

Cite as: L. G. Pee, S. Pan, M. Li, S. Jia (forthcoming) Social Informatics of Information Value Co-creation: A Case Study of Xiaomi's Online User Community, Journal of the Association for Information Science and Technology

**Social Informatics of Information Value Co-creation:  
A Case Study of Xiaomi's Online User Community**

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**Abstract**

The perennial issue of information value creation needs to be understood in the contemporary era of a more networked user environment enabled by information technology (IT). This study investigates information value *co-creation* from the social informatics perspective to surface sociotechnical implications for IT design and use, since co-creation is inherently social and technology-mediated. Specifically, the co-creation of software as an information-intensive product is examined. Data on the co-creation of Xiaomi's MIUI firmware were collected from two sources: 49 interviews of staff and user participants and Web crawling of the co-creation platform. They were analyzed with interpretive analysis, topic modeling, and social network analysis for triangulation. Findings indicate three sociotechnical information practices co-constituted by information, IT, people, and their activities. Each practice is instrumental in rapidly and continuously converting external information into co-created information value. The adsorption information practice attracts new and diverse external information; the absorption practice integrates external and internal information rapidly by involving users; the desorption practice allows rapid adoption of the co-created product so that information value can be realized and demonstrated for further co-creation. Critically analyzing these practices reveals unanticipated or paradoxical issues affecting the design and use of common co-creation technology such as discussion forum.

**Keywords:** Information value, social informatics, information practices, information product, continuous co-creation, rapid co-creation, sociomateriality

## **Social Informatics of Information Value Co-creation: A Case Study of Xiaomi's Online User Community**

### **Introduction**

There is increasingly need for research on information value co-creation, as advances in information technology (IT) increasingly connect knowledgeable users beyond the organized professional context of information provision to providers of information products and services (Foster et al. 2018). Users are becoming more active in co-creating information-intensive products such as software and services such as public libraries for information urbanism (Mainka et al. 2016; Osborne et al. 2016), through “processes...to access and aggregate across many minds, their deliberative rather than hierarchical approach to the process of value creation, and their production of information goods that exist in a peer produced space that invites further contribution” (Foster et al. 2018; p. 747). Co-created information value accounts for the multiplicity of networked users and user-provider interactions, thereby extending traditional notions of information value in exchange (e.g., value embedded in information products) and value in use (e.g., information applied to solve a problem).

Since information value co-creation is primarily enabled by IT and is inherently social in nature, this study's objective is to draw implications for IT design and use based on a sociotechnical understanding of co-creation. We seek to address a key gap in information science research, as highlighted by Foster et al. (2018): “how networked information production...feed into the development and provision of traditional information products and services are under researched questions in terms of existing information value concepts and models” (p. 745)...“The emergence of an active user means that value is not only value added but also cocreated. What does this mean for a value-added model of information systems and services? And what methods can be used to underpin the coproduction and cocreation of value in search, information services etc.?” (p. 747). This study complements existing research on co-creation, which has mostly adopted marketing or business theories and focused on customers, products, or services (Galvagno et al. 2014), by examining how external information is gathered through an online platform and converted into co-created information value. This information science perspective is essential as co-creation with users always involve information flow.

To achieve our research objective, we take the social informatics perspective to analyze a case of online software co-creation. Social informatics is the study of interrelationships among information technology (IT), the people who use them, and the context of use to inform the design or use of IT (Kling 2007). The problem-driven perspective emphasizes informing professional practice by understanding IT “so that they are actually workable for people” (Kling 2007; p. 210) and helps to avoid technological designs and implementations without adequate consideration of the social context. Social informatics

views IT and the social setting as embedded in a sociotechnical relationship of mutual shaping (Kling 2007). Instead of focusing exclusively on technology, sociotechnical relationships are critically analyzed, often leading to the discovery of unanticipated, paradoxical issues affecting IT design and use. To surface sociotechnical relationships, social informatics scholars have recommended incorporating sociomaterial practice approaches to understand how people and IT interact (Cox 2014; Jarrahi et al. 2018; McCoy et al. 2019). Accordingly, we identify sociomaterial information practices in information value co-creation and critically analyze them to uncover unanticipated issues affecting IT design and use. Information practices “foreground the interplay between individual choices and environments, the forces of social context, and the embeddedness of information-related actions” (Jarrahi et al. 2017; p. 1076), and thereby offers an understanding of information, people, IT, and context as inextricably fused assemblages rather than separate elements of practice (Cecez-Kecmanovic et al. 2014).

Data about Xiaomi Corporation’s software co-creation with its online user community were collected and analyzed. Xiaomi is one of the world’s top five smartphone manufacturers (McCaskill 2018). At the heart of a Xiaomi smartphone is its pre-installed firmware, MIUI, which allows users to customize the user interface and tweak their smartphones. MIUI had over 300 million active users globally as of January 2019. Every week since its launch in August 2010, Xiaomi releases a new beta version of MIUI that incorporates new features or bug fixes co-created with users through its online platform. This resonates with many users, who actively participate and contribute an average of 1,191 posts and replies daily. The success and longevity of Xiaomi’s software co-creation warrant a close examination of how it co-creates information value with the online user community.

Findings from interviews of Xiaomi staff and users who participated in co-creation as well as analysis of social interactions in the online co-creation platform indicate three key information practices that offer critical insights for IT design and use. The adsorption information practice attracts new and diverse external information from users continuously; the absorption practice integrates external and internal information rapidly by involving users directly; the desorption practice drives immediate adoption of the co-created information product so that the co-created information value can be realized and demonstrated for further co-creation. The sociomateriality of these information practices sheds light on the configurations of information, IT, people, and activities underlying continuous and rapid information value co-creation. Critically analyzing situational variations of these information practices reveal unanticipated or paradoxical issues affecting the design and use of common co-creation technologies such as online discussion forum, online polling, and activity-based user ranking. Overall, this study contributes to research and practice by delineating the key information co-creation practices and offering suggestions for avoiding the pitfalls of technology determinism in IT design and use. This is also one of the earliest attempts to study information value co-creation using multiple complementary data sources.

## Conceptual Background

This study seeks to draw implications for IT design and use in information value co-creation, through a case study of online software co-creation. We approach the research objective from the social informatics perspective, which involves critically analyzing sociotechnical relationships among people, IT, and context. The relationships are delineated in terms of information practices, following the recommendations of social informatics scholars (Cox 2014; Jarrahi et al. 2018; McCoy et al. 2019).

### Information Value Co-creation

Information value refers to the worth or usefulness of information (Foster et al. 2018). Co-creation of information value is enabled by the widespread diffusion of Internet technologies that provide a networked environment for the flow of information; the availability of tools for information production allowing not only professionals but also users to be involved in the production; and the emergence of active rather than passive users (Foster et al. 2018). Co-creation allows knowledge to flow across the institutional boundary separating internal and external knowledge and acknowledges that users' knowledge is at least as valuable as professional knowledge (Mainka et al. 2016). Co-created information value accounts for interactions involving diverse users in a more connected and networked environment as a source of value (Foster et al. 2018).

Information value co-creation has its roots in open innovation. Open innovation differentiates among three processes (Chesbrough 2006; Enkel et al. 2009). The outside-in process involves enriching an organization's knowledge base through the integration of external information sources such as customers, suppliers, and research institutions. The inside-out process refers to generating profits by transferring ideas to other organizations through licensing or multiplying technology. The coupled process refers to co-creation, which combines the outside-in process (to gain external information) with the inside-out process (to take ideas to market) and focuses strongly on peer production through communities, consumers, lead users, or research institutes. Co-creation has been studied from knowledge, behavioral, organizational, strategic, and legal perspectives (Enkel et al. 2009), and is expected to generate value in the form of an enhanced knowledge base, better products/services, monetary profit, and customer satisfaction (Nambisan et al. 2009; Suseno et al. 2018). Although it is generally believed that co-creation improves access to external information, our understanding of how external information is turned into co-created information value has remained limited. Most research has focused on analyzing co-creation from the perspective of the host company, customer, or product rather than information, and adopted theoretical lens in service science, innovation and technology, management, and marketing and consumer research rather than information science (Galvagno et al. 2014). This study seeks to fill this gap by examining the co-creation of information value.

