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Online communities (OCs) are a virtual organizational form in which knowledge collaboration can occur in unparalleled scale and scope, in ways not heretofore theorized. For example, collaboration can occur among people not known to each other, who share different interests and without dialogue. An exploration of this organizational form can fundamentally change how we theorize about knowledge collaboration among members of organizations. We argue that a fundamental characteristic of OCs that affords collaboration is their fluidity. This fluidity engenders a dynamic flow of resources in and out of the community—resources such as passion, time, identity, social disembodiment of ideas, socially ambiguous identities, and temporary convergence. With each resource comes both a negative and positive consequence, creating a tension that fluctuates with changes in the resource. We argue that the fluctuations in tensions can provide an opportunity for knowledge collaboration when the community responds to these tensions in ways that encourage interactions to be generative rather than constrained. After offering numerous examples of such generative responses, we suggest that this form of theorizing—induced by online communities—has implications for theorizing about the more general case of knowledge collaboration in organizations.

Key words: computer-supported collaborative work; organization communication and information systems; innovation; technology and innovation management; organizational processes; organizational behavior; organizational form; organization and management theory
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Introduction

Like markets and hierarchies, communities are an important source of knowledge (Adler 2001, Powell 1990). Online communities (OCs) are open collectives of dispersed individuals with members who are not necessarily known or identifiable and who share common interests, and these communities attend to both their individual and their collective welfare (Sproull and Arriaga 2007). An OC is a virtual form of a community whose evolution has closely paralleled the developments in the worldwide Internet revolution (Rheingold 2000, Tapscott and Williams 2006). Some OCs are focused on social bonding (e.g., Facebook), some are platforms where individual creativity can thrive (e.g., YouTube, InnoCentive), and others have become sources of innovation (O'Mahony and Ferraro 2007, Tapscott and Williams 2006, von Hippel and von Krogh 2003, von Krogh and von Hippel 2006).

Knowledge collaboration is defined broadly as the sharing, transfer, accumulation, transformation, and cocreation of knowledge. In an OC, knowledge collaboration involves individual acts of offering knowledge to others as well as adding to, recombining, modifying, and integrating knowledge that others have contributed. Knowledge collaboration is a critical element of the sustainability of OCs as individuals share and combine their knowledge in ways that benefit them personally, while contributing to the community's greater worth (Blanchard and Markus 2004, Jeppesen and Fredericksen 2006, Murray and O'Mahoney 2007, von Hippel and von Krogh 2006, Wasko and Faraj 2000). In OCs, knowledge collaboration occurs often and in a variety of ways.[1] For example, on Wikipedia.com, individuals add knowledge to articles and shape and integrate the knowledge that others have contributed. On ccMixter.org, music is remixed, and on Sourceforge.net, software applications are openly codeveloped by any participant. In other OCs, knowledge collaboration may still occur, but only when standard answers are insufficient to help participants with their problems, such as when a participant in a health-related support community has a particularly complex problem that members collaborate to help resolve.

In this article we theorize how these OCs are able to engage in knowledge collaboration. Understanding the dynamics of knowledge collaboration in them is important not only because of the increasing prevalence of such OCs, but also because OCs have unique characteristics that make the manner in which they collaborate important for understanding the more general phenomenon of organizational knowledge collaboration. For instance, knowledge collaboration in OCs can occur without the structural mechanisms traditionally associated with knowledge collaboration in organizational teams: stable membership, convergence after divergence, repeated people-to-people interactions, goal-sharing, and feelings of interdependence among group members (Boland et al. 1994, Carlile 2002, Dougherty 1992, Schrage 1995, Tsoukas 2009). In most OCs, knowledge collaboration takes place despite the absence of existing social relationships. The lack of traditional structural mechanisms appears to partly free the collaboration from concerns of social conventions, ownership, and hierarchy. In addition, the lack of such structural mechanisms, when coupled with certain technical standards (such as a single platform), has created the possibility of unconstrained recombinations (Hughes and Lang 2006)—a degree of innovative knowledge collaboration rarely seen in more traditional organizational structures. In essence, we view OCs as a generative space partially disembodied from typical structural mechanisms and unencumbered by the social shadows of past and future. Consequently, OCs offer the possibility of exploring new organizational mechanisms that have replaced traditional ones in facilitating knowledge collaboration. Our intent in this exploration is to stimulate the *Organization Science* reader to consider new perspectives in studying knowledge collaboration in both new and traditional organizational forms.

We organize the rest of this paper into four sections. In the first section, we briefly review extant literature on knowledge collaboration in OCs and identify a paucity of theoretical development concerning one of their fundamental characteristics: their fluidity and the dynamics that result from that fluidity. In the second section, we describe resources that come and go in such a community, and the tensions in resources that fluidity creates. We argue that these tensions offer not simply challenges for the OC but the opportunity for knowledge collaboration. In the third section, we describe generative responses of OCs that can turn the tensions into knowledge collaboration opportunities. Finally, in the fourth section, we raise a number of research questions to stimulate organization scientists as they explore this area of research.

The Need for a Focus on Fluidity of OCs

Researchers have demonstrated a significant interest in online communities. The substantial body of literature has provided a growing consensus on factors that motivate people to make contributions to these communities, including motivational factors based on self-interest (e.g., Lakhani and von Hippel 2003, Lerner and Tirole 2002, von Hippel and von Krogh 2003), identity (Bagozzi and Dholakia 2006, Blanchard and Markus 2004, Ma and Agarwal 2007, Ren et al. 2007, Stewart and Gosain 2006), social capital (Nambisan and Baron 2010; Wasko and Faraj 2000, 2005; Wasko et al. 2009), and social exchange (Faraj and Johnson 2011). These motivating factors are often simultaneously present and interact with each other in complex ways (Roberts et al. 2006). The literature has also produced a variety of other structural mechanisms that help sustain community membership, including community size (Butler 2001), critical mass (Blanchard and Markus 2004, Peddibhotla and Subramani 2007), and external recognition (Jeppesen and Frederiksen 2006). There is also an emerging literature on roles and rules (Fleming and Waguespack 2007), authority (O'Mahony and Ferraro 2007), and governance (Murray and O'Mahony 2007).

We believe it is necessary to expand on the extant literature on OCs. This literature has not focused on the dynamics of knowledge collaboration, whereby others' contributions are iteratively integrated and recombined in complex ways. The primary focus of previous research on individual contributions to an OC (such as by posting a comment on a blog, answering a question on a discussion forum, or reporting a bug to a software development community site) does not explore the interactive dynamics of the community over time that involve the collaborative melding of ideas and contributions. To understand the creation of a new music video that combines and reworks others' videos, the evolution of an article from the judicious blending of dozens of contributors, or the development of a new software application based on the transformative revisions of contributions of others requires more than an accounting of the structural mechanisms or an explanation of why someone contributes to a site. Instead, it requires understanding how the multiple contributions of various people unfold over time. Where the dynamics have been of theoretical interest in previous research on OCs, they have been studied through a focus on resource sustainability (Butler 2001), herd behavior (Oh and Jeon 2007), and network exchange mechanisms (Faraj and Johnson 2011) without a focus on knowledge collaboration.

Fluidity is not simply an important characteristic of OCs that has been understudied. We argue that fluidity is a fundamental characteristic of OCs that makes knowledge collaboration in such settings possible. As simply depicted in Figure 1, we envision OCs as fluid organizational objects that are simultaneously morphing and yet retaining a recognizable shape (de Laet and Mol 2000, Law 2002, Mol and Law 1994). They may partially overlap with, but are clearly distinguishable from,

Figure 1   OC as a Fluid Object
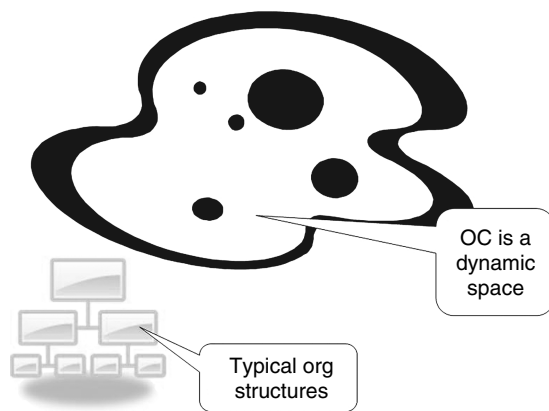
traditional organizational structures. They will not look like an organization structure, but rather a dynamic virtual space.

