Patterns of Designer-User Interactions in the Design Innovation Process

Completed Research Paper

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Abstract

In previous research, human-centered interaction patterns and protocols have not been documented adequately in IS design and innovation research; therefore, this paper empirically explores designer-user interaction patterns in the design innovation process. To do this, we believe that designer-user interaction will function as the core action in discovering design requirements and validating the design problems and solutions by understanding users and their information in IS. With this view on designer-user interaction, we ask the following research question--what do interactions between designers and users characterize distinctive patterns in the design innovation process? As an empirical approach, this study analyzed thirty two digital innovation project narratives and synthesized four designer-user interaction patterns, which demonstrate nine sub-patterns. The significance of this study is to theorize the patterns of designer-user interaction and suggests a theoretical / practical guideline for researchers and practitioners in the community of the three innovation research communities.

Keywords (Required)

Innovation patterns, designer-user interaction, design process, information systems development

Introduction

IT innovation has radically identified new forms and functions of product innovation, and it has reconfigured the established ill-defined social, business, or individual matters. In information systems (IS), previous IS researchers have highlighted the IT innovation in terms of IT values in the firms, which focus on the relationships among firms' IT assets, capabilities, and performances (Benbasat & Zmud, 2003; Melville, Kraemer, & Gurbaxani, 2004; Sambamurthy & Zmud, 2000). Yet, the IT value research has encountered limitations of how this firm-oriented research approach could invite customers' behaviors and attitudes into the IT assets and IT capabilities. With this consideration, some IS researchers have sought to expand the existing IT value research by understanding users' information environments (Jarvenpaa & Tuunainen, 2013), while the others have identified digital innovation research, which deals with the boundary research areas between IT innovation and product innovation (Henfridsson, Yoo, & Svahn, 2009; Yoo, Henfridsson, & Lyytinen, 2010). In digital innovation research, IS researchers have discovered the issues of products, services, and systems as multiple layered IS design artifacts (Boland Jr, Lyytinen, & Yoo, 2007). Thus, current IS artifact research paradigm has moved toward how IT innovation could be coupled with product and digital innovation.

Based on this view, a few prior IS researchers have already argued the importance of user interaction and considered the methodologies of how designers (developers) could invite users (customers) into the design process; however, the existing models and frameworks in IT, product, digital innovation studies do not provide any clear protocols, models, and theories on this issue. Therefore, in this study, we empirically investigate the forms of interactions and applied methods between designers and users during a design innovation process. With this objective, we ask the following research question--*what characteristic interactions and applied interaction methods between designers and users could identify designer-user interaction patterns in the design innovation process?* To address this research question, we invite Bourdiue's theory of practice (Bourdieu, 1973, 1986, 1998; Bourdieu & Nice, 1997; Bourdieu & Wacquant, 2004) and Star and Griesmer's boundary objects (Star & Griesemer, 1989) as theoretical foundations.

As empirical evidence, this study collected thirty two digital innovation project narratives and analyzed them focusing on actual designer-user interactions and their applied methods. To analyze the collected data set, this study follows a grounded theory approach (Strauss & Corbin, 1990) for understanding the micro dynamics of designer-user interaction and their resulting outcomes. As a result, this study synthesized four designer-user interaction patterns demonstrating nine sub-patterns.

This study makes three contributions: first, it empirically theorizes the patterns of designer-user interaction in the process of design innovation; second, it opens the concept of genetivity of designer-user interaction, focusing on how the actual interaction between designers and users could interact with each other; third, it will give practical and methodological directions and guidelines for the communities of IS design -- how the IS designers could interact with users in creating better design outcomes in the process of IS innovation.

Next, we briefly review the designer-user interaction in IS and three innovation studies (IT, product, and digital innovation). We then demonstrate theoretical foundations and present research methodology that we conducted in this research. Then, we summarize the findings and discuss the implication of the identified designer-user innovation patterns.

Literature Reviews

This study explores patterns of interaction between designers and users in the design process. The designer-user interaction and its patterns have not documented adequately in IS; however, these interactions have been partly considered in information systems development (ISD) and three innovation research-- IT, product, and digital innovation.

Information Systems Development

In information systems development (ISD) research, some studies have investigated designer user interaction in terms of communication problems, user involvement, success of IS products.

With the view of communication problems between designers and user, Kaiser & Bostrom (1982) argue communication gaps among a user, a manager, a system analyst, and their different considerations in a MIS project team. Levina (2005) argues design collaboration among multiple stakeholders to combine different design actions and opinions. Robey (1994) proposes a model of interpersonal processes to overcome the conflicts by understanding the importance of interpersonal activities in ISD. Barki & Hartwick (2001) test how IS designers and users can minimize interpersonal conflicts that occur in ISD.