## **Social Informatics Perspective**

The social informatics perspective informs the design and use of IT by taking into account their interaction with social and institutional contexts (Kling 2007). It is therefore a useful lens for understanding information value co-creation in an online community of software product users, which is primarily technology-mediated and inherently social. Social informatics considers the social context as a matrix of social relationships and views it as part of a sociotechnical system comprising people, hardware, software, techniques, processes, and information in an interdependent relationship. It is not uncommon for a technology to have varied, conflicting consequences in different contexts. To improve the design and workability of IT for various users, social informatics examines how people work in practice, often across technologies and social boundaries.

The social informatics perspective involves normative, analytical, and critical orientations (Kling 2000). The normative orientation focuses on recommending alternatives for professionals who design, implement, or develop IT policies. The analytical orientation contributes to theorizing about IT in its social or institutional contexts. The critical orientation examines IT by challenging basic assumptions around the use and design of IT rather than automatically adopting the goals and beliefs of those who commission it. Common critical findings include the paradoxical effects of technology use and unanticipated differences in benefits accrued for different users. The critical orientation rejects the view that IT exists in social or technological isolation and is a key feature of social informatics research.

The sociotechnical focus of social informatics can be advanced by attending to people's practices when they interact with IT (Cox 2014; Jarrahi et al. 2018; McCoy et al. 2019). Incorporating the understanding of sociomaterial practices (micro-framing) into the social informatics perspective (macro-framing) "foregrounds the fact that technologies are embedded in networks of people, organizations and other social contexts, and other material artifacts with shifting boundaries, which have consequences for the practices of users" (McCoy et al. 2019; p. 2). Detailing practices also complements social informatics by providing a viable way of representing particular technological features, functions, or behaviors that IT allows, supports, or defers. Accordingly, we delineate sociotechnical relationships in information value co-creation in terms of information practices before analyzing them critically to draw implications for IT design and use. The information practice theory is described next.

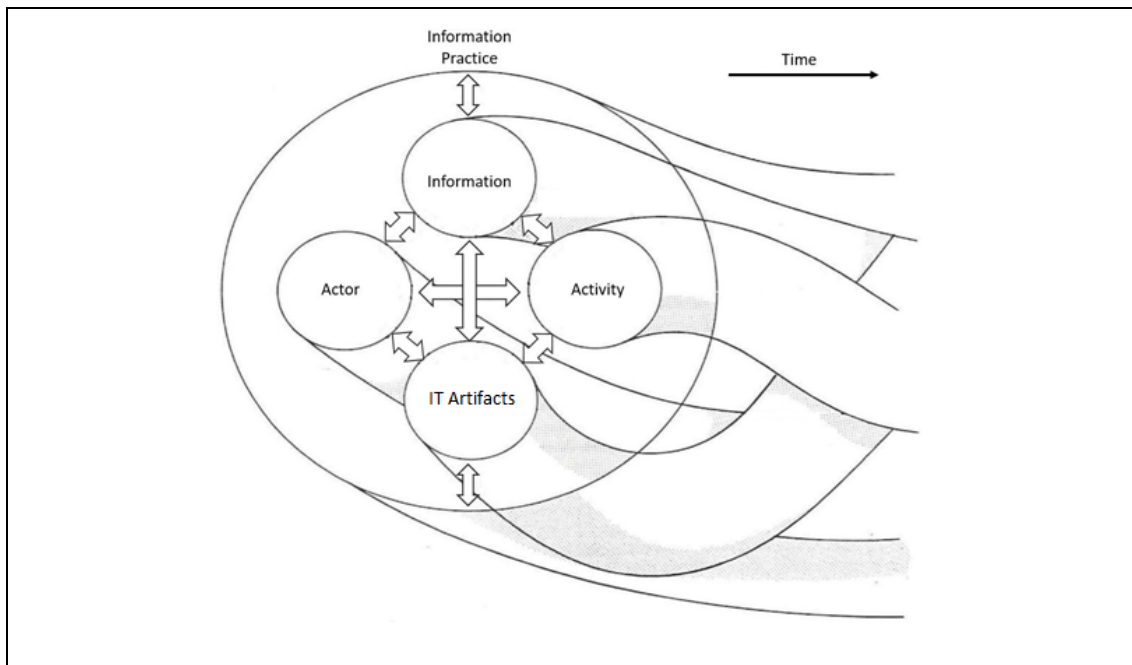
## Information Practice

Understanding practice is necessary from the social informatics perspective, as “the design and configuration of information systems that work well for people and help support their work...are neither obvious nor effective when they are based on technological considerations alone. Their formulation requires understanding how people work and what kind of organizational practices obtain” (Kling 2007, p. 206). Practices describe “social phenomena in a processual way without losing touch with the mundane nature of everyday life and the concrete and material nature of the activities with which we are all involved” (Nicolini 2012, p. 9). It emphasizes people’s actions and the performativity of artifacts, conceiving a practice as “the intermeshing of the discursive and the material that is mutually constitutive and continuously becoming” (Cecez-Kecmanovic et al. 2014; p. 815).

This study focuses on information practices in information value co-creation due to its information intensiveness. An information practice is “an array of information related activities and skills, constituted, justified and organized through the arrangements of a social site, and mediated socially and materially with the aim of producing shared understanding and mutual agreement about ways of knowing and recognizing how performance is enacted, enabled and constrained in collective situated action” (Lloyd 2011, p. 285). Information practices are means to become informed and gain knowledge, constituting activities that focus on manipulating information as an object. Information practices are fundamentally processual and tend to see the world as an ongoing routinized and recurrent accomplishment, consisting of several elements interconnected to one another: social actors, bodily or mental activities, material artifacts and their use, and information (see Figure 1). They are co-constituting and inextricable – a practice is unthinkable when any one of them is missing (Cecez-Kecmanovic et al. 2014). It is possible to untie the knots of sociomaterial assemblages only analytically (Orlikowski et al. 2008). Information practices are shared sociomaterial patterns that recur over time, but are also prone to change. To engage in practices, people must develop know-how and competencies and involve material things in a socially recognizable way. But because practices are enacted through individuals in specific situations, they are also open to improvisation and creativity, and this over time may change the practices.

Information practice theory has gained momentum in information science research. For example, Greyson (2018) identified the health information triangulation practices of young parents, described as complex practices that weave together different information activities and source. One of the practices is inclusive triangulation, which involves comparing information from an authoritative source against multiple other sources, both authoritative and nonauthoritative. Our study contributes to this literature by delineating information practices in value co-creation as part of the social informatics analysis. In another study, Isah et al. (2016) identified the practice of intertwined access to patient care information, which involves obtaining information from complementary textual, physical, and social sources

varying in value. The actor not only accesses information, but also provides access to information through learning at work. Our study contributes to this literature by delineating information practices in value co-creation as part of the social informatics analysis.



**Figure 1. Information Practice and its Intertwining Constituents**

### Research Method

To study the social informatics of information value co-creation, we used the case research method for several reasons. First, our research objective calls for exploratory rather than confirmatory analyses as information value co-creation is not yet well theorized (Pan et al. 2011). Second, co-creation is still an emerging rather than stable phenomena and the interpretive approach is particularly suitable as it permits new, unexpected observations that were not identifiable at the outset of the inquiry to emerge (Klein et al. 1999). Third, clarifying the nature of information value co-creation requires in-depth and multifaceted investigations of sociotechnical issues in their real-life social contexts and an in-depth case study is therefore necessary. This section details the data collection process and analyses conducted, followed by the case description.