This definition of OCs as fluid objects is a definition that extends beyond the existing literature's notion of examining dynamics through a lens of participants' comings and goings (e.g., Kuk 2006, Oh and Jeon 2007). Fluid OCs are ones where boundaries, norms, participants, artifacts, interactions, and foci continually change over time—in the sense of Heraclitus' pronouncement of not being able to step twice in the same river. All organizations change, but OCs are characterized by constant changing, flowing, and shape-shifting as tensions grow within and pressures mount from outside. Fluid objects may leak resources, balloon from attracting new ones, and rapidly change boundary conditions, yet there is no discontinuity, leaving the community essentially the same (Law and Singleton 2005).

Recognizing the fluid nature of OCs has significant implications beyond the study of such organizational forms. As the Internet platform makes it possible for traditional organizations to become more fluid, we contend that a deeper understanding of the fluid nature of OCs will have significant implications with regard to how to study collaboration in organizations in general.

Fluidity recognizes the highly flexible or permeable boundaries of OCs, where it is hard to figure out who is in the community and who is outside (Preece et al. 2004) at any point in time, let alone over time. They are adaptive in that they change as the attention, actions, and interests of the collective of participants change over time. Many individuals in an OC are at various stages of exit and entry that change fluidly over time. For example, 68% of newcomers to Usenet groups drop out after contributing a single post (Arguello et al. 2006), and only 22% of members of 204 Usenet groups contributed to the community during a 130-day study period (Cummings et al. 2002). Participation in OCs ranges from the highly committed core participants to interested others who partake in different ways at different

points in time. For example, in OCs, a large percentage of participants—estimated at up to 90%—are inactive (Nonnecke and Preece 2000), such that they may use community resources (i.e., listen, read, watch) but do not contribute. However, failure to examine the critical role of even the inactive participants in the functioning of the community is to ignore that passive (and invisible) participation may be a step toward greater participation, as when individuals use passivity as a way to learn about the collective in a form of peripheral legitimate participation (Lave and Wenger 1991, Yeow et al. 2006).

Fluidity requires us to look at the dynamics—i.e., the continuous and rapid changes in resources—rather than the presence or the structural form of the resources. Resources may flow from outside the OC (e.g., passion) or be internally generated (e.g., convergence), subsequently influencing and influenced by action (Feldman 2004). Resources come with the baggage of having both positive and negative consequences for knowledge collaboration, creating a tension within the community in how to manage the positive and negative consequences in a manner similar to the one faced by ambidextrous organizations (O'Reilly and Tushman 2004).

As fluctuations in resource endowments arise over time because of the fluidity in the OC, these fluctuations in resources create fluctuations in tensions, making simple structural tactics for managing tensions such as cross-functional teams or divergent opinions (Sheremata 2000) inadequate for fostering knowledge collaboration. As complex as these tension fluctuations are for the community, it is precisely these tensions that provide the catalyst for knowledge collaboration. Communities that then respond to these tensions generatively (rather than in restrictive ways) will be able to realize this potential. Thus, it is not the simple presence of resources that foster knowledge collaboration, but rather the presence of ongoing dynamic tensions within the OC that spur the collaboration. We describe these tensions in the following section.

Fluidity Leads to Dynamic Changes in Resources That Create Tensions in OCs
The fluid nature of the OC creates fluctuations in resources. Because resources have both positive and negative consequences, creating a tension in how to manage the positives and negatives, this fluctuation in resources creates fluctuations in the nature of the tensions over time. We argue that it is the fluidity, the tensions that fluidity creates, and the dynamics in how the OC responds to these tensions that make knowledge collaboration in OCs fundamentally different from knowledge collaboration in teams or other traditional organization structures.

We identify five tensions associated with five different resources that dynamically affect knowledge collaboration in OCs. The five tensions are in (1) passion,

(2) time, (3) socially ambiguous identities, (4) social disembodiment of ideas, and (5) temporary convergence. Although there may be other resources such as expertise or participation—with tensions associated with OC knowledge collaboration—we have focused on these five, as we have found them to be significant in our own research on OCs, and they have received scant attention in the literature.

Tension 1: Positive and Negative Consequences of Passion

Passion, or devoted enthusiasm for the OC's goals or work, is an important resource in OCs. Passion is present at the individual level by passionate individuals making contributions to the OC, as well as in the collective's group identity, collective action, and social mobilization (Goodwin et al. 2001). Passion drives participation by enticing individuals to join and focus their efforts in developing the community's knowledge base. Because participation is volitional, those with more passion are more likely to invest the time and effort in building and sustaining the community (Butler et al. 2007, Wasko and Faraj 2000). Early adopters of the online social networking site MySpace were passionate about music and actively promoted the site with their friends (Boyd 2008). Passionate members can affect the mood of other members and generate increased involvement by others via specific behaviors, exemplary participation, or just charismatic actions (Bono and Illies 2006, Sy et al. 2005). Thus, passion is an important resource on which OCs rely.

Passion has positive consequences for knowledge collaboration in an OC. Passion can provide the well from which new ideas and collaborative opportunities spring. Passion drives entrepreneurial spirit, encouraging new recombinations and bricolage of others' ideas (Baum et al. 2001, Chen et al. 2009, Elsbach and Kramer 2003). Passion can provide the motivation for members to spend the time persevering in struggles to understand new perspectives, find new sources of information, and share seeds of ideas for others to add to and recombine (Kane et al. 2009). Passionate people tend to be better at associating disparate experiences in their daily life to a problem they are working on (Chen et al. 2009).

Yet the presence of passion in OCs can create negative consequences. Passion can be a barrier to collaboration (Fiol and O'Connor 2002). Differences between passionate individuals can lead to protracted debates on how to proceed or the right way to do things. In stable organizational structures, passion can lead to interpersonal conflict, which harms attempts at rapid conflict resolution (Hinds and Bailey 2003, Jehn et al. 1999). In OCs, passion can lead to flame wars that result in interpersonal conflict. Passion can keep people from being willing to compromise, leading to a greater probability of win–lose resolutions to conflict, rather than win–win resolutions

(O'Connor and Adair 2003). Win–lose resolutions are more likely to lead to the losing party becoming disenfranchised and reducing his or her active participation. Finally, passion may reduce participation of members who are less passionate. A member who believes in an issue but not as passionately as another may find his or her less emotional arguments misinterpreted or pushed to the periphery by more passionate members.

This tension between the positive and negative consequences of passion becomes a particularly salient issue for knowledge collaboration because of the fluidity of the OC. At an individual level, as people with passion join the community, the positive consequences of their passion can inspire others by example or by strength of conviction. At a collective level, when the passions are directed at similar goals and processes, individuals in the collective can become inspired and encouraged to create knowledge. In fluid OCs, as individuals choose to participate at different points in time, the focus of discussions becomes quite transitory. Consequently, the topic that creates passion for the collective is likely to shift over time as individuals with different passions join. Maintaining a careful alignment between passions of the collective and passions of individual participants over time is a difficult challenge for OCs. Even when passions are temporarily aligned among some of the participants, the tension between the positive and negative consequences is likely to fluctuate. A cycle may occur as knowledge collaboration derives from a passionate few who alienate some participants who then leave, which may lead to the passionate few losing interest out of a lack of participant engagement, which may in turn engender new participants to share the interests about which they are passionate, which may be recombined with the knowledge that the earlier passionate people had left behind. In sum, fluidity drives tensions in passion in the OC.

Tension 2: Positive and Negative Consequences of Time

A second tension is between the positive and negative consequences of the time that people spend contributing to the OC. Knowledge collaboration requires that individuals spend time contributing to the OC's virtual workspace (Fleming and Waguespack 2007, Lakhani and von Hippel 2003, Rafaeli and Ariel 2008). Time has a positive consequence for knowledge collaboration. The more time people spend evolving others' contributed ideas and responding to others' comments on those ideas, the more the ideas can evolve. In Wikipedia, a detailed analysis of an article evolution found that after a participant initially suggested an idea for inclusion, the idea was likely to be eventually included in the article if someone other than the original initiator spent the time to modify the idea in response to the many contributors who shared their opinions about the idea (Kane et al. 2009).