With the view of user involvement, prior IS researchers have considered how users can become a more active stakeholder group in ISD. Ives & Olson (1984) investigate the degree of user involvement in creating a final IS product. Schonberger (1980) suggests a contingency model including user involvement and decision making. Tait & Vessey (1988) also argue the effect of user involvement in a contingency approach for system success. Hirschheim (1989) explores participative system design with the degree of users' involvement between social content and technical content. Kasper (1996) seeks to enhance the design of decision support systems (DSS) through user calibration of their performance.

With the respect of successful IS products, some previous IS scholars have argued the importance of interactions between IS designers and IS users. Baskerville & Stage (1996) regard prototypes between systems developers and users as tools of risk analysis and IS control in ISD. Marakas & Elam (1998) investigate the semantic questioning patterns between analysts and users in software system development. McLean (1979) offers an alternative model in which end-users can be application developers in ISD. As empirical studies, Boland (1978) tests a more effective protocol of user interaction in ISD, and Salaway (1987) tests two different organizational learning models between users and analysts.

Designer-User Interaction among Three Innovation Studies

In IS research, there is a research direction for discovering values of IS artifacts, considering the three innovation research areas--IT, product, and digital innovations. In this research direction, I posit the meanings of designer-user interaction in IS artifacts, concerning three innovations, because current established IS artifacts do not highlight the importance of designer-user interaction in the design process. Also, these three innovation studies do not include the value of designer-user interaction in the process of products, systems and services. Thus, these research areas call for more attention users and their information environments in the early stage of innovation.

In IT innovation research, most IS researchers have emphasized the IT values in firms' performance, which examine the relationships among IT assets, firm capabilities, and firm performances (Benbasat & Zmud, 2003; Melville, et al., 2004; Sambamurthy & Zmud, 2000) and some studies have examined the effectiveness of IT innovation compared with administrative innovation (Swanson, 1994; Swanson & Ramiller, 1997). Therefore, IS researchers have taken a fairly narrowed focused meanings of IT values in the firm and organizational levels. On the other hand, a few IS scholars have argued to reconsider the meanings of IS artifacts with to balance research topics and directions (Orlikowski & Iacono, 2001). On the other hand, current a few researchers have sought to enhance the meanings of IT value research models and frameworks by understanding a more elusive boundary stemming from IT values in the firm level to multiple levels including customers and community learning (Jarvenpaa & Tuunainen, 2013; Wang & Ramiller, 2009).

In product innovation research, many product innovation researchers have developed the knowledge and practice for identifying different forms and functions. Henderson & Clark (1990) propose the frameworks of IT innovation arguing four categories of IT innovation and Verganti (2013) argues design meanings in IT innovation for identifying the values of design in the IT organization. Some product innovation researchers have argued product components, architecture types, and the importance of modularity in order to incorporate appropriate problem solving outcomes in product innovation (Baldwin & Clark, 2003; Ethiraj & Levinthal, 2004; Ulrich & Eppinger, 1995). Only a few scholars have considered the importance of users and user-driven product innovation in the design process (Von Hippel, 1986, 1994, 2005).

In digital innovation research, IS researchers have argued the importance of relationships between IT innovation and product innovations. Yoo *et al.* (2010) summarize two innovations (product innovations versus process innovation), and they argue the importance of modular architect in order to incorporate the problems and solutions in products, systems, and services with a view of systems. Some researchers have highlight the heterogeneous characteristics and roles of IT artifacts (Boland Jr, et al., 2007; Yoo, Boland Jr, Lyytinen, & Majchrzak, 2012). In addition, some IS researchers have considered the importance of modularity and malleable platforms, which consider heterogeneous stakeholders' interactions in order to synthesize successful IS artifacts in the process of digital innovation (Henfridsson & Bygstad, 2013; Henfridsson, et al., 2009; Svahn, Henfridsson, & Yoo, 2009).

Considering the three innovation approaches, IT, product, and digital innovations have discovered the following issues. The IT innovation have investigated the importance of IT value in firms and expanded the meanings of IT values in multiple organizations. Product innovation has improved the meaning of forms and functions among stakeholders in the innovation process. Digital innovation community have argued the importance of modularity focusing on the functions of platforms, balancing among products, systems, and services balancing IT and product innovation for enhancing the domain of knowledge in IS. Yet, the a critical problems on these three innovations, only a few scholars have regarded users or designer-user interaction as a critical issue in creating better design outcomes in the design process.

Theoretical Foundations

To address the research question, *what do interactions between designers and users characterize distinctive patterns in the design innovation process?* we take up Bourdieu's theory of practice (Bourdieu, 1973, 1986, 1998; Bourdieu & Nice, 1997; Bourdieu & Wacquant, 2004) and the theory of boundary objects (Star & Griesemer, 1989) as theoretical foundations. Bourdieu's theory of practice and boundary objects account for a theoretical intersection, which we define as the designers' and users' generative actions (Bourdieu's theory of practice) and their resulting outcomes (boundary objects) in the design innovation process.