### Data Collection and Analytical Approach

To study online co-creation at Xiaomi, we collected both primary and secondary data in two steps. First, after research access was granted in March 2017, we gathered secondary data from a variety of sources, including newspapers and websites. They provided background information on the case, such as how and when the online community started. We also

gathered information from Xiaomi's website, such as the stated purpose of each co-creation activity.

Second, we collected two sets of primary data that are essential for understanding Xiaomi's co-creation: interviews of Xiaomi staff and users as well as the actual social interactions in the online co-creation platform. Researchers studying online social networks have emphasized the need to adequately account for the multi-dimensional nature of social networks by combining and triangulating different data, including data on content (user-generated data crawled online), relations (structural data crawled online), and experiences (reported data collected through interviews; Behrendt et al. 2014; Whelan et al. 2016). The diversity of data calls for a mixed-methods approach that combines qualitative and quantitative methods, and "a mixed methods research approach...yields additional insights and improves the validity of the results by means of triangulation, that is, a systematic comparison of results from different sources of evidence" (Behrendt et al. 2014, p. 566). Specifically, among the six major mixed-methods designs presented by Creswell et al. (2017), we used a convergent parallel design to develop a more complete understanding of the domain of interest. Accordingly, we collected the two sets of data simultaneously, analyzed them separately, and then examined the consistency of findings.

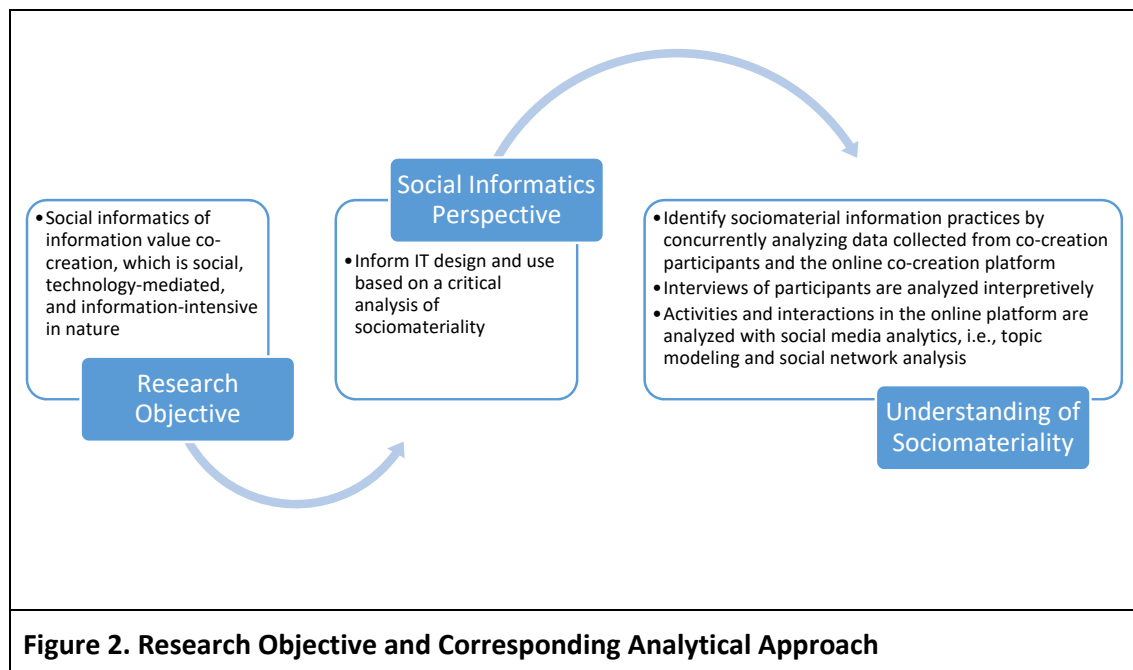
For the interviews, we visited Xiaomi's headquarter five times to meet 14 managers and software engineers. We also interviewed 11 users who participated in co-creation. In addition, we had informal interviews in person with 8 employees and online with 7 employees and 9 users. Each interview lasted one to two hours. In total, we interviewed 29 employees and 20 users. These interviews allowed us to understand how informants made sense of the different activities they engaged in, their roles, IT used, as well as the interrelationships among these elements. We also retrieved content from the online platform using a Web crawler, along with other information such as name and role (e.g., staff or user) of participants. This data offered detailed view of the actual amount of activities, the nature of information flowing through different activities, and social interactions among staff and users. It served as an important and independent data source for enhancing validity through triangulation (Klein et al. 1999). The two datasets were expected to elaborate findings from one another, delineate overlapping but distinct aspects of a phenomenon, or expand potential findings.

The two datasets required different analytical methods. The interview data were qualitatively interpreted and coded through multiple and independent readings by the authors and two post-graduate research assistants. The first author developed the initial set of information practices by summarizing narratives in a tabular form and categorizing them into emerging themes. There were four sets of 33 narratives, which correspond to the four co-creation activities Xiaomi offered in its online platform, namely "new feature suggestion", "bug reporting", "polling", and "beta release". To identify information practices, themes were identified inductively through interpretive analysis. For example, we observed that the narratives related to "new feature suggestion" and "bug reporting" shared much similarities



and therefore merged them into a single theme. Constant comparison was used to see whether a narrative belongs to one theme or another – and from there compare the content of one theme with another. The goal was to “discern conceptual similarities, to refine the discriminative power of categories, and to discover patterns” (Boeije 2002, p. 393). The other authors also played the role of devil’s advocates by questioning the analyses, purposively looking for counter evidence (e.g., the themes identified were not as comprehensive as inferred). This prompted discussions that led to further refinements and better agreement among data, analyses, and results. All the data were in Chinese and were translated into English by the bilingual authors for reporting.

The large content corpus collected from the online community demanded social media analytics (Stieglitz et al. 2018). In addition to descriptive statistics (e.g., no. of posts in each co-creation activity), topic modeling was conducted to understand the nature of information flowing through different activities, and social network analysis was performed to examine interactions among users and Xiaomi staff. In topic modeling, Latent Dirichlet Allocation (LDA) was used to cluster the content constituting 10,028,197 words into distinct topics. It goes beyond word count to discover abstract topics in a corpus based on clusters of words found in each document and their respective frequency. To determine the number of topics representing a corpus, perplexity analysis was conducted to estimate and choose an internally coherent and consistent topic model (Blei et al. 2003; p. 993). In social network analysis, degree centrality was calculated to identify key participants and community analysis was conducted to identify key clusters. Figure 2 summarizes how our research objective guided data collection and analytical approaches.