Spending time, however, can also have negative consequences for knowledge collaboration. A participant who spends a disproportionate amount of time contributing to the OC may exert excessive influence over the knowledge collaboration process, crowding out the contribution of others with more expertise and harming others' collaborations. For example, Silva et al. (2008, p. 71) found that "old-timers"—those spending significant elapsed time in the OC—took it upon themselves to ridicule and even insult newcomers who they felt deviated from the expected ways of making a contribution. Thus, those who spend more time may hamper newcomers from spending time.

This tension becomes a particularly salient issue for OCs because of their fluidity. Different participants can selectively devote more or less time to the OC, leading to unpredictable fluctuations in the collaborative process. Gradually, there may be points in time when participants spend little time contributing to the OC, starving it of needed ideas and recombinations, creating a risk of little collaboration. This void of time may then in turn become unpredictably filled by individuals with time to rescue the OC in new and unpredictable ways. Those who begin to spend too much time relative to the time spent by other members may drive out people who never intended on spending significant amounts of time in the OC and feel their influence waning. The fluidity iteratively and continuously shifts the nature of the time tension in the OC: from too little, to inequitably distributed, to too much and back to too little, with each shift having potential positive and negative consequences for knowledge collaboration.

Tension 3: Positive and Negative Consequences of Socially Ambiguous Identities

The third tension rallies around the positive and negative consequences of socially ambiguous identities. Social anonymity leaves an OC actor's identity unknown to others in terms of who contributed what to a software artifact, encyclopedia entry, or a music remix. As OC boundaries are permeable and morphing, people, their identifying information (names, intent, location, expertise, etc.), and their contributions often become separated. The separation leads to socially ambiguous identities. Even when names, location, and experiences are known to OC participants, this information means little because the individuals involved lack the social relationships that provide unambiguous interpretations of this information. For example, in Wikipedia, a participant in an OC developing a medical article who describes herself as a doctor does not immediately engender respect, expertise, or similarity of values and goals by others in the community, as others may feel ostracized by the medical establishment, may have experienced problematic side effects from medical treatment, or may feel that the article should be written from a broader view than

that provided by a medical doctor. When people do not share social relationships, participants do not necessarily compensate by disclosing more personal information (Qian and Scott 2007).

There are several positive consequences for knowledge collaboration from a community of individuals with ambiguous social identities. One such positive consequence is that individuals are more likely to have increased communication satisfaction and higher performance in an online communication task when communication partners have ambiguous identities (e.g., Tanis and Postmes 2007). This is due, in part, to reduced concern about status differences, specific reciprocity concerns, and less stereotyping. In brainstorming, anonymity encourages participation, minimizes undue influence, and encourages focus on the merit of ideas rather than the status of the contributor (Jessup et al. 1990, Nunamaker et al. 1991), leading to a greater number of better quality ideas (Parent et al. 2000). Anonymity is related to factors that may promote collaboration more generally. For example, because anonymity provides "a degree of liberation from social evaluation" (Pinsonneault and Heppel 1997, p. 103), anonymity increases variety in comments, as people are less constrained by social controls and more willing to take risks without facing embarrassment or other negative consequences (Jessup et al. 1990, Marx 1999).

There are negative consequences of ambiguous social identity for knowledge collaboration in OCs, however. These negative consequences include deindividuating (Postmes and Lea 2000, Tanis and Postmes 2007), unruly behavior (Jessup et al. 1990), and hyperpersonalization (Walther 1996). Anonymity decreases trustworthiness and accountability of knowledge (Rains 2007). Anonymity may also reduce knowledge contributions if people are worried about not getting credit for their input and ideas (Scott 2004). Although people have been found to attribute anonymous comments more accurately than expected by chance, many attributions are incorrect (Hayne et al. 2003). Anonymity also allows for a substantially increased risk of deception and frivolousness (Hancock 2007, Scott 2004).

The positive and negative consequences of social ambiguity create tension in how to manage the OC in a way that balances the positives and negatives. For example, at the individual level, the negative consequences of social ambiguity may lead some participants to act to connect ideas with people so that they feel more psychologically safe in the OC. For other people, this linking will reduce their own psychological safety in contributing their own risky ideas, because they have some social connection to others but few ways to monitor how the others react. This tension will fluctuate with the fluidity in the OCs. As the same parties interact over time, a social identity of the parties becomes constructed, reducing the ambiguity. However, with fluidity come new parties. As they join, they may reconfigure the focus of

the contributions in such a way that the existing parties' actions are either no longer appropriate or take on a new form or focus. Consequently, the social identity created may no longer be appropriate, bringing back the social ambiguity and leaving some of the parties feeling confused and deceived about what they had come to construe as others' social identities.

Tension 4: Positive and Negative Consequences of Social Disembodiment of Ideas

Social disembodiment in an OC, or what others call decontextualization (Hughes and Lang 2006), refers to the notion that, in an OC, ideas can become independent of their authors and of the context in which they were originally created and shared. OCs allow combination and recombination of ideas unconstrained by conventions of social interaction, shared context, or even a shared set of ontological assumptions. For example, the ccMixter.org community has cocreated several million pieces of music remixes that anyone can remix into new combinations. Cocreators are required to make their contributions available to others as separate constituting parts (e.g., vocals, rhythm tracks, baselines, keyboard melodies, guitar riffs, etc.). Anyone can mix without having to understand the original context and purpose of the original musical contribution.

There are several positive consequences of social disembodiment for knowledge collaboration. Integration and recombination are facilitated by the ability to use ("lift") others' ideas easily. Many ideas can be contributed in parallel rather than in sequence. OCs do not require the original idea contributors and the subsequent developers to be present at the same time, freeing the collaborative process from conventional social process losses.

However, there are several negative consequences of social disembodiment for knowledge collaboration in the OC. There is no common ground that facilitates the integration of ideas (Woodman et al. 1993). Recombination of ideas might create harm, either intentional or unintentional, but without the ability to hold anyone accountable. The ideas can be easily misunderstood and misapplied. For example, a contributor to a Wikipedia article inserting the biased, uninformed comments of a radio commentator as an illustration of bias was criticized by the community for violating the neutral point-of-view guidelines; the contributor complained that he had been misunderstood because he thought his contribution was intended as a neutral illustration of bias, not as an endorsement of the biased assertion (Kane et al. 2009). In some communities, the misuse of an idea may actually lead to collaboration, but sometimes the misuse of an idea may lead to opportunistic risk.

This tension between the positive and negative consequences of social disembodiment is made particularly salient because of the fluidity in the OC. Shared contexts around ideas are likely to be temporary based on who participated at the time an idea was contributed. Sometimes, the context may be situationally inferred; for example, following the death of a pop singer, music tracks contributed to a site might share a similar context of being reflective of the singer's style. During the period immediately after the singer's death, those participating in the community may engage in significant knowledge collaboration by focusing their collaboration on music that eulogizes the singer. At other times, when the community is functioning without the benefit of a unifying event, the same idea—of creating songs associated with a particular singer—might be criticized as copying or lacking novelty. The fluidity in an OC means that the shared context is likely to dissipate rapidly over time and as new people contribute. This may create dynamics between those with and those without a shared context (Kane et al. 2009). Moreover, some participants may contribute ideas without offering any context, allowing the idea to evolve in unexpected ways as follow-on contributors draw their own inferences about an appropriate context for the evolved idea. This unpredictable evolution may hurt collaboration when new entrants to a community expect more clarity or value from the contributions they examine in the OC, as has been observed in open source development communities (Roberts et al. 2006). Alternatively, this unpredictable evolution may hurt collaboration because others do not understand the idea well enough to recombine it.