Bourdieu's Theory of Practice

Bourdieu's theory of practice (Bourdieu, 1973, 1986, 1998; Bourdieu & Nice, 1997; Bourdieu & Wacquant, 2004) deals with social interactions between individuals and the social structures in a society. In his theory, he defines three components -- 'field', 'habitus', and 'practice' -- in order to explain the relationships between individuals and a society. In order to demonstrate them in a societal context, Bourdieu classifies these three components as follows: field entails a series of rules; habitus is the values from the cultural history; and practice is the outcomes from habitus existing in moments of practice. Based on his basic definition, we interpret Bourdieu's theory of practice as a macro structure in order to explore how designers and users can produce interaction patterns during a design process (Park, 2013). In the design innovation process, designer-user interaction follows from habitus to practice, and on to field in Bourdieu's theory. In this sequence, we identify three components of Bourdieu's theory of practice as the following: 'field' as a determined history of actions; 'habitus' as a mode of collected actions; and 'practice' as a situated action.

In this paper, we invite Bourdieu's theory of practice as a macro view of designer-user interactions in order to understand the structure of designer-user interaction in the process of design innovation. Based on this theoretical perspective, we will determine the structures of the generative interactions between designers and users by asking what actual interaction patterns exist in, and what design methods are applied for indentifying users in the design innovation process.

Boundary Objects

Star and Griesemer (1989) introduce the original concept of boundary objects, and Carlile (2002, 2004) further develops the boundary objects. Star and Griesemer (1989) originally define boundary objects as a term of institutional ecology in order to distinguish amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, where they observe boundary objects as mediating translation among different perspectives across diverse groups. Carlile (2002, 2004) expands boundary objects as knowledge boundaries and observes three different knowledge boundaries in new product development -- syntactic, semantic, and pragmatic boundaries by emphasizing the material structures of knowledge sharing in the process of a new product development in an engineering company. In his studies, Carlile (2004) enhances the definition of boundary objects and views intangible knowledge as a boundary object when it is shared as common knowledge among project stakeholders and let them see how one's domain-specific knowledge is different but dependent on the others'. Therefore, boundary objects can be understood as a process or a protocol, which demonstrates the relationships between designer-user interactions and their outcomes in the design process. Prior researchers define three types of boundary objects (Star and Griesemer 1989; Carlile 2002; 2004; Bergman et al. 2007): (1) boundary objects as objects (e.g. repositories, database, and parts of libraries) (2) boundary objects as models (e.g. standardized forms and methods for problem solving across different functional settings), and (3) boundary objects as maps (e.g. representations such as prototypes, Gantt charts, process maps, and workflow matrices).

In this paper, we view boundary objects as outcomes from designer-user interactions by the view of micro dynamic. The designer-user interactions create tangible and intangible design outcomes in the design process. The tangible boundary objects (design outcomes) will be visible design prototypes, while intangible boundary objects (design outcomes) will be designers' invisible design orientations or identified design problems.

Methodology

Collected Data

We collected *thirty two* digital innovation project stories related to designer-user interaction and their design outcomes from the thirty five designer interviews. Based on the question, only thirty two designers answered and shared their project experiences among thirty five designers, because the other a few designers did not have any experience about innovation projects with real users in their design processes.

Collected Data		Designer-User Interactions in the Design Process		
Projects (N)	Design Artifacts (N)	Research	Synthesis	Development
Innovation	Products (12)	6	1	5
	Systems (11)	2	1	8
	Services (9)	7	1	1
Total: 32 (N)		15	3	14

Table 1. Interview Data

As Table 1 presents, this study collected data regarding design artifacts and processes. From the collected *thirty two* projects, it shows that designer-user interactions do not have quite differences among different types of IS artifacts (products, software/systems, and services), while it represents differences in the IS design processes.

Data Analysis

To analyze the collected *thirty two* project stories, we performed a grounded theory approach (Strauss & Corbin, 1990). During this analysis, we highlighted the forms of designer user interaction and their applied method in the design process. Throughout this analysis, we identified *four* designer-user innovation patterns in the design innovation process.

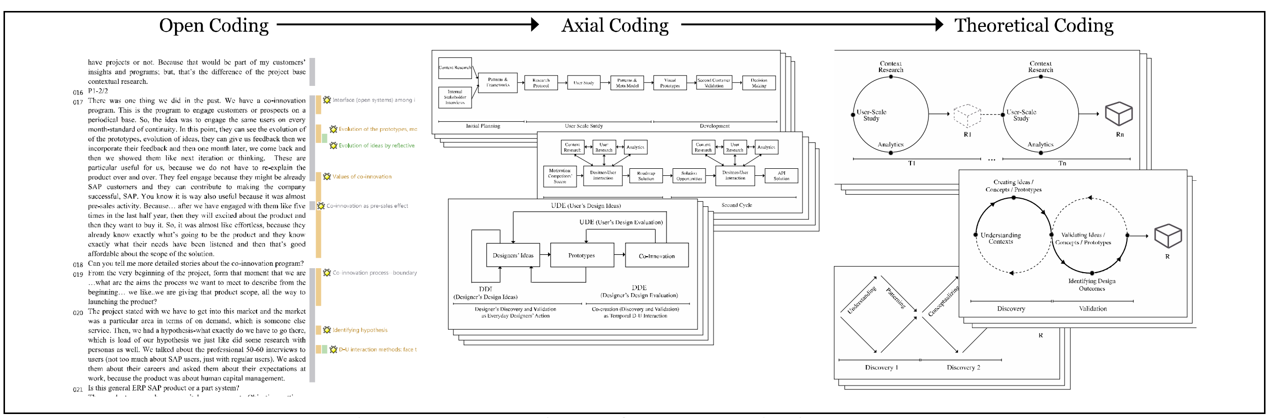

Figure 1. Overview of Data Analysis Process

As Figure 1 presents, this data analysis followed the three steps of the grounded theory approach: from open, to axial, and to theoretical coding processes. In the open coding step, we reviewed every single line of the design project narratives using Atlas.ti, qualitative research software. In the axial coding step, *thirty two* process diagrams were synthesized, which represent the sequence of designer-user interactions and the applied design methods in the design projects. In this step, we compared the similarities and differences and sought to categorize the *thirty two* project diagrams. In the theoretical coding process, we incorporated the given process diagrams in order to synthesize designer-user interaction patterns.

During this grounded theory approach, we clarified eight designer-user interaction criteria to identify innovation patterns: (1) time (temporal versus longitudinal), (2) space (micro versus macro), (3) purpose (discovery versus validation), (4) history (with prior history versus without), (5) method (indirect versus indirect), (6) designer-user interaction leadership (designer-centered vs. user-centered vs. co-creation), (7) number of cycles (single versus multiple), and (8) problem-solving (problem-centered versus solution-centered). These eight criteria demonstrate the issues of scale / measurement how each pattern is identified through the data analysis process.

Findings: Four Innovation Patterns

As Table 2 shows, the four innovation patterns, concerning nine sub-patterns are summarized.

Patterns	Pattern Name	Sub-Pattern Name		Data (N)
Pattern 1	Discovery & Validation	Pattern 1.1	Single Discovery & Validation	3
		Pattern 1.2	Multiple Discovery & Validation	2
Pattern 2	Business & Design	Pattern 2.1	Business-Design	1
		Pattern 2.1	Design-Business	7
Pattern 3	Value of User-centered	Pattern 3.1	Analysis & Synthesis Discoveries with Users	4
		Pattern 3.2	From Designer-centered to User-centered	4
Pattern 4	Leadership & Methods	Pattern 4.1	Direct User Interaction	6
		Pattern 4.2	Co-creation	4
		Pattern 4.3	Combined Methods	1
Total	Nine Design Innovation Patterns			32

Table 2. Design Innovation Patterns

Pattern 1: Discovery Validation Pattern

Pattern 1 represents discovery and validation by designer-user interaction in the process of design innovation, and it has two sub-patterns: single and multiple discovery and validation patterns.

Pattern 1.1: single discovery & validation

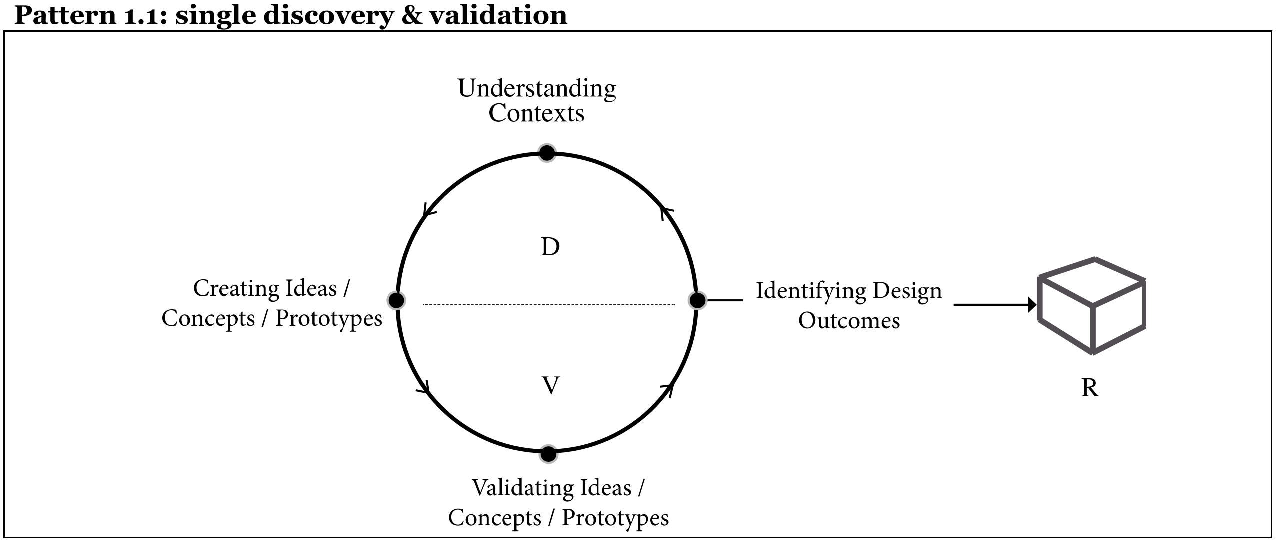

Figure 2. Single Discovery & Validation (Pattern 1.1)

The pattern 1.1, *discovery and validation*, explains a cycle of discovering design ideas, concepts, and guidelines (D) and validating them (V) in order to identify design outcomes (R) in a design process. Generally, this pattern 1.1 consists of four actions reflecting designer-user interaction: 1) understanding contexts, 2) creating ideas, concepts, or prototypes, 3) validating them, and 4) identifying design outcomes in a design process (Figure 2).

Pattern 1.2: multiple discovery & validation

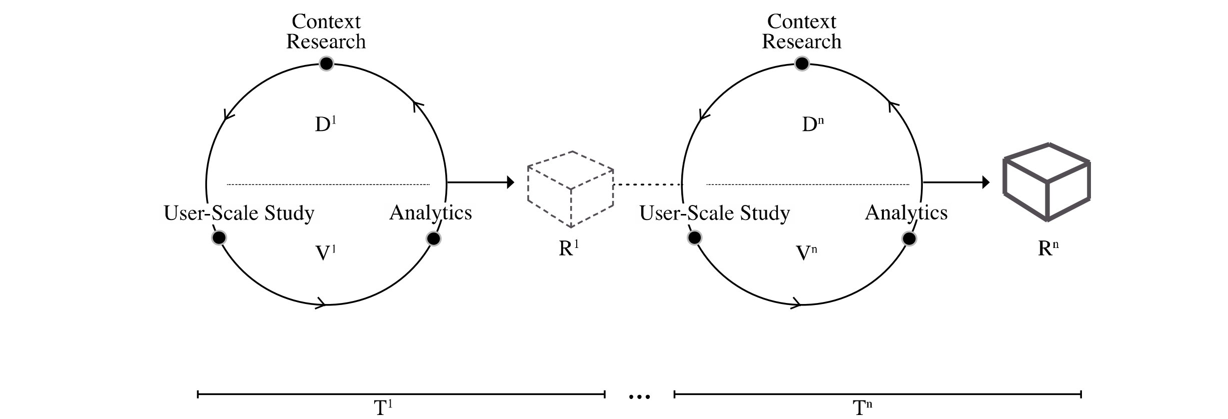

Figure 3. Multiple Discovery & Validation (Pattern 1.2)

As Figure 3 presents, the pattern 1.2 demonstrates multiple cycles to consider discovery and validation actions, and it cycles three design actions to discover reliable design outcomes with a longitudinal perspective: context research; user-scale study; and analytics. These three design actions can produce a design outcome (R^1) as a result of the first design cycle (T^1), and then these three design actions construct or reconstruct the previous design outcome (R^n) in a different discovery / validation cycle (T^n). Compared to the pattern 1.1, the pattern 1.2 should include at least two design innovation cycles to synthesize a design innovation over time (Figure 3).

Pattern 2: *Business & Design Pattern*

Pattern 2 represents the relationships between business and design by designer-user interaction in the process of design innovation, and it has two sub-patterns: 1) business-design (pattern 2.1) and 2) design-business (pattern 2.2).

Pattern 2.1: business-design pattern

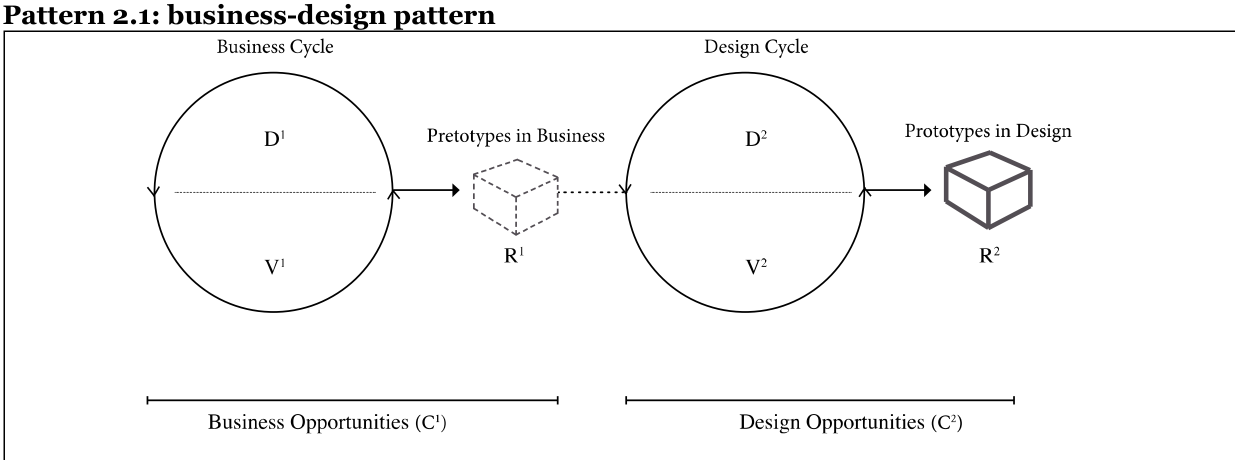

Figure 4. Business-Design (Pattern 2.1)

The pattern 2.1, *business-design pattern*, consists of two cycles (C^1 and C^2) of discovery (D^1) and validation (V^1). The first cycle (C^1) conducts a discovery (D^1) and a validation (V^1) to identify business opportunities (pretotypes in business) (R^1), and the second cycle (C^2) performs a discovery (D^2) and a validation (V^2) to develop design opportunities (prototypes in design) (R^2) in a design process.

Pattern 2.2: design - business pattern

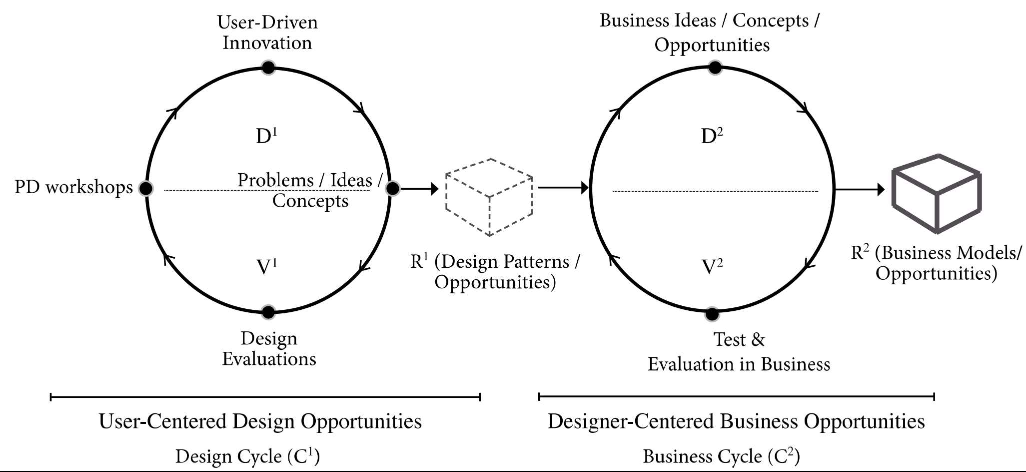

Figure 5. Design-Business (Pattern 2.2)

The pattern 2.2, *design-business pattern*, represents first user-discovery and then designer-validation cycles in Figure 8 presents. Given the problems, the first user-discovery cycle performs the action of users being designers, and it suggests potential design solutions as users' design ideas. The first user-driven discovery cycle creates a set of problems stemming from users' everyday contexts and their information environments. The second designer-validation cycle conducts how designers can develop the design solutions from users' design suggestions. Also, designers seek to connect a reasonable direction between creative design ideas from users and the corporate values in creating projects and services for market success.

Pattern 3: *Value of User-centered*

Pattern 3 deals with the value of user-centered approaches by understanding users and their information environments, and it has two sub-patterns: 1) analysis & synthesis discoveries with users (pattern 3.1) and 2) from design-centered to user-centered (pattern 3.2).

Pattern 3.1: analysis & synthesis discoveries with users

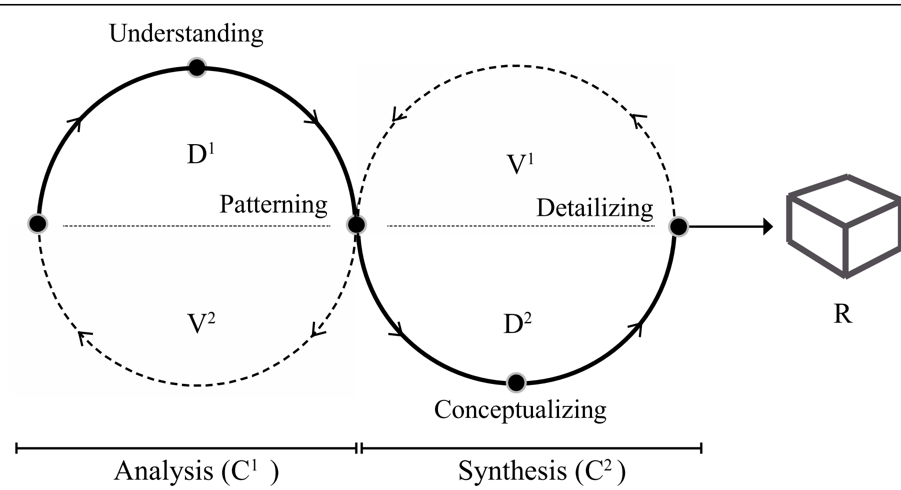

Figure 6. Analysis & Synthesis Discoveries with Users (Pattern 3.1)

As Figure 6 shows, the pattern 3.1, analysis & synthesis by user-centered design (UCD), consists of two discoveries (design analysis and design synthesis) with four actions reflecting on designer-user interaction as follows: 1) understanding contexts, 2) generating patterns and design opportunities, 3) developing design ideas (concepts), and 4) identifying design outcomes in a design process. The first discovery (D^1) cycle understands contexts (exhale) and generates patterns (inhale). The second discovery (D^2) cycle develops design ideas & concepts (exhale) and identifies design outcomes (inhale) in a design process.

Pattern 3.2: From designer-centered to user-centered

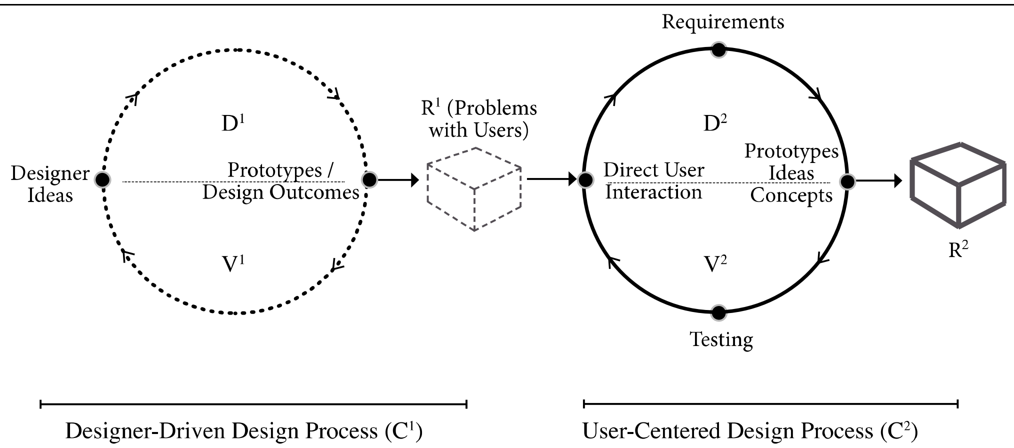

Figure 7. From Designer-centered to User-centered (Pattern 3.2)

The pattern 3.2, from designer-centered to user-centered, consists of two cycles of discovery: designer-driven discovery and user-driven discovery. The first designer-driven discovery cycle produces designers' ideas and prototypes and then meets user problems with direct user interactions (DD). Based on the first cycle, the second user-driven discovery reveals users' requirements, creates designers' prototypes, and tests them on a user' perspective (UD).

Pattern 4: *Leadership and Methods*

Pattern 4 deal with leadership & methods for identifying effective interactions between designers and users in the design innovation process, and it has three sub-patterns: 1) direct-user interaction (pattern 4.1); 2) co-creation (pattern 4.2); and 3) combined methods (pattern 4.3).

Pattern 4.1: discovery validation with direct user interaction

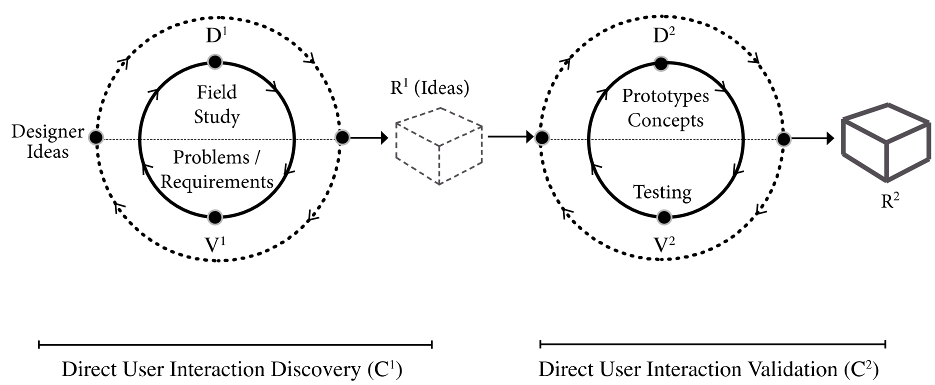

Figure 8. Discovery Validation with Direct User Interaction (Pattern 4.1)

The pattern 4.1, direct-user interaction, illustrates two direct user interactions in the design discovery and validation: The first cycle is to discover temporal design outcomes (e.g. design ideas, concepts and prototypes) with direct user interaction (e.g. field study); and the second cycle is to validate them with direct user interaction to synthesize a final design outcome in the design process. In other words, designers discover design ideas and user requirements from field study and create design concepts in the first cycle. Following that, users validate the suggested design concepts and provide their design ideas to finalize the detailed design outcomes in the second cycle (Figure 8).

Pattern 4.3: combined methods

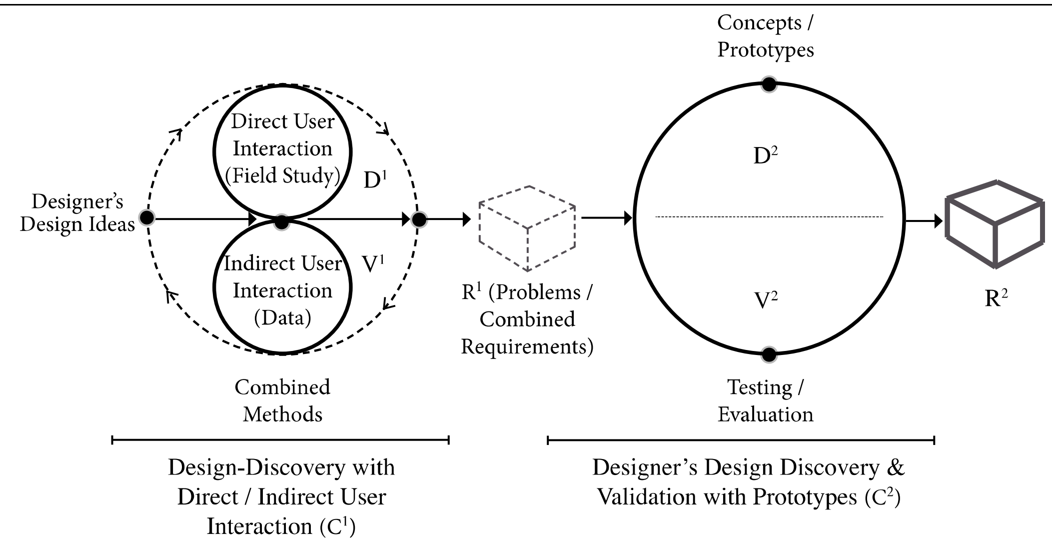

Figure 9. Combined Methods (Pattern 4.3)

The pattern 4.3, combined methods, includes *direct* and *indirect* user interaction to identify design requirements in the first cycle. Then, the second cycle discovers detailed design concepts and prototypes to synthesize design outcomes. Especially, in this pattern, designers could conduct direct (e.g. field study) and indirect user interactions (e.g. existing data) to identify design requirements, which include design concepts, prototypes, and design outcomes in the design process (Figure 9). In the next section, we will discuss the meanings of the identified four designer-user interaction patterns.

Conclusions and Implications

This proposes four innovation and nine sub-patterns as designer-user interaction innovation patterns. These identified four designer-user innovation patterns interaction will open a research direction of how the generative interactions among multiple stakeholders can be empirically studied. Theoretically, this research will describe the importance of intangible interactions in creating better IS design artifacts and process as well. In addition, this research will also provide methodological and practical guidelines for the communities of ISD and three innovation research areas (IT, product, and digital innovation) in IS.

Theoretically, this research theorizes the complex tangible and intangible interactions of two major stakeholders (designers and users) with a view of two inter-related social theories (Bourdieus' theory of practice and boundary objects) to understand their interaction structure (reflected on Bourideu's theory of practice) and micro dynamic (reflected on boundary objects). Consequently, these interaction patterns between designers and users would give theoretical propositions for the communities of current three innovation communities (IT, product, and digital innovation) to rethink the followings of how IT innovation can be considered human-centered approach; how the product innovation can deeply invite users' or customers' voices and needs in the process of innovation; and how do the digital innovation can develop the platforms, balancing with the other innovation directions for users in the design process.

Methodologically, this study will overcome the gaps of existing design vocabularies from the three innovation studies, because the shifting business-design paradigm calls for more structural ways for identifying users and their information environments for the success in a market. Therefore, the major contribution of this study is to reveal their tangible and intangible interactions with empirical evidence in a design project. Practically, practitioners of IS design artifacts and processes could understand the contexts of why and how the interactions between designers and users are interplayed with each other for identifying design outcomes in an innovation project. With a structural view, IS practitioners might recognize their everyday design activities of how / why they could invite, interact with, and co-create users in their everyday design projects.

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