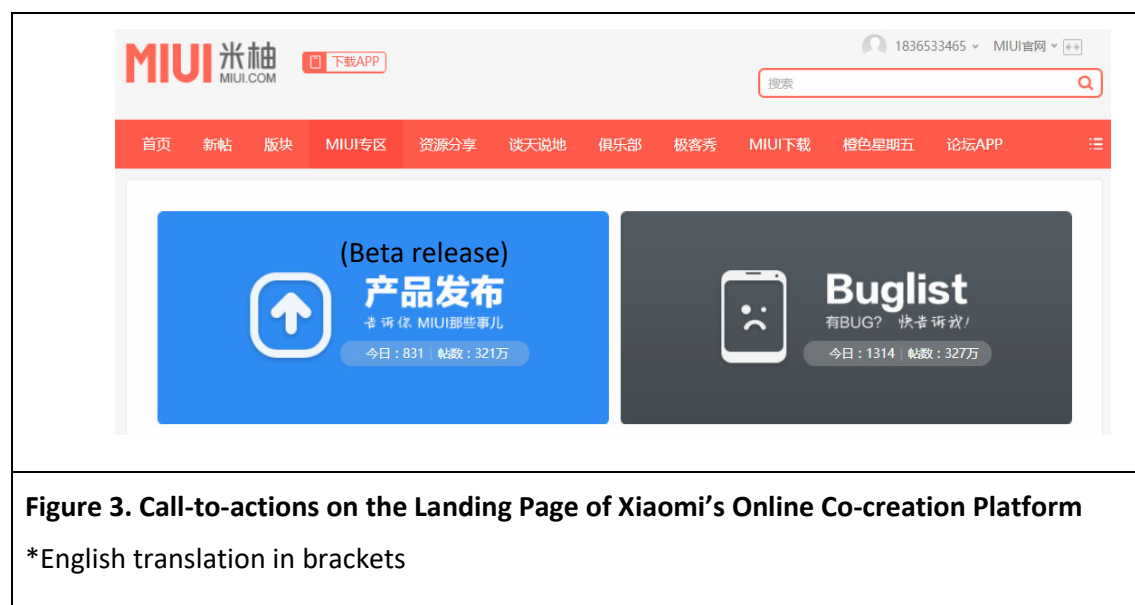


**Figure 2. Research Objective and Corresponding Analytical Approach**

## Case Description

This section describes the background of Xiaomi’s co-creation and the co-creation activities offered in the online platform. Xiaomi was established in 2010 and the founders invited 100 geek users from various software developer forums to try its firmware, MIUI. MIUI is stored in a smartphone’s read-only memory to control the physical device and manipulate data. MIUI can be installed on Xiaomi’s smartphones, as well as Android-based devices by other manufacturers such as Samsung, Sony, HTC, and Google Nexus. Users were invited to suggest ideas for improving MIUI and identify bugs, which Xiaomi promised to incorporate into new beta versions released weekly on Fridays. Motivated by the highly visible impact of their power to influence product development, more and more users joined and actively participated in co-creation. MIUI users grew rapidly to about 500,000 a year later, as Xiaomi began selling its smartphones with the software pre-installed. Users had been participating very actively in co-creation. As of 31 March 2018, users contributed an average of 1,191 posts and replies daily.

Xiaomi offered four co-creation activities in its online platform, named “new feature suggestion”, “bug reporting”, “polling”, and “beta release”. The call-to-action buttons for these activities appeared conspicuously on the landing webpage of the co-creation platform (see Figure 3). In *new feature suggestion*, users could submit new ideas for features and functions they wish to see in future beta versions of the software by creating a new post in the corresponding online discussion forum. Posts were categorized according to the aspect of interest, e.g., file management, camera, voice assistance, or mobile payment. As of 31 March 2018, there were 76 categories and an average of 59 new suggestion posts daily.

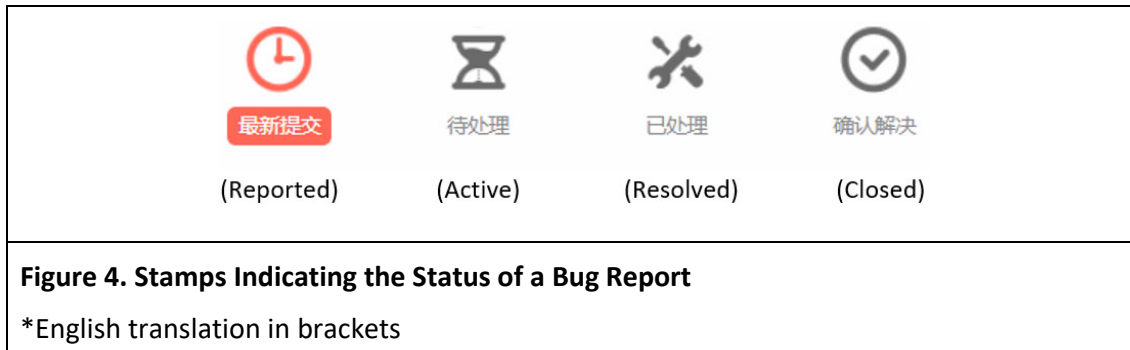


**Figure 3. Call-to-actions on the Landing Page of Xiaomi’s Online Co-creation Platform**

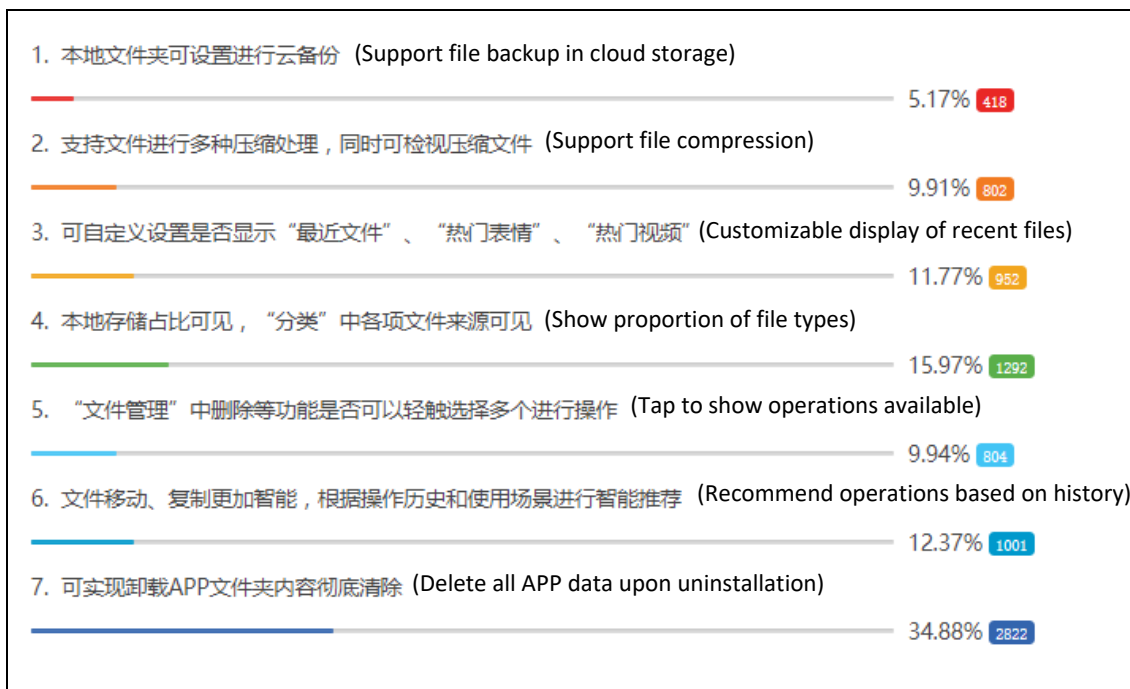
\*English translation in brackets

The *bug reporting* activity is similar to the new feature suggestion activity, except that the focus is on bugs rather than new ideas. Software engineers could respond by stamping a

bug report to indicate its status (see Figure 4). Bugs are prioritized and fixed in new beta releases.



In *polling*, users could indicate their preferences by voting and commenting. For example, Figure 5 shows options and results in a poll about file management, displayed to users after they have voted. Users could justify their votes by posting comments in text. Poll results helped to prioritize the new features or bug fixes to implement.



In *beta release*, a new software version embodying new features and bug fixes co-created with users is announced through an online forum post. The weekly release is named “Orange Fridays” to mark the brand color of Xiaomi. A description of all new features and bugs fixes are provided with each release, along with the installation instruction. Software engineers could respond to user queries regarding the new version as they see fit. Users are encouraged to share their opinion and experience of a new version in the forum.

## Interpretive Analyses and Findings

### Information Practices in Co-creation

Three information practices emerged in data analyses, namely information adsorption, absorption, and desorption. Each practice has a critical role in sourcing information from not only professionals but also voluntary, active users in a networked environment and in turning the external information into a productive, valuable form through user-provider as well as user-user interactions and negotiations. Each sociomaterial practice is discussed next by highlighting how it is performative, processual, and recurrent (Nicolini 2012) as information value is being co-created. We also analyze how the three information practices are interrelated as recommended by Nicolini (2012).