Tension 5: Positive and Negative Consequences of Temporary Convergence

The classic models of knowledge collaboration in groups give particular weight to the need for convergence. Convergence around a single goal, direction, criterion, process, or solution helps counterbalance the forces of divergence, allowing diverse ideas to be framed, analyzed, and coalesced into a single solution (Couger 1996, Isaksen and Treffinger 1985, Osborn 1953, Woodman et al. 1993). In fluid OCs, convergence is still likely to exist during knowledge collaboration, but the convergence is likely to be temporary and incomplete, often implicit, and is situated among subsets of actors in the community rather than the entire community. Although in a fluid OC there is unlikely to be convergence about goals, processes, proposed solutions, or even evaluation criteria, there is likely to be temporary convergence around general topics, broad framing of the topics, generally appropriate uses of an idea, or a collective passion around which ideas are worth converging. In a mobile movie community, for example, different community members can upload video clips they have taken with mobile devices; any community member then creates video stories with these independently produced video clips from different places at different times (Multisilta

and Mäenpää 2008). The convergence among members in the OC, then, is not associated with the specific goal to be accomplished in a movie, but rather the general use of the community to creatively remix movie clips—a purpose that may only be temporary.

There are positive consequences for knowledge collaboration in OCs from temporary and incomplete convergence. Some degree of convergence—albeit temporary—may help avoid fault lines, subgroups, and an inability to understand each other's perspectives sufficiently to collaboratively recombine that knowledge. The incompleteness of the convergence allows ideas to evolve along different tangents, directions, disciplines, foci, interests, and goals. As ideas attract the energy of participants, they are modified, integrated, and recombined based on an unfolding temporary and incomplete convergence by whoever chooses to participate. Thus, multiple ideas may undergo a process of divergence–convergence in different stages, by different actors, in different ways.

However, the temporary and incomplete nature of the convergence can have negative consequences for knowledge collaboration. The lack of convergence can eliminate a critical reinforcement process for continued collaboration. When feedback to an idea is provided by other community members, the response is considered an acknowledgement of valued contribution, irrespective of the valence (negative or positive) of the response (Silva et al. 2008). Particularly for a new entrant to a community, the lack of response to an idea may suppress future participation (Joyce and Kraut 2006). The temporary and incomplete convergence may also create fault lines between those ideas and individuals who converge on an idea and those who do not. In wikis, the fault lines become "forks" for new pages that, unless actively integrated by participants, end up creating subgroups that fail to learn from each other. The temporary and incomplete convergence may also harm knowledge collaboration, because processes and criteria for evaluating ideas necessary for collaboration may not be agreed upon, understood, or followed by the community, leading to frustration at the pace of knowledge building.

This tension between the positive and negative consequences of convergence for knowledge collaboration in OCs becomes particularly salient. Over time, ideas compete, combine, fork, and reemerge. Some ideas that are successfully incorporated into a convergent idea attract energy from other ideas, morphing into new ideas with new possibilities. However, a convergent idea develops more as a function of who chooses to comment on a particular idea than by any subgroup agreeing on the criteria for evaluating ideas or even on the goals associated with the commenting. Similarly, depending on who chooses not to comment, a convergent idea may quickly unravel with unanticipated and anomalous effects. In a

fluid OC, convergence is serendipitous in a manner that is continually gained and lost.

In sum, we have suggested that the knowledge collaboration in OCs is facilitated by the presence of tensions among five resources: passion, time, ambiguous social identity, social disembodiment of ideas, and temporary convergence. Each resource comes with both positive and negative consequences. The fluid nature of the OC creates fluctuations in the resources, which cause fluctuations in the tensions between the positive and negative consequences. These fluctuations in tensions have the potential of harming or facilitating knowledge collaboration over time. In the next section, we describe how OCs may be able to respond to these tension fluctuations in ways that avoid the harm and encourage knowledge collaboration.

Generative Responses of OCs to Tensions

Tensions in an OC will flare up. Passionate emotions will become inflamed. Time will pressure people into making statements that might appear harmful to the community. Ideas may become cryptic and not helpful to the community. Temporary and incomplete convergence may lead to such disorganization that participants cannot find ideas, threads of ideas, or ways to enter into a topic to be able to make a valuable contribution. The negative consequences of social ambiguity may take hold to such an extent that deception and uncivilized behavior prevails. All of this takes place in an open virtual place, which may lead to the outside impression that the community is spiraling downward, fostering further disruption and exiting.

Although existing research on OCs might suggest the utility of structural mechanisms (e.g., formal roles or participation rules) in helping the community to cope with these tensions, we argue that such structural mechanisms fail to explain how these tensions unfold in ways that eventually lead to knowledge collaboration in the dynamic space of OCs. *We believe that a focus of research on how OCs respond to these tension flare-ups can be more productive than further exploration of structural mechanisms.* As a fluid object, an OC is not likely to be in "equilibrium," nor should an equilibrium state even be desirable. Rather, the tensions are likely to ebb and flow, with each flux providing equally viable opportunities for knowledge collaboration. Consequently, it is how people, subgroups, and the community as a whole respond to the ebbs and flows that, we argue, is likely to be more informative of how the knowledge collaboration process unfolds than examining the structural mechanisms of the community. We describe responses that the community may exercise as these tensions ebb and flow. We refer to these responses as "generative," in that they are able to "harness" the tensions in a way that stimulates collaboration. Our presumption is that tensions cannot be avoided, nor can they be permanently resolved.

They are to be managed to ensure community survival and, we argue, foster collaboration.

Based on our collective research on to date, we have identified that as tensions ebb and flow, OCs use (or, more precisely, participants engage in) any of the four types of responses that seem to help the OC be generative. The first generative response is labeled *Engendering Roles in the Moment*. In this response, members enact specific roles that help turn the potentially negative consequences of a tension into positive consequences. The second generative response is labeled *Channeling Participation*. In this response, members create a narrative that helps keep fluid participants informed of the state of the knowledge, with this narrative having a necessary duality between a front narrative for general public consumption and a back narrative to air the differences and emotions created by the tensions. The third generative response is labeled *Dynamically Changing Boundaries*. In this response, OCs change their boundaries in ways that discourage or encourage certain resources into and out of the communities at certain times, depending on the nature of the tension. The fourth generative response is labeled *Evolving Technology Affordances*. In this response, OCs iteratively evolve their technologies in use in ways that are embedded by, and become embedded into, iteratively enhanced social norms. These iterations help the OC to socially and technically automate responses to tensions so that the community does not unravel. We next discuss how each generative response facilitates leveraging the tensions for knowledge collaboration.

Engendering Roles in the Moment

As tensions among ideas, passion, time, and social ambiguity ebb and flow, one generative response that we have observed in OCs is that individual participants will make and then take situationally specific roles that last only for the moment in which they are needed; then, almost as quickly, they shed those roles. By role making, we mean the enactment of temporary sets of behaviors that are volitionally engaged in, self-defined, and inductively created for the purposes of the OC. Following Goffman (1959), role making emphasizes the emergent and enacted nature of the role in the existing network of emerging and changing roles. This view is different from the more traditional structural and predefined connotation of role taking arising from behavioral expectations, observable by others, and characterized by norms and status position (cf. Katz and Kahn 1978).

In an OC, as the dynamics of the resource tension unfold over time, our observations indicate that participants often voluntarily "role-make" by contributing to the community in certain ways that help overcome the negative consequences of the tension, enhance the positive consequences, and, by so doing, sustain collaboration. These role-making contributions do not appear to

be part of a repeated pattern, but rather a reaction by a single participant to a perceived state of the community, coupled with a perceived self-efficacy that a particular contribution might be helpful to the community. These people are not appointed by the community to serve this role, nor do they necessarily serve the same role over time. At different points in time, with different participants, the same type of role may be served by different people, and the same participant may take different roles—depending on the perceived needs for the community at the time. These roles are not enacted because the participant is a member of a core group or asserts leadership authority—because leadership authority tends to be so fleeting in such communities. Instead, we suggest that the participant appears to be enacting a self-defined role at that moment in which the participant happens to be engaged online—a self-defined role as a mediator, "unmasker," organizer, or supporter.

Roles evolve in response to tension fluctuations. When passions run too high in a community, a participant may create a scaled-down version of a mediator role by reminding others that anger will not help the community. When convergence is so incomplete and temporary that ideas become disorganized, a participant may create an organizer role for herself by organizing ideas that others have posted into a hyperlinked set of Web pages with a table of contents as the home page. When deception harms the community because of ambiguous social identification, a participant may create an investigative type of role for himself by spending time outside the community researching the online behaviors of potential deceivers to identify who might have perpetrated the deception and then sharing the results of the investigation with the community, causing the perpetrator to be unmasked and either apologize to the community or leave.

Our research has identified a number of different roles being created by participants of OCs in response to tensions. Wagner and Majchrzak (2006–2007) and Yates et al. (2009) identified the role of a "shaper" in an online community; shapers help organize the community's diverse threads into a coherent message so that knowledge gaps become more identifiable to the community. Kane et al. (2009) identified other roles—including flitterer, idea champion, and defender—that participants in a Wikipedia article use for collaborating on an article. The flitterer is a participant who comes to the community, places an idea, and then leaves. The idea champion was rarely the initiator of the idea but instead ensured that the kernel of the idea was maintained and evolved through the discussion. The role of defender involved those who used technology to create self-alerts when changes were made to the article so that community participants would be informed immediately when an article is being actively discussed or changed so that they could respond to (and in some cases, defend)

changes to the status quo. Few people served these roles for long periods of time or consistently throughout the development of a Wikipedia's article community, in part because there were few people who stayed in the community throughout the article's development. Moreover, in the case of Wikipedia, these roles were not ones sanctioned by the extensive network of Wikipedia norms and rules; these were roles that were simply enacted by participants to keep collaboration flowing.

There may be other roles as well that help sustain knowledge collaboration as dynamic tensions ebb and flow. In one community (Gu et al. 2007), a participant with no formal role in the discussion forum became a conflict mediator when a disagreement between two individuals became personal and destructive. In another community that was operated within a corporation, one participant stepped into the role of standards-bearer and another stepped into the role of identifying and integrating productivity tools for community use. Both of these roles helped increase scale and variability in participant ideas while at the same time identifying ways for creating temporary incomplete convergence.

Channeling Participation

Another response that OCs use to maintain knowledge collaboration in the face of ebbing and flowing tensions is identifying ways to keep interested participants informed of the current state of the OC's collaborative efforts. By keeping participants informed of knowledge that has been posted, discussions that have transpired, decisions that have been made, paths that have been taken, and directions that have been set, any participant can jump into the collaborative process without spending excessive time on the periphery gaining this basic knowledge of the community. If participants are kept informed, those who have little time can make valuable contributions. If participants are kept informed, those with less passion can skim over the passionate exchanges between participants to focus their efforts. If participants are kept informed, contexts for ideas can be inferred despite socially disembodied ideas, weakly tied ideas can be linked together despite socially ambiguous identities, and a temporary convergence can be forged from the current state of the OC's contributions.

We suggest that participants are kept informed in these communities through efforts that turn simple individual contributions into coherent narratives. Narratives are stories that describe how a collective of individuals acted. Narratives are knitted together from individual behaviors; thus they represent a collective understanding of how individual behaviors interrelate over time. Narratives may not be consciously created but are often implicitly inferred by participants observing the behavior of the collective. Narratives have been identified in non-OC settings as helping promote adherence to core values (Bartel and Garud 2009); linking

past, present, and future actions (Boland et al. 2007); helping socialize participants (Bruner 1991); helping shape future action (Pentland 1999); and providing individuals with the means for legitimating their behavior (Czarniawska 2004).

We have observed in OCs that no single narrative is able to keep participants informed about the current state of the OC with respect to each tension. These communities seem to develop two different types of narratives. Borrowing from Goffman (1959), we label the two narratives the "front" and the "back" narratives.

Front narratives refer to the front stage of the collaborative work. In a play, the front narrative is the part of the play that is seen by the audience, i.e., the performance. In OCs, the front narrative is the part of the community's work that the entire community sees. In Wikipedia, the front narrative is the current version of the article that the community has edited (Kane et al. 2009). In Salesforce .com's AppExchange, the home page serves as the front narrative. The front narrative informs the public at large and the community in particular of the current state of the "performance" of the community. Skimming the AppExchange home page, for example, informs the reader of the number and types of software applications that have been developed by the public using the Salesforce.com platform; this helps show the public that Salesforce.com is an enterprise-wide application solution rather than one just focused on the narrow set of customer relationship management activities for which it was originally developed. Skimming a Wikipedia article informs the reader of the areas in an article that are still undeveloped (e.g., poorly cited) and areas that appear well developed. The front narrative, therefore, provides the viewer with an overall impression of the general state of the community and an overall impression of where the participant can contribute. Similarly, the front page allows the fluid object of an OC to be temporarily fixed in time so that contributions from that point on can be directed to where the needs are greatest. People may enter and leave the community, but the front narrative is always there and is always current, as of the latest contribution of a participant. Such a front narrative is likely to help respond to tensions by creating a context for disembodied ideas, providing a temporary convergence, and allowing passionate and time-constrained participants to direct their efforts.

Back narratives in OCs are quite different from front narratives, referring to the preparation, dress rehearsal, and role negotiation that takes place away from the public (Goffman 1959). Narratives occurring backstage provide an opportunity for the informal organization to assert itself and convey possibilities of various roles, abilities, attributes, and expertise that can be put to use. Similarly, the back narrative in an OC is substantially different from the its front page. Just as role negotiations, flaring tempers, alternative trials, and starts and

stops occur backstage as actors prepare for a performance, the back narrative of an OC is likely to display paths taken but not completed, ideas started but not finished, contribution threads that appear to go nowhere, chaos rather than order. In Wikipedia, the "talk pages" are likely to display the back narrative. In other OCs, the comment page, discussion thread, or private messages may provide the back narrative. The back narrative serves as a response to tensions in passion because it allows passionate people to disagree, serves as a means to work out a temporary incomplete convergence, and provides a means to respond to the ambiguity in social identity by monitoring for deception.

Dynamically Changing Boundaries

A third response to manage tensions is to promote knowledge collaboration by enacting dynamic boundaries. In social sciences, although boundaries divide and disintegrate collectives, they also coordinate and integrate social action (Bowker and Star 1999, Lamont and Molnár 2002). Fluidity brings the need for flexible and permeable boundaries, but it is not only the properties of the boundaries but also their dynamicity that help manage tensions. The organizational literature has traditionally associated boundaries with efficiency, incentives, and property and decision rights, but the recent interest in nascent markets, social movements, and new organizational forms has expanded this view to conceptions of identity, expertise, and power (Santos and Eisenhardt 2005). OCs have become exemplars of how boundaries are multifaceted and coevolving in different layers (e.g., community, project, subgroup, idea), and it is through the dynamicity in these boundaries that the coherence, flexibility, and capacity to inspire are provided (O'Mahony and Bechky 2008). It is this dynamicity of boundaries, then, that helps channel resources to prevent tensions from unraveling the collaborative potential of the community.

Boundaries can be multilayered and multifaceted, rallying around "attention" at the community level and around "property rights" of a subgroup at one particular moment. As tensions change, so do boundaries. When tensions derive from the need to transfer weakly tied ideas without people-to-people relationships, boundaries may become temporarily more salient in pursuit of a common purpose. When tensions are salient around too much passion, boundaries may evolve to be based on a common set of norms; when tensions stem from too little passion, boundaries may help rally members against a perceived common enemy (e.g., Microsoft). When tensions surface around having too much convergence, the community can broaden the knowledge-based boundaries of the community by inviting other communities with different ideas to share their ideas; when there are too many disorganized ideas, the community can shift topical boundaries by creating subgroups with more limited focus. O'Mahony and Bechky (2008) describe the dynamics of how the divergent interests of the open source software movement and the commercial software firms' interests were managed by setting a subgroup, or boundary organization, that continually negotiated the property rights, identity, power, and expertise boundaries. Whereas Santos and Eisenhardt (2005) note that boundaries serve the role of providing coherence, flexibility, and the capacity to inspire, we argue that in fluid OCs, it is the dynamic changes in the boundaries rather than boundaries themselves that allow communities to—in their words—"cohere and motivate their members in the absence of fiat and hierarchy" (p. 503).

Evolving Technology Affordances

A fourth response of the OC to tensions that help sustain knowledge collaboration is evolving technology affordances. An OC's participants contribute their ideas and interact on a technology platform. That platform becomes a "great good place" (Oldenburg 1989) akin to a neutral meeting place in face-to-face environments (e.g., a neighborhood bar, a park, a memorial), where social conventions are democratic and people engage in conversations or in their own activity. On a technology platform, individuals can be affected by those around them even without direct interaction (Latané and Liu 1996, Latané et al. 1995).

The technology platform supports the OC's activities and serves to organize its interactions. Beyond supporting the main activities of the community (e.g., threaded discussion lists and postings management systems), the platform consists of a variety of technological tools that fluidly evolve in support of individual, group, or community interactions. User-centric perspectives look at these tools as bundles of features, where users select a set of functionalities to support their work (Clark et al. 2007, Griffith 1999). We prefer to move beyond perspectives that view technology existing separately from the people using them. Given the fluid nature of OCs and their rapidly evolving technology platforms, and in line with calls to avoid dualistic thinking about technology (Leonardi and Barley 2008, Markus and Silver 2008, Orlikowski and Scott 2008), we suggest technology affordance as a generative response, one that views technology, action, and roles as emergent, inseparable, and coevolving. Technology affordances offer a relational perspective on human action, where neither the technology nor the actor is dominant in the sense that the technology does not define what is possible for the actor to do, nor is the actor free from the limitations of the technological environment. Instead, possibilities for action emerge from the reciprocal interaction between actor and artifact (Gibson 1979, Zammuto et al. 2007). Thus, an affordance perspective focuses on the organizing actions that are afforded by technology artifacts. It builds on the

possibility of new ways of working and organizing that are difficult to predict a priori, but it also recognizes that certain uses are facilitated or hindered by the qualities inscribed in the current technological artifact.

Technology platforms used by OCs can provide a number of affordances for knowledge collaboration, three of which we mention here: reviewability, recombinability, and experimentation. These affordances evolve as new participants provide new ways to use the technologies, new social norms are developed around the technology affordances, and new needs for fresh affordances are identified.

Reviewability refers to the enactment of technology-enabled new forms of working in which participants are better able to view and manage the content of front and back narratives over time (West and Lakhani 2008). By allowing participants to easily and collaboratively review a range of ideas, technology-afforded reviewability helps the community respond to tensions in disembodied ideas, because the reviews can provide important contextual information for building on others' ideas. Likewise, tensions in socially ambiguous identities can be managed by reviewing the full range of contributions from a single individual to construct an identity for the person; tensions in creating incomplete temporary convergence as reviews make it possible to more quickly identify the incompleteness in the convergence. For example, on Wikipedia, those involved in the development of an entry are able to rely on automated software to specify and keep track of changes made by others. Any malicious or unvetted change can then easily be responded to or discarded. Thus, the evolution of such a technology affordance is a generative response by the Wikipedia community to support its organizing principle—that anyone can contribute content (Zittrain 2008).

Recombinability refers to forms of technology-enabled action where individual contributors build on each others' contributions. For example, in video mashing communities, videos that follow the community's established standard formats are likely to foster more recombination than videos that use unique software applications and unusual formats. In social networking sites, the ability to differentially aggregate social relationships allows a participant to keep different subgroups informed of his activities in different ways. Recombinability can be seen as both a technology design issue and a community governance principle focused on inviting and facilitating the free borrowing of and building on each others' contributions (Lessig 2008).

Experimentation, the third affordance, refers to the use of technology to encourage participants to try out novel ideas. Experimentation can be promoted through virtual sandboxes that allow simulated piloting of software ideas (Majchrzak and Maloney 2008) or by the

provision for comment boxes and rating feedback systems that encourage participants to rate the creativity, potential, and excitement of a posted idea. Experimentation helps the community respond to a range of tensions. Passion for ideas can be expressed through a passionate plea as well as demonstrated via a prototype within the sandbox. Participants can respond to time tensions by rating ideas so that only those with the highest ratings get attention from time-starved participants. An example of a technology platform that provides all three affordances is IBM's ThinkPlace (Majchrzak et al. 2009).

Although affordances are helpful because they offer a generative response to organizing issues, their outcomes are not known in advance nor are they always positive. For example, norms on Wikipedia have become hardwired into an automated blocking of further discussion after three revisions, a step that could limit content generativity (Zittrain 2008). Moreover, the continuous ebb and flow of tensions suggests that the sociotechnology affordances need to be easily evolvable, as they can quickly become obsolete or a hindrance to further progress. Therefore, it is likely to be not simply the affordances themselves that provide the response of the OC to the tensions, but the coevolution of the technology and social structure affordances that provide the response.

Implications for Organization Science Research on OCs

Figure 2 depicts our framing of knowledge collaboration in OCs. We have identified five tensions that when met with four generative responses help to sustain knowledge collaboration. Our tensions and generative responses are incomplete, awaiting future research that we hope we have stimulated.

Our goal in this paper, then, has been to investigate dynamics related to knowledge collaboration in

Figure 2   Partial List of OC Knowledge Collaboration Dynamics
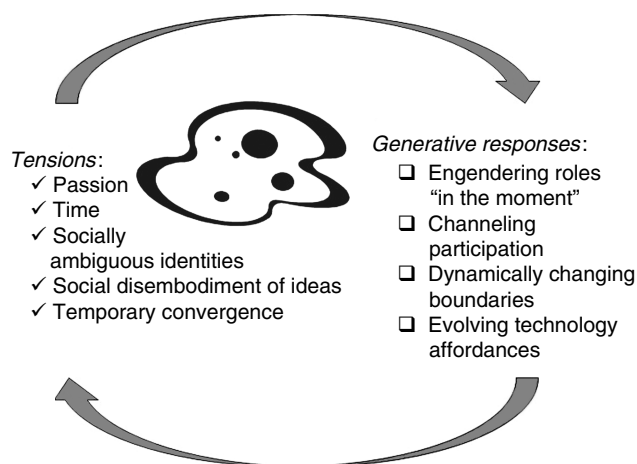
OCs. Although others have called for research on online knowledge collaboration (e.g., Jeppesen and Frederiksen 2006, von Krogh and von Hippel 2006), the extant literature theorizes little about how it happens. In the existing literature, researchers have focused primarily on what drives individuals to participate and contribute in these open and virtual forums and secondarily on what psychological, social, and economic factors sustain these communities (Butler 2001, Butler et al. 2007, Ma and Agarwal 2007, Preece 2000, Ren et al. 2007, Wasko and Faraj 2000). Existing theories of knowledge collaboration in diverse groups have traditionally characterized the collaboration process as one of people-to-people sensemaking, challenged assumptions, and pragmatic negotiations among individuals with different perspectives or thought worlds (Boland et al. 1994, Carlile 2002, Dougherty 1992, Schrage 1995, Tsoukas 2009). The use of people-to-people relationships allows for immediate feedback, the ability to directly challenge assumptions, the opportunity to identify interdependencies, joint engagement in hermeneutic inquiry, open information sharing, development of common goals, and identification of a common problem-solving approach—all critical components of traditional collaboration. However, these components are not present in OCs. Given the dearth of common ground and preexisting people-to-people relations in OCs, we have suggested an alternative conceptualization that takes into account their unique nature, including the lack of deep social ties. To encourage new research directions, we offer a fluidity-based perspective of resources, tensions, and generative responses.

One key area of our fluidity perspective for future research is to study organizational collaboration less with a focus on the structural mechanisms and governance of the community's or members' motivation, and more on flow and connection of ideas over time. Research needs to model the emergent properties of collaboration. Such modeling might capture the initial conditions of the ideas, how the ideas evolve within the community in response to local problems, and how these changes generate additional connections and trajectories to other contexts. Fluidity suggests that conventional linear relationships between structure and action are unlikely. Rather, initial conditions and specific events can produce qualitatively differentiable, and even abrupt, effects. Given that it is the ideas rather than people that undergo rapid change in OCs, future research should consider studying the connections and dynamics of ideas along with the flow of people.

This suggestion has implications for small group theories. Extant theories of small group processes are beginning to develop insight into the highly dynamic and evolving phenomena of knowledge collaboration in dynamic organizations such as OCs (Argote et al. 2003, Argote and McGrath 1993). Recent small group research has identified positive as well as negative aspects of membership change for group performance. Membership turnover may help group performance by bringing in novel expertise, but it threatens the cognitive structures and processes that are so useful for expertise coordination (e.g., Lewis et al. 2007). The fluidity perspective we offer focuses on self-managed communities of fleeting memberships that emphasize dynamic boundaries and membership, distributed ideas in time and space, and multiple goals and meanings. Core assumptions of group knowledge-sharing research—such as visible membership, organizational structuring and framing, and the reliance on transactive memory and related cognitive processes—are likely to be inoperative in this setting. Extensions to group research findings on membership turnover are needed as individuals participating in online collaboration generally do not know others, carry different meanings of even the same idea, and may not even be aware of the others' ideas or backgrounds.

A third implication is that conventional social science methods that strive for a single account, description, or model are likely to be inadequate to study fluid knowledge collaboration in emergent and complex dynamic organizational forms such as OCs. For research to develop practically useful theory, methods and tools are needed that can grasp the new realities of knowledge collaboration, no matter how emergent, complex, and ephemeral. Thus, we support Law and Urry's (2004) call for "messy" holistic methods for understanding fluid and complex connections.

Each generative response that we identified as important for OC knowledge collaboration raises questions that need to be researched. First, engendering roles in the moment (our first generative response) appears to be an important action for facilitating knowledge collaboration in OCs, but little is understood about the nature of these roles and how to promote their development. Do different tensions create the need for different roles? That is, if passion is running high, is the best reaction for sustaining collaboration to have short-term conflict mediators or to have longer-term systems thinkers help others see the larger view of the problem? Do roles interact with each other over time? That is, if one person enacts a role of conflict mediation while another individual enacts the role of a flitterer, who, by definition, creates conflicts, do the two roles together cancel each other out, thereby harming collaboration? We also do not know why people create these roles. In a study explicitly on one emergent role—shaper—Yates et al. (2010) found that, in contrast to previous expectations in the literature, shapers were unlikely to be knowledgeable about the topic, to know others in the community, to be experienced wiki users, or to be even members of the core group responsible for the community's sustainability. Therefore, research is needed on what motivates individuals to engender these various roles.

Second, the generative response of channeling participation, by having a front and a back narrative to help with the tensions in different ways, calls for new research—particularly in two areas. The first area of research on channeling participation concerns the evolution of these narratives. How do newly emerging communities initially develop their narratives? Although individuals may play critical roles in this initial evolution, the fluid nature of the open OC suggests that the evolution of these narratives is no more controllable than the participants themselves. Once a narrative is started, is it in fact transformed and reconstructed in response to different tensions, or does it simply capture the community's response? That is, does narrative making have an agency, as we have suggested, or is it simply a story of times past? The second research area on channeling participation concerns the need to address the issue of how the two narratives coevolve. If both narratives are required, do the contributions need to be aligned across the two narratives, or can the two be focused on very different subtopics at different points in time? Is there some set of actions the community takes for each narrative that facilitates easy travel between the two?

Third, much more research is needed about how boundaries are dynamically changed to adjust to resource tensions. Are there discernable patterns and dependencies in how some boundaries evolve among substantive (e.g., expertise), social (e.g., cohesion or common goals), cognitive (e.g., attentional), and efficiency-focused (e.g., property rights) boundaries? Are some of these boundaries more salient to certain resource tensions? For example, enacting social boundaries may serve as a complementary mechanism to time-based resource tensions, whereas attentional boundaries may serve as a complementary mechanism to social disembodiment resource tensions. How do these facets of boundaries interact and coevolve to support each other to facilitate knowledge collaboration in light of resource tensions over time? Social movement theories (Benford and Snow 2000), with their emphasis on issue framing and collective action, may provide a useful theoretical lens for how OC boundaries can be managed or studied.

Fourth, the evolution of technology affordances requires facing issues at the intersection of the materiality of technology (as an obdurate but shapeable object) and the evolving social processes in the community. We offer research questions in two areas. First, given their mutual constitution, is there a preferred evolutionary pairing between technology and the social structure? Do they need to be tightly coupled, or could we have healthy, long-lived OCs with very different technologies in use? A second set of questions refers to the relation between the fluid nature of the OC and technology affordances. Changing technology requires new learning and cognitive effort from participants before a new way

of collaborating can evolve. If every time the individual visits the community the technology looks different, does this negate the technology's benefits? Given the fluidity in participation, must the community devise new ways that allow newcomers and early technology adopters to operate with one set of technologies and others in the community to operate with a second set? Further research on OCs cannot continue to consider technology as a black box. Rather, it is a fundamental building block that is intertwined with the actions leading to the community's collaborative success. In line with earlier calls (Zammuto et al. 2007), research that effectively integrates technology with social actions in fostering knowledge collaboration is needed.

Conclusion

In conclusion, we raise a call for research on knowledge collaboration in online communities that emphasizes fluidity over structure. Such research should examine a whole host of resources beyond expertise, including passion, time, identity, social disembodiment of ideas, socially ambiguous identity, and temporary convergence. Such theorizing should recognize that, in these communities, it is not the case that "more resources are better." Rather, these resources create tensions between their positive and negative consequences that make it easy for the community to quickly unravel. Research should therefore focus on understanding how these communities respond to the tensions that will inevitably arise. We have identified four generative responses that may help explain some of the dynamics of this adaptation: engendering roles in the making, channeling participation, dynamically changing boundaries, and evolving technology affordances. This is a challenging area of research, but we hope that our framing helps encourage researchers to revisit assumptions and explore tractable new directions. Our understanding of new organizational forms depends on the ability of researchers to rise to the challenge.

Endnote
[1]We recognize that many OCs may be characterized by negligible knowledge collaboration as they may be oriented toward sustaining civic activities, sports activities, and social ties, or providing social support. Such OCs are not the focus of this paper.

References

Adler, P. S. 2001. Market, hierarchy, and trust: The knowledge economy and the future of capitalism. *Organ. Sci.* **12**(2) 215–234.

Argote, L., J. McGrath. 1993. Group processes in organizations: Continuity and change. C. L. Cooper, I. T. Robertson, eds. *International Review of Industrial and Organizational Psychology*, Vol. 8. John Wiley & Sons, New York, 333–389.

Argote, L., B. Mcevily, R. Reagans. 2003. Managing knowledge in organizations: An integrative framework and review of emerging themes. *Management Sci.* **49**(4) 571–582.

Arguello, J., B. S. Butler, E. Joyce, R. Kraut, K. S. Ling, C. Rosé, X. Wang. 2006. Talk to me: Foundations for successful individual-group interactions in online communities. *Proc. SIGCHI Conf. Human Factors Comput. Systems*, ACM, New York, 959–968.

Bagozzi, R. P., U. M. Dholakia. 2006. Open source software user communities: A study of participation in Linux user groups. *Management Sci.* **52**(7) 1099–1115.

Bartel, C. A., R. Garud. 2009. The role of narratives in sustaining organizational innovation. *Organ. Sci.* **20**(1) 107–117.

Baum, J. R., E. A. Locke, K. G. Smith. 2001. A multidimensional model of venture growth. *Acad. Management J.* **44**(2) 292–303.

Benford, R., D. A. Snow. 2000. Framing processes and social movements: An overview and assessment. *Annual Rev. Sociol.* **26**(1) 611–639.

Blanchard, A. L., M. L. Markus. 2004. The experienced "sense" of a virtual community: Characteristics and processes. *ACM SIGMIS Database* **35**(1) 64–79.

Boland, R. J., R. V. Tenkasi, D. Te'eni. 1994. Designing information technology to support distributed cognition. *Organ. Sci.* **5**(3) 456–475.

Boland, R. J., Jr., K. Lyytinen, Y. Yoo. 2007. Wakes of innovation in project networks: The case of digital 3-D representations in architecture, engineering, and construction. *Organ. Sci.* **18**(4) 631–647.

Bono, J. E., R. Illies. 2006. Charisma, positive emotions and mood contagion. *Leadership Quart.* **17**(4) 317–334.

Bowker, G. C., S. L. Star. 1999. *Sorting Things Out: Classification and Its Consequences*. MIT Press, Cambridge, MA.

Boyd, D. 2008. Taken out of context: American teen sociality in networked publics. Ph.D. thesis, University of California, Berkeley.

Bruner, J. S. 1991. The narrative construction of reality. *Critical Inquiry* **18**(Autumn) 1–21.

Butler, B. S. 2001. Membership size, communication activity, and sustainability: A resource-based model of online social structures. *Inform. Systems Res.* **12**(4) 346–362.

Butler, B. S., L. Sproull, S. Kiesler, R. Kraut. 2007. Community effort in online groups: Who does the work and why? S. P. Weisband, ed. *Leadership at a Distance: Research in Technologically-Supported Work*. Lawrence Erlbaum Associates, Mahwah, NJ, 171–194.

Carlile, P. R. 2002. A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organ. Sci.* **13**(4) 442–455.

Chen, X.-P., X. Yao, S. Kotha. 2009. Entrepreneur passion and preparedness in business plan presentations: A persuasion analysis of venture capitalists' funding decisions. *Acad. Management J.* **52**(1) 199–214.

Clark, T., M. Jones, C. Armstrong. 2007. The dynamic structure of management support systems: Theory development, research focus, and direction. *MIS Quart.* **31**(3) 579–615.

Couger, J. D. 1996. *Creativity and Innovation in Information Systems Organizations*. Boyd & Fraser, Danvers, MA.

Cummings, J. N., B. Butler, R. Kraut. 2002. The quality of online social relationships. *Comm. ACM* **45**(7) 103–108.

Czarniawska, B. 2004. *Narratives in Social Science Research*. Sage, London.

de Laet, M., A. Mol. 2000. The Zimbabwe Bush Pump: Mechanics of a fluid technology. *Soc. Stud. Sci.* **30**(2) 225–263.

Dougherty, D. 1992. Interpretive barriers to successful product innovation in large firms. *Organ. Sci.* **3**(2) 179–202.

Elsbach, K. D., R. M. Kramer. 2003. Assessing creativity in Hollywood pitch meetings: Evidence for a dual-process model of creativity judgments. *Acad. Management J.* **46**(3) 283–301.

Faraj, S., S. L. Johnson. 2010. Network exchange patterns in online communities. *Organ. Sci.*, ePub ahead of print December 29, http://orgsci.journal.informs.org/cgi/content/abstract/orsc.1100.0600v1.

Feldman, M. S. 2004. Resources in emerging structures and processes of change. *Organ. Sci.* **15**(3) 295–309.

Fiol, C. M., E. J. O'Connor. 2002. When hot and cold collide in radical change processes: Lessons from community development. *Organ. Sci.* **13**(5) 532–546.

Fleming, L., D. M. Waguespack. 2007. Brokerage, boundary spanning, and leadership in open innovation communities. *Organ. Sci.* **18**(2) 165–180.

Gibson, J. J. 1979. *The Ecological Approach to Visual Perception*. Houghton Mifflin, Reading, MA.

Goffman, E. 1959. *The Presentation of Self in Everyday Life*. Doubleday, New York.

Goodwin, J., J. M. Jasper, F. Polletta. 2001. *Passionate Politics: Emotions and Social Movements*. University of Chicago Press, Chicago.

Griffith, T. L. 1999. Technology features as triggers for sensemaking. *Acad. Management Rev.* **24**(3) 472–488.

Gu, B., P. Konana, B. Rajagopalan, H.-W. M. Chen. 2007. Competition among virtual communities and user valuation: The case of investing-related communities. *Inform. Systems Res.* **18**(1) 68–85.

Hancock, J. T. 2007. Digital perception: Why, when and how people lie online. A. Joinson, K. McKenna, T. Postmes, U.-D. Reips, eds. *The Oxford Handbook of Internet Psychology*. Oxford University Press, Oxford, UK, 289–301.

Hayne, S. C., C. E. Pollard, R. E. Rice. 2003. Identification of comment authorship in anonymous group support systems. *J. Management Inform. Systems* **20**(1) 301–329.

Hinds, P. J., D. E. Bailey. 2003. Out of sight, out of sync: Understanding conflict in distributed teams. *Organ. Sci.* **14**(6) 615–632.

Hughes, J., K. Lang. 2006. Transmutability: Digital decontextualization, manipulation, and recontextualization as a new source of value in the production and consumption of culture products. *Proc. 39th Annual Hawaii Internat. Conf. Systems Sci.*, IEEE Computer Society, Washington, DC, 165a.

Isaksen, S. G., D. J. Treffinger. 1985. *Creative Problem Solving: The Basic Course*. Bearley, Buffalo, NY.

Jehn, K. A., G. B. Northcraft, M. A. Neale. 1999. Why differences make a difference: A field study of diversity, conflict, and performance in workgroups. *Admin. Sci. Quart.* **44**(4) 741–763.

Jeppesen, L. B., L. Frederiksen. 2006. Why do users contribute to firm-hosted user communities? The case of computer-controlled music instruments. *Organ. Sci.* **17**(1) 45–63.

Jessup, L. M., T. Connolly, D. A. Tansik. 1990. Toward a theory of automated group work: The deindividuating effects of anonymity. *Small Group Res.* **21**(3) 333–348.

Joyce, E., R. E. Kraut. 2006. Predicting continued participation in newsgroups. *J. Comput.-Mediated Comm.* **11**(3) Article 3.

Kane, G. C., A. Majchrzak, J. Johnson, G. Chen. 2009. A longitudinal model of perspective making and perspective taking within fluid online collectives. *Proc. Internat. Conf. Inform. Systems, Phoenix, AZ,* AIS Electronic Library, Paper 10.

Katz, D., R. L. Kahn. 1978. *The Social Psychology of Organization.* John Wiley & Sons, New York.

Kuk, G. 2006. Strategic interaction and knowledge sharing in the KDE developer mailing list. *Management Sci.* **52**(7) 1031–1042.

Lakhani, K. R., E. von Hippel. 2003. How open source software works: "Free" user-to-user assistance. *Res. Policy* **32**(6) 923–943.

Lamont, M., V. Molnár. 2002. The study of boundaries in the social sciences. *Annual Rev. Sociol.* **28** 167–195.

Latané, B., J. H. Liu. 1996. The intersubjective geometry of social space. *J. Comm.* **46**(4) 26–34.

Latané, B., J. Liu, A. Nowak, M. Bonevento, L. Zheng. 1995. Distance matters: Physical space and social impact. *Personality Soc. Psych. Bull.* **21**(8) 795–805.

Lave, J., E. Wenger. 1991. *Situated Learning. Legitimate Peripheral Participation.* Cambridge University Press, Cambridge, UK.

Law, J. 2002. Objects and spaces. *Theory, Culture Soc.* **19**(5/6) 91–105.

Law, J., V. Singleton. 2005. Object lessons. *Organization* **12**(3) 331–355.

Law, J., J. Urry. 2004. Enacting the social. *Econom. Soc.* **33**(3) 390–410.

Leonardi, P. M., S. R. Barley. 2008. Materiality and change: Challenges to building better theory about technology and organizing. *Inform. Organ.* **18**(3) 159–176.

Lerner, J., J. Tirole. 2002. The simple economics of open source. *J. Indust. Econom.* **50**(2) 197–234.

Lessig, L. 2008. *Remix: Making Art and Commerce Thrive in the Hybrid Economy.* Penguin, New York.

Lewis, K. M., Belliveau, B., Herndon, J. Keller. 2007. Group cognition, membership change, and performance: Investigating the benefits and detriments of collective knowledge. *Organ. Behav. Human Decision Processes* **103**(2) 159–178.

Ma, M., R. Agarwal. 2007. Through a glass darkly: