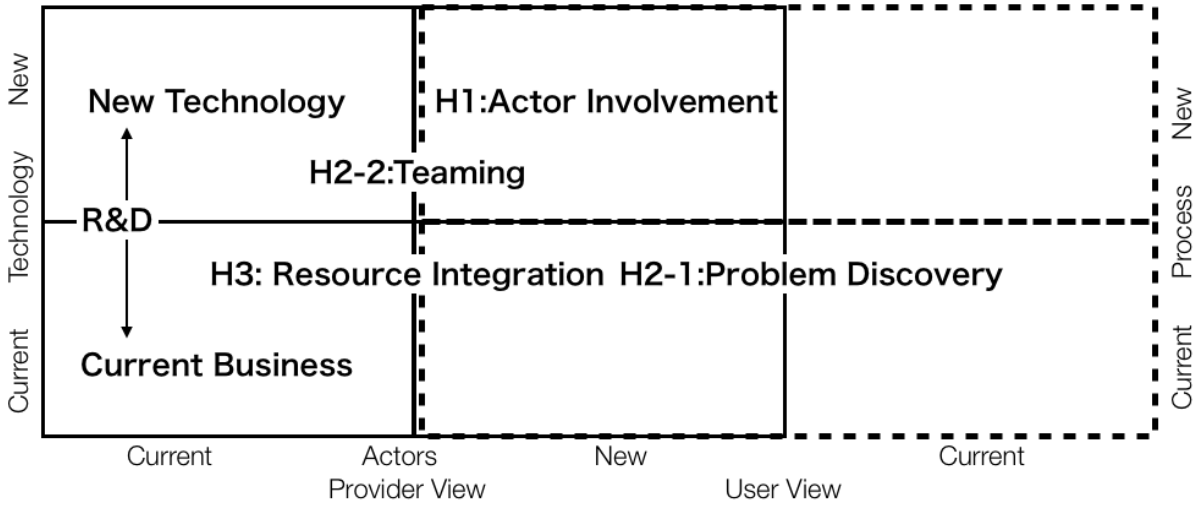


Figure 1. Research Framework Positioned Generated Hypotheses

Research Methodology

Only limited literature is available on this research area so that the case study method is chosen for this study. This approach fits quite new research. The case study methodology requires research design [11] including objective setting, selecting cases, crafting instruments and protocols, entering the field, analyzing data, shaping hypotheses, enfolding literature and reaching closure [12]. In this paper, the case study method acknowledges us to use rich sources of data, such as interviews, workshops, on-site visits, observation, public web pages, reports, articles, and analyze those contents in order to generate new insights for research on innovation activities. The case study approach allows us to develop novel insights as a basis for further research. To choose companies for the case study, the size of companies and industry are investigated carefully since these may affect the service innovation activists. For this consideration, the following companies are chosen for the study.

• Large information technology-based service company (Case 1)
• Large product based company toward service innovation (Case 2)

The study is conducted observing the cases activities as one of the team members. The case 1 is developing new technology, trying to adopt the technology at the user site and expand the possibility of the technology. The company has initiated the new program focusing on service innovation creating with consultants and customers. Case 2 is started as a new program applying design thinking to R&D based technologies. This program has been just started and trial phase.

Case Study

First, we describe successful examples of service innovation creation. In Case 1, a consulting and R & D configuration team was created to respond to customer requests. A value proposition was created by integrating the potential technology with the problem definition from deep insights into the customer environment through consulting. Case 1 then launched a collaborative PoC with the customer. After carrying out value verification by PoC, case 1 entered into an agreement with customers for full-scale service provision and provided technology and products.

First, there was a collaboration (1) of actors consisting of a consultant who understood the customer's problem, R & D for proposing a solution to the problem, and a customer who provided the problem for consulting. After that, members for carrying out the project in the company are gathered (2), and a deep understanding of the problem is conducted through customer visits and surveys by team members (3). During this time, a hypothesis on customer value is made, and verification is repeated by discussions with the customer. New members are added by forming hypotheses from the information obtained, such as discussions with other departments introduced

by customers, approaches to other companies, and discussions with other R & D members with potential technology. The Then a prototype is created to embody the solution (4) and the PoC project is started (5). After value verification in the PoC project, as a formal service (6), a solution is provided to solve the customer's problems (7).
Links between consultants who have relationships with customers who provide new problems in advance and links with R & D that can provide solutions are defined as a program, so that problem discovery and problem resolution can be performed quickly in collaboration with customers. In addition to products, since service provision has become established as a normal business, there is little need for major organizational changes from PoC to formal contracts. Resource integration for technology and knowledge will be conducted as part of the members' participation in the contracted service project. When Actor Involvement (H1) and Problem Discovery (H2-1) occur, subsequent Teaming (H2-2) and Resource Integration (H3) are embedded in the program. Therefore, how to improve the first two precisions is the key to service innovation success.
Actor Involvement comes from strategy consultants and customer discussions and experiences to R & D. Rather than a minor operation problem, the customer's essential problem hypothesis is triggered, and simulation of hypothesis setting and a virtual solution is performed. Second, adding customers to the team increases the accessible resources. Therefore, problem discovery and verification are repeated. Problems are defined by access to people (customers), technologies, and businesses (strategies) that are considered important in design thinking. As a result, the accuracy of the first two activities is also considered to be high.

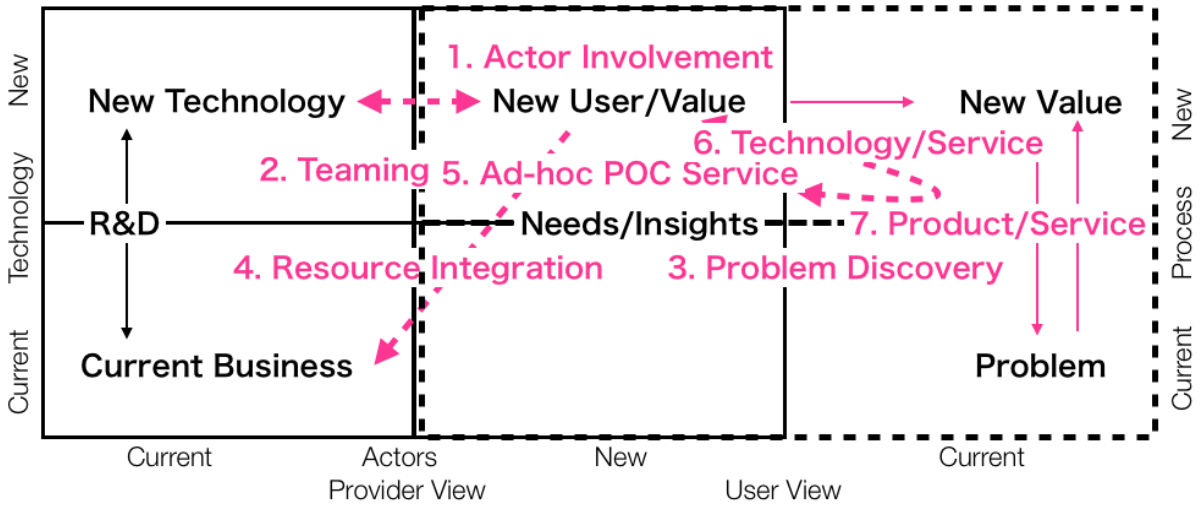
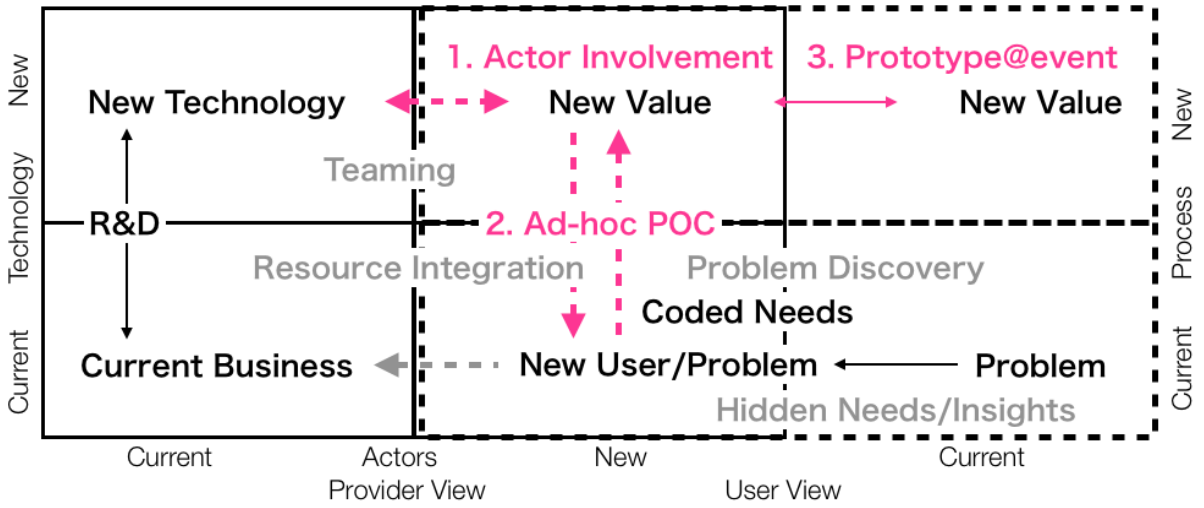


Figure 2. Case 1 Service Innovation Activities

Next, I will introduce Case 2, the first program that utilizes design thinking. The program aimed to discover new values for R & D technology, prototype development, exhibit at the event and get feedback. An organization that ties R & D and potential customers leads this program. In the program, participants from R & D and customers were connected, and various inputs were obtained (1). Then I developed a prototype that received it (2) and got feedback at the event (3).
Because of the limited period of about half a year, customer input was limited to superficial ones. Therefore, the essential meaning for various inputs could not be made sufficiently. In addition, the members were limited to R & D, and it was difficult to create value from diverse viewpoints. At the problem definition stage, because access to customers was limited and intimate understanding, it could not be said enough to discover the new value of the technology which is the original purpose. As a result, Actor Involvement (H1) occurred, but teaming, problem discovery and resource integration did not happen.
In retrospect, the original purpose was myopic to get an output for the current work, so a specific technology to use was already assumed. As a result, it was tempted to move away from the current customers and to search for customers that bring new problems different from the ones assumed. However, it brought about significant changes in the thinking and behavior changes of the

participants. The members who participated were made aware that they practiced innovation activities other than normal business and tried methods for discovering new values through customer observation etc. Also, program providers were able to obtain input for future policies.



Figire 3. Case2 Service Innovation Activities

Discussion

The case study shows that Actor Involvement, Problem DIscovery, Teaming and Resource Integration presented in this paper are important for the idea creation of service innovation. Not only the novelty of the technology but also the existence of a new customer and user contact point (H1) is significant for the current process and new value creation not recognized at present. On top of that, not only receiving their problems as coded information, but also gathering information to go to the customer site and gain deep insights that have not been verbalized (H2-1), and a team configuration consisting of diverse members (H2-2) is required for problem setting. These things are pointed out by design thinking. In addition, it is often necessary to work with broader organizations, not just the original team members, in order to solve the problem definitions obtained there. Therefore, further resource integration takes place (H3). If these can not be fully implemented, the solution will not be possible as it will end up with an interwoven result or even if an important problem is defined, more resource consolidation will be difficult.

In other words, in order to create new service innovations, a mechanism to connect actors (Actor Involvement), a mechanism to form a new team (Teaming), a mechanism to encourage new problems to be discovered (Problem Discovery), and a mechanism to support the service system that utilizes social capital brought by changing team members (Resource Integration) are effective. However, it is necessary to discuss whether these are enough. We also need to consider the initial issues such as the cost of doing them, the capitalization of the actors, etc.

These findings have two important implications. First of all, the design activity that enhances interactions both inside and outside the company seems to have an impact on the radical innovative capability. Innovation is basically a collaborative effort and successful incorporation of diversity plays a central role in creating radical innovation. Diversity, communication, fluid diffusion of information, sharing and assimilation of knowledge is an important element of innovative capabilities regardless of its kind. It is unlikely that radical innovation will be created only by processing route-dependent information in a way that is routinized in the enterprise.

Investment in design activities that encourage interaction and co-creation of value inside and outside the company enables problem setting by a new perspective from various actors, encourages internal and external interactions and new associations of organizational capital, and can be the basis for selectively using these capabilities to gain the flexibility to respond to market or competitive emergencies. Therefore, design activities open to the inside and outside of companies can be key to developing "dynamic ability" that is not only to create ideas from the discovery of

new perspectives but also to enable organizations to change the focus of competition and achieve a new form of competitive advantage (Teece, Pisano, & Shuen, 1997).
Secondly, in order to create discontinuous ideas from internal and external interactions, it is essential to invest continuously in design activities to encourage setting new problems, not only for the organizational capital to solve the given problem. However, it is suggested insufficient for radical innovation if the firm is biased toward strengthening only design activities or only organizational capital. In order to enhance the radical innovative capability of the organization, it is important to enhance the ability to realize potential enhancement obtained by interaction with the inside and outside of the company through the introduction of design thinking, without conflicting with the fundamental aspect of corporate organizational capital and intellectual capital for individual skill improvement.

Future Research Directions

Innovation has become an increasingly important and difficult task for businesses. Innovation is built by connecting corporate intellectual capital to the heading value system. This research was conducted as a first step by paying attention to the design function integrating the intellectual capital of the company. However, the subject companies in this survey were limited only to Japan. Moreover, the definition of design and design activities is still ambiguous and it is expected to be an early stage and common recognition will be obtained in a wide area in the future. Furthermore, innovation is a complex phenomenon, and elements other than intellectual capital are also involved. Therefore, it is necessary to deepen understanding by combining interviews and other methods.
Initiatives of innovation and form of innovation, in particular, innovation of service systems are gaining attention as future research areas. Also, service systems extended from conventional physical products are based on the complementary resources of multiple actors. In order to construct a new service system, it is necessary to consider initial problems such as costs for connecting participating actors, cost to link actors to join, the compensation for the cost of a service system created by the social capital and assets provided by actors, risk premium and cost for contribution of primary actor of a service system. In order to create service innovation and service systems, it is important to develop a human-centered design activity and a mechanism to encourage co-creation of value beyond the boundary of the company. In other words, corporate activities (problems recognition, idea creation/implementation, decision making, etc.) that integrates resources beyond the company's boundary by removing the framework of existing organizations will be necessary.

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