#### *Information adsorption.*

As an information practice, adsorption is performative in that it offers access to diverse and new external information for value co-creation by attracting external information sources (e.g., end users) to contribute through the online co-creation platform. Adsorption involves various informational activities, actors, and IT in an inextricable, mutually constituting sociomaterial relationship. Xiaomi's adsorption manifests in two online activities, officially named "new feature suggestion" and "bug report". Each instance of the activities is initiated by users who ideate new features inspired by day-to-day use or encounter bugs. Users contribute new ideas or report bugs by submitting posts to the corresponding online forum. Posts remain persistent in the online platform and allow information contributed to be accessed, rated, and commented by Xiaomi staff or other users. Staff often responds by expressing gratitude for users' input, explaining how a suggestion or bug will be acted upon, or seeking further details. Other users typically add information or indicate support by sharing their own opinion or experience. Users receive additional participation credits for contributing highly rated posts, in addition to credits for posting. The submitted posts make external information arising in users' mind and personal experience visible to Xiaomi's staff. This is made possible in a large scale yet efficient manner by the online platform. Carrying out the practice offline would have been prohibitively costly and cumbersome. The IT platform holds information resulting from actors enacting the adsorption practice so that it is accessible for further co-creation. Different instances of the practice vary in the content of ideas/bugs and the context giving rise to them. Yet, the practice remains intelligible by the horizon of actions it makes available to users and staff.

The potentiality to access diverse external information is built on interrelationships among the practice elements that can be characterized as encompassing. As the first point of contact, the call-to-action buttons on the online platform are labeled with broad taglines prompting social interactions, i.e., "Let's chat about the MIUI you want" and "There's a bug? Tell me". They urge users to communicate and appear to welcome any user and any input. The online platform allows any user with a web browser and Internet connection to

participate by submitting a post. The user interface for posting new ideas or bugs is easy for those with Internet browsing experience, requiring only a title, message, and category (from a dropdown list, e.g., camera, calendar, file manager). Analysis of the online platform shows that all posts are replied by Xiaomi staff promptly, within 7.9 hours on average. For instance, an engineer responded to a suggestion about file management as follows:

*“We will look into this. It’s a very nice idea. Thanks for the suggestion.”*

Engineers’ responsiveness, clearly visible to all users in the online platform, make users feel that their input is instrumental to product development and motivates their continuous participation. Users interviewed commended:

*“Shortly after I suggested the idea, an engineer replied that it would be incorporated soon. It’s really nice that our views are taken seriously...This keeps me coming back to the community.”*

This inclusive, mutually reinforcing online interaction between users and staff is instrumental in perpetuating the inflow of diverse information for developing MIUI. The diversity is clearly visible in the results of topic modeling, which identified 15 topics in each of the new feature suggestion and bug reporting activities, as opposed to eight in each of the other activities.

The sociomateriality of Xiaomi’s adsorption practice also attracts new external information by being empowering. Users are typically the most powerful in adsorption as they have the free will to decide whether to participate. By ranking users based on their participation, Xiaomi inadvertently balances the power through empowering them. Users are ranked according to their participation credits, earned through posting new ideas or reporting bugs. There are eight ranks labeled to indicate a user’s level of experience (e.g., newbie, master, wizard) and a user’s rank is shown right next to the username in all posts. Highly ranked users who have contributed “wild ideas or original, high-quality content” as judged by engineers can apply to join elite groups. Elite users are regarded as expert geeks who qualify to become alpha testers, online forum moderators, and even members of the software development team working directly alongside Xiaomi’s staff. They also have exclusive privileges such as paid-for trips to Xiaomi’s annual “family banquet” at the headquarters, where 200 selected users meet senior managers, company founders, and staff in person and enjoy their performances. Attending the banquet is on the wish list of many Xiaomi users, as an ardent user expressed:

*“Xiaomi banquet is a gathering that users look forward to. It represents the highest honor for a Xiaomi user...I was very happy and excited to be invited. It was of course a strong motivation for me to contribute more.”*

Empowering users with ranking elicits social comparison among users and thereby motivates novel input. To maintain the status, elite users also contribute more intensely to the development and inspire other users to engage in co-creation. Analysis of posts in the online platform indicates that the new feature suggestion activity attracted an average of 59 new submissions daily while bug reporting attracted 206 new submissions daily. The social network’s degree centrality painted a more detailed picture of users who post new information (see Table 1). Users who contributed popular new posts (i.e., high in-degree) were not the same as those who reply frequently (i.e., high out-degree). On average, those who contributed popular new feature suggestions tended to submit 5.3 new posts per hour

spent in the platform, compared to 0.8 by the other group. They spent slightly more time than the other group (519 hours in total per user versus 488), though the difference was small. These suggest that contribution of new information is independent of one's tenure with the community. Users tend to post issues related to multiple rather than a single aspect of MIUI (e.g., voice recorder, notification bar). These features could be used to identify key sources of new information early to foster a sustainable balance between new posts and comments.

### ***Information Absorption***

The absorption information practice focuses on integrating external information with internal information to augment information products, by engaging both professional staff and users in the online community to negotiate their perspectives. Xiaomi's absorption practice partly occurs through the activity named "polling", in which staff or highly ranked users create online polls with a question and a number of answer options. Analysis of the online platform indicates that Xiaomi staff creates up to 6 polls per month and users create up to 48 polls per month. Polling offers access to information about users' general preference and helps Xiaomi staff determine the priority and best solution for incorporating a new feature or bug. Users, staff, their informational activities of polling, voting, integrating, and the online polling forum are inextricable for enacting the practice. Users and staff exist in the form of a virtual user profile in the online polling forum, which is neither strictly human nor technical. Absorption occurs and recurs to sort through the large amount of diverse and new information constantly flowing in from external sources resulted from the adsorption practice.

The sociomateriality of the absorption practice brings the most valuable external information to light by affording consensus. Online polling makes it possible to gather the opinion of a large number of users efficiently (up to 31,577 votes in a seven-day poll) and makes the majority opinion visible to all users and staff in the form of poll results. Xiaomi staff often turned to online polling when several viable options exist. A manager explained:

*"We should trust users' intuition. Users are not professionals so they don't need to know the product deeply. It's adequate that the product meets their needs. Their gut feel is often the most accurate."*

**Table 1. Users with Highest Degree Centrality in the New Feature Suggestion Activity**

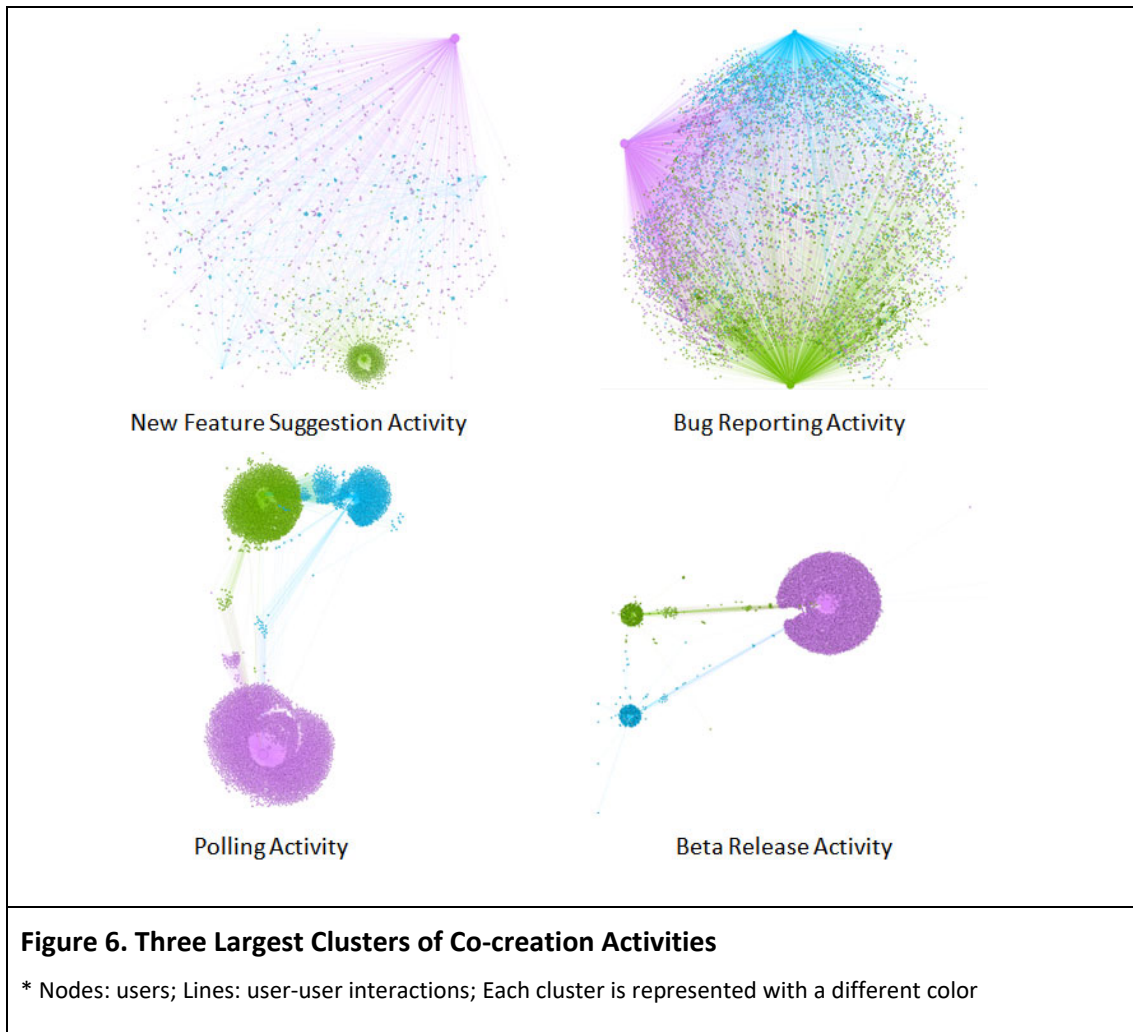
In-degree Centrality (based on comments received)							Out-degree Centrality (based on comments on other posts)					
Degree	Username	Topic of posts	No. of posts	No. of replies	Time spent (hour)	Login (day)	Degree	Username	No. of posts	No. of replies	Time spent (hour)	Login (day)
201	(~°3°)	Transport payment	975	3,450	122	64	572	啊我看到那	110	36,622	259	71
169	颁布了统一	Voice recorder, notification bar, camera, screenshot	753	2,620	120	59	469	fyx2002	20	16,352	885	90
145	啊我看到那	Browser, notification bar, voice wake	110	36,622	259	71	352	langkiss	69	11,289	951	152
124	Sunshineeeeeeee	App auto start, notification bar, icon	185	8,451	2,021	25	315	辽紫叶	103	3,174	38	160
103	威武哒	Second space, camera, speech recognition, gesture	880	3,684	74	895	265	Bugkillman	374	15,747	311	74
Average			580.6	10,965.4	519.2	222.8	Average		135.2	16,636.8	488.8	109.4

Results of degree centrality analysis indicate that longtime users were better able to filter and identify important features or bugs of interest to the majority, as those who created the most popular polls (i.e., high in-degree; see Table 2) tended to spend much more time (averaging total 460 hours per user versus 67.2) in the online platform. Community analysis of the interactions in the online platform offers more concrete details about consensus. A subset of staff and users (represented by nodes) in a network is considered a community or a social cluster if nodes in this cluster have denser links with nodes within the group than with nodes outside the group (Wasserman et al. 1994). We found that nodes in the polling activity formed 34 clusters, which is much less compared to 541 in the new feature suggestion activity and 2,684 in bug reporting. The three largest clusters in the polling activity (see Table 3) discussed camera functions, the Second Space function, and the weather app. These show that user interactions became more focused in polling (see visualization in Figure 6) and users were most interested in improving these three aspects. The very small clustering coefficients indicate that users within each cluster tend to discuss by replying to the poster, rather than replying to other users' comments.

In-degree Centrality (based on comments received)						Out-degree Centrality (based on comments on other posts)					
Degree	Username	No. of posts	No. of replies	Time spent (hours)	Login days	Degree	Username	No. of posts	No. of replies	Time spent (hours)	Login days
2714	levialv	11	1,971	153	70	262	DJ 次郎	22	1,544	22	59
1622	WGzeyu_	98	633	104	1,606	179	豆沙包 2	20	1,550	64	59
1602	PhilipYoung	10	661	78	33	169	WGzeyu_	98	633	104	1,606
920	花折、花开	158	1,382	417	39	52	3311314500	3	288	47	10
559	cyuil	38	1,556	1,548	599	41	超能少年...	106	2,184	99	112
Average		63	1,240.6	460	469.4	Average		49.8	1,239.8	67.2	369.2

Cluster Measure	New Feature Submission	Bug Reporting	Polling	Beta Release
Total no. of clusters	541	2,684	34	648
% of nodes in the largest cluster	10.78%	21.57%	30.82%	60.42%
% of nodes in the second largest cluster	8.37%	18.73%	14.96%	4.68%
% of nodes in the third largest cluster	4.29%	11.38%	8.71%	4.01%
Clustering coefficient of the largest cluster	0.084	0.044	0.013	0.000
Clustering coefficient of the second largest cluster	0.001	0.058	0.013	0.000
Clustering coefficient of the third largest cluster	0.037	0.062	0.009	0.003
Topic(s) in the largest cluster	Torchlight, power saving	Battery	Camera, visual effects	Change log
Topic(s) in the second largest cluster	Speaker	Battery drain, unexpected restart, process error	Second space	Preview of beta release
Topic(s) in the third largest cluster	Brightness, keyboard	Heat, payment, bluetooth	Weather, map	Comparison of MIUI versions





The sociomateriality of the absorption practice is also consolidating in that the integration of external and internal information augments the information product. Based on poll results and its technical expertise, Xiaomi prioritized new features/bug fixes and was able to identify those that could be implemented swiftly yet significantly improve user satisfaction. The direct involvement of elite users in development alongside staff also allowed Xiaomi to shorten the learning curve and integrate new features or bug fixes rapidly. These users voted with their feet and provided the technical skills needed to realize their suggestions. A manager explained:

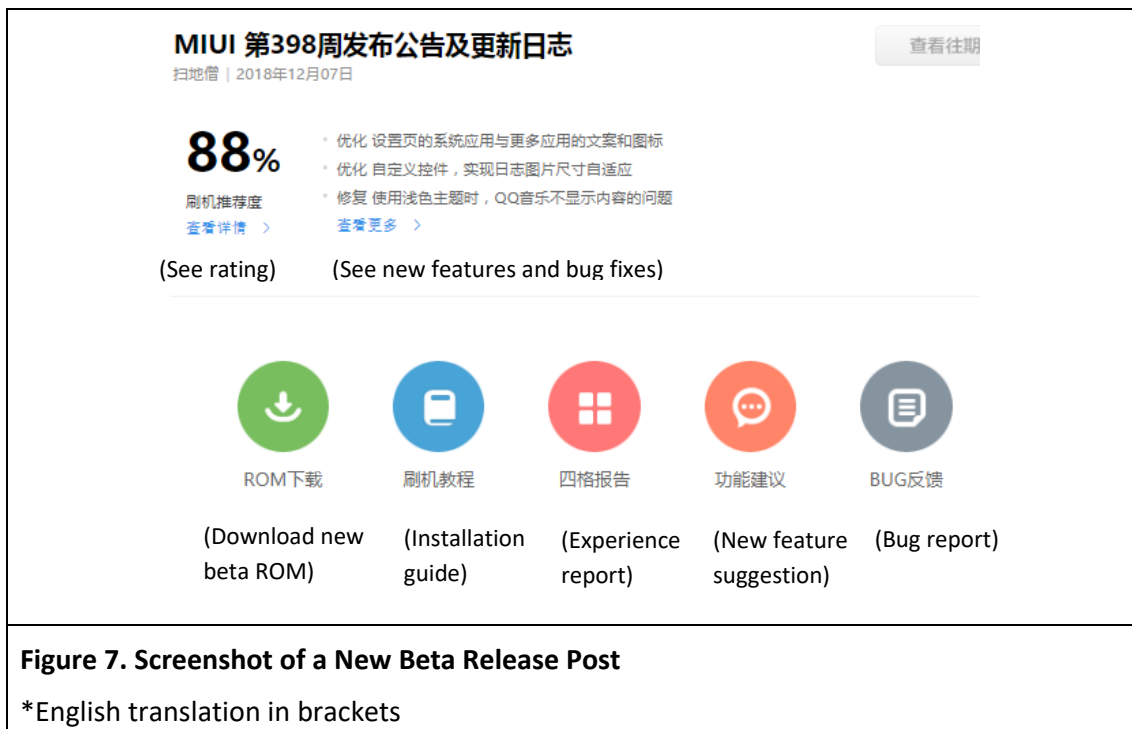
*“Some users don’t just criticize, they suggest solutions and even create prototypes...They help us with the preliminary work and reduce our workload. There are about ten or twenty of such users among a few thousand of them.”*

### Information Desorption

The information practice of desorption focuses on disseminating the information product embodying the co-created information value to users online, so that the value can be realized through adoption and use. These human and non-human elements are co-

constitutive in actualizing the value. Xiaomi releases a new beta version through its online co-creation platform every Friday, along with a description of new features and bug fixes, detailed installation guide, and hyperlinks to user feedback as well as the “new feature suggestion” and “bug report” activities (see Figure 7). Users could also seek help from staff or other users by posting questions in the online forum. Users are encouraged to provide feedback online, by rating or commenting on the new version or submitting an “experience report”. The experience report consists of four components: attitude, favorite new feature/bug fix, the most anticipated new feature/bug fix, and the most “unreliable” (a popular Chinglish term meaning unsatisfactory) new feature/bug fix. The reports are compiled on Wednesdays and the staff team that developed the most favorite new feature/bug fix will receive the “Popcorn award”:

*“Internally, we have a ‘Popcorn Award’ for staff. Based on users’ feedback on a beta version, the most favorite new feature/bug fix is identified, and the team that developed it will be recognized. The team gets a tub of popcorn, and a divine sense of honor.”*



**Figure 7. Screenshot of a New Beta Release Post**  
 \*English translation in brackets

The sociomaterial assemblage in the desorption information practice drove rapid adoption of a new product version by being communal. New users could get instant help with installation from the online community consisting staff and users. There was also a community of alpha testers who would readily accept and try a new version. Analysis of the online platform shows that each beta release post was viewed by 496,636.4 users and saved by 238,731 users on average. About 28 percent of the views occurred within the first two days of beta release. Alpha testers were automatically notified of a new version, and because new

versions were released regularly, it felt almost habitual to adopt the latest version, as a user commented:

*“The latest beta release is not yet posted...hanging around for the new version released weekly has become a habit for users.”*

Many alpha testers and other elite users regularly try out new versions and provide feedback in order to maintain their privileged social status in the online community. Analysis of interactions in the online platform indicates that each weekly beta release gets an average of 1,015 replies and up to 4,104 replies. The first user reply is received within 2 hours on average.

The sociomateriality of desorption practice allowed the demonstration of realized co-created information value to different participants in a corroborating way. Feedback on a new version was gathered from staff (in alpha tests), elite users who participated in various co-creation activities, as well as common users. The online platform made it possible to gather feedback from different participants quickly. Analysis of the online platform shows that each weekly release received up to 4,104 comments from staff and users and 1,015 comments on average. Analysis of degree centrality indicates that the most interactive nodes were staff engineers who received comments for posting previews of or hyperlinks to new beta versions. Among the users, the most interactive were those who post comparisons of different beta versions or comprehensive review of the latest version. Community analysis of the social network highlights one very large cluster constituting 60.42% of nodes discussing changes to a new version. Taken together, these provide concrete evidence that the main concern of different users in the desorption practice was the value added by a new version. In the online platform, the co-created value is demonstrated in various ways, including percentage of alpha testers recommending a version and bar charts summarizing “experience reports”. One of the bar charts identifies the best new feature or bug fix, which pinpoints the specific aspect of a new version most valued by the majority of users and thereby clarify the value of co-creation to users. For Xiaomi staff, the co-created value is demonstrated by publicly recognizing the team that developed the best co-created feature voted by users with the “Popcorn Award” on the company’s wall of honor. This shows to staff in general the importance of information co-created with users, in terms of new ideas, bug reports, technical solutions, as well as feedback they contributed throughout co-creation. As an engineer interviewed emphasized:

*“We have a quality committee that would identify the top ten feedback daily after a beta release. The feedback is then shared with engineers...This is very valuable to our understanding.”*

With each beta release, Xiaomi also acknowledges two users with “special thanks”, for providing the most valuable information in the form of ideas or bug reports leading to a new version.

Overall, the co-created information value realized is made observable in multiple ways for different groups of users and staff. This makes it easier for different co-creation participants to see the realized value of information co-creation and is more in line with the multi-

perspective nature of co-creation. This is also more convincing than showing only on product rating and feedback.

***Relationship among information practices.***

Xiaomi's case shows that the information practices of adsorption, absorption, and desorption are related in a spiraling loop that sustains information value co-creation. The looping is driven by the desorption practice, specifically, the demonstration of realized co-created value in different ways. The demonstrated value propels further contribution of new information, igniting new instances of the adsorption practice. The large amount of new information in turn calls for consensual negotiation so the most valuable information can be integrated in the absorption practice. Looping through the information practices ensures that there is a continuous inflow of fresh external information and relentless information value co-creation for an ever-improving product. A manager interviewed described the importance of external information accessed through co-creation:

*"We have long-, mid-, and short- term user needs. The long-term needs are discussed in monthly internal meetings with our CEO. Mid- and short- term needs basically emerge based on fragmented information in interactions with users, which often lead to adjustments in the long-term needs."*

Each loop in the co-creation spiral builds on previous loops in that the co-created information is seeded by bugs or new features arising in previous versions and the information product is enhanced with each information co-creation loop.

The case also indicates that the information value co-creation spiral can be very rapid despite the large number and diversity of participants. Xiaomi's weekly co-creation is made possible by its empowering adsorption practice, consolidating absorption practice, and communal desorption practice. In adsorption, Xiaomi is able to attract a large amount of information because users find the powerful elite status strongly appealing and want to earn the prestigious honor. In absorption, valuable external information can be integrated with internal information swiftly because the practice allows high-impact, low-effort new features or bug fixes to be identified through voting and more challenging ones to be implemented by directly involving geek users. In desorption, rapid adoption of and feedback on a new product version is driven by a community of alpha testers and elite users who want to maintain or improve their user rank. The sociomateriality of these information practices work in concerto to ensure that information is co-created at a high speed and its value is realized and made visible promptly. Although the rapid spiraling approach is not immune to mistakes, constant enhancements increase its robustness, as an engineer interviewed explained:

*"We had developed and implemented features that turned out to be not really useful. But because we update the product weekly with a new version, it's okay to make some mistakes. We will be able to correct it in two weeks."*

## Implications for IT Design and Use

To draw implications for IT design and use, we critically analyzed the information practices as per the social informatics perspective. To unravel non-deterministic, unanticipated issues in IT design and use, we look beyond the recurrent patterns of activities and outcomes in the three practices and focus on notable deviations from the typical, as discussed next and summarized in Table 4.

The encompassing nature of adsorption allowed Xiaomi to access diverse external information for co-creation, but also had the unintended effect of increasing information noise. The online co-creation platform allowed user-user interactions and users sometimes digressed into topics unrelated to the information product. Recognizing the necessity of personal interactions in building a community, Xiaomi managed this by creating a separate, miscellaneous discussion forum for off-topic discussions. Moderators would shift posts irrelevant to new feature suggestion or bug reports to the forum as necessary. Guidelines for posting were also provided to users.

The adsorption practice also empowered users through user ranking to increase participation. Paradoxically, this could have limited the diversity of participants over time. We observed that Xiaomi's user ranking tended to acknowledge pro-users or geek users who were more knowledgeable about software engineering, as they were more likely to be selected to join the elite group by engineers. This appeared to have attracted the participation of pro-users much more than other users. Analysis of the online interactions supports this observation: although the proportion of pro-users was small, almost half of the new feature suggestions were contributed by them (25,063 vs. 26,980 posts). To ensure the diversity of external information, user ranking should be designed to acknowledge different types of users.

The absorption practice foregrounded the most valuable external information through voting by being consensual. Despite the wide reach of IT, it is important to remain aware that the poll results have limited generalizability as they exclude many other major user groups who are less avid in software development. The online polling results should be complemented with data from other sources, especially for decisions that would affect the majority of users. An engineer highlighted a related consideration when determining whether to implement a new feature:

*“The new feature has to be easy to learn. Some new features suggested online were too difficult for the majority of users and they turned out to be meaningless despite being great ideas.”*

The absorption practice was also consolidating in that external information was integrated with Xiaomi's knowledge to resolve conflicting preferences and technical incompatibilities to augment the information product. However, users sometimes expressed negative feelings online when their preferences were not incorporated:

*“Can’t stand the advertisements! What happened to the promise to add an off switch!!!”*

To manage conflicts and alleviate negative feelings, Xiaomi engineers often discuss technical details and justify design choices by publishing developer stories online shortly after a new beta release.

The desorption practice promoted rapid adoption of new product versions by being communal and this contributed to constant product enhancement. Unexpectedly, MIUI had advanced to a point where it became unsafe to allow unlimited rollback to earlier versions. Beginning in July 2018, Xiaomi decided to implement anti-rollback in some devices to maintain security and quality and this had dampened some users’ willingness to try new versions, as a user commented:

*“Not sure if I should try the new version...will I be able to roll back to my preferred version?”*

To alleviate users’ concern, Xiaomi staff created online posts to explain the rationale and highlight the security risks of allowing unlimited rollback. Xiaomi also began providing information about rollback options along with each new beta release.

Desorption was also corroborating in that the co-created information value was demonstrated for different participants in various ways, such as overall rating of a new version and the favorite new feature. In addition to an enhanced information product and better addressing users’ pain points, topic modeling indicates that co-creation could benefit users by augmenting their knowledge, as “learn” is found to be a keyword in discussions of new versions (see Table 4). By regularly posting the technical details and design rationale behind a new feature or new version in developer stories, Xiaomi shares its knowledge and experience of co-creating the product. This extends the co-created information value through reciprocal application of information and knowledge through information practices for the benefit of one another. This learning enables users to participate more effectively in further co-creation.

<b>Table 4. Implications for IT Use and Design based on Social Informatics Analysis</b>			
<b>Information Practice</b>	<b>Nature of Sociomateriality and Implication for Information Value Co-creation</b>	<b>Unanticipated Issues</b>	<b>Implications for IT Use and Design</b>
Adsorption	Encompassing: allow access to diverse external information	Increased information noise (e.g., digressions)	Dedicate an online space for off-topic discussions (e.g., miscellaneous forum)
	Empowering: allow access to new external information continuously	User ranking criteria might limit the diversity of participants	Ensure that user ranking acknowledges different types of users
Absorption	Consensus: helps identify the most valuable external information	Online polling is not generalizable to users not participating in the online platform	Complement online polling results with data from other sources when considering major changes
	Consolidating: helps integrate external and internal information to augment information product rapidly	Some users express negative feelings online when their preferences are not incorporated	Publish developer stories online to justify design choices
Desorption	Communal: promotes rapid adoption and use of new product versions	Anti-rollback in some Xiaomi devices beginning July 2018 discouraged some users to try new versions	Publish the security risks of allowing unlimited rollback online
	Corroborating: helps demonstrate the realized value of co-created information convincingly	Information co-creation also adds value to users by enhancing their knowledge	Publish developer stories online to share technical details of new features or bug fixes

## Discussion

Examining information value co-creation from the social informatics perspective, this study set out to draw implications for IT design and use by investigating Xiaomi's online software co-creation. Sociotechnical relationships among people, IT, information, and activities were first foregrounded in terms of information practices. Critical analyses of the practices revealed non-technology-deterministic and paradoxical issues in IT design and use. The implications of these findings for research and practice are discussed next.

First, the three information practices of adsorption, absorption, and desorption help to clarify the sociomaterial assemblages and their roles in sustaining information value co-creation. We found that demonstrating the realized value of information co-creation for different participants in desorption drives further contribution of new information (i.e., enact adsorption), thereby creating a spiraling loop that perpetuates co-creation. Research on co-creation has begun to emphasize the need for constant co-creation to ensure access to the latest external information such as emerging user preference (e.g., Ramaswamy et al. 2016). This study contributes to the growing information value co-creation research by detailing information practices that make this possible. Xiaomi's case also illustrates that the realized value of information co-creation can be demonstrated online using a variety of IT artifacts, such as rating scale and forum posts. As Repo (1986) explained, information value cannot be quantified directly and must be observed from different viewpoints and levels. When understanding information value, it is necessary to ask users' opinion and account for the context of use.

Second, the information practices also shed light on the sociomaterial mechanisms underlying rapid information value co-creation. Specifically, the empowering nature of adsorption strongly attracts external information sources to Xiaomi's online co-creation platform; the consolidating nature of absorption expedites the incorporation of new features or bug fixes as knowledgeable users are involved directly in software engineering; the communal nature of desorption creates a favorable condition for immediate adoption of and feedback on new product versions. Rapid co-creation is especially useful for information products that evolve quickly or when user preferences are critical (Gardien et al. 2014). Fast-tracking new features or bug fixes accelerates the realization of co-created information value and visibly demonstrates the benefits of co-creation to participants.

Third, critical analysis of the three information practices based on the social informatics perspective uncovers unanticipated or paradoxical issues that affect IT design and use (see Table 4). For example, the encompassing nature of adsorption attracts diverse external information that enriches information value co-creation but also increases information noise. To manage the latter, a miscellaneous forum should be created and volunteer moderators should be recruited to manage posts. While empowering users with virtual ranking and elite membership entices them to contribute information, it could also



limit the diversity of information if it favors pro-users. The user ranking mechanism should be designed to acknowledge different contributions. We also found that the co-created information value manifests for users as improved knowledge about a product, in addition to addressing their product needs. The learning allows users to participate in the software's development continuously.

Fourth, this study also contributes to research by demonstrating the utility of incorporating an understanding of practices into the social informatics perspective for deepening our understanding of information value co-creation, addressing the growing need to orient information science research to address the topic of information value in the contemporary era (Foster et al. 2018). Analyzing information practices helps to clarify the interrelationships among people, IT, information, and activities and how they co-constitute one another in turning external information into co-created information value. For example, without an appreciation of the sociomaterial assemblage, our analysis would be restricted to disparate elements and it would be difficult to go beyond the motivating effect of online user ranking to detect its power-balancing effect and the paradoxical effect of attracting external information while limiting information diversity. Going beyond a descriptive and analytical account of the practices to critically analyze the information practices from the social informatics perspective allows us to derive actionable insights for IT design and use.

Fifth, this study also demonstrates a mixed-data, mixed-methods approach to study information value co-creation with the user community. Although researchers studying value creation and online communities have called for this approach (Wenger et al. 2011; Whelan et al. 2016), such studies remain rare. Wenger et al. (2011) have emphasized that value creation stories should be complemented with additional quantitative indicators, such as social network analysis demonstrating the patterns of online interactions. Similarly, Whelan et al. (2016) highlighted the need for studies of online social networks to complement quantitative analytics of large trace data with qualitative approaches to address questions that matter. As this study has shown, a qualitative analytics approach deepens our understanding of the phenomenon than either alone provides.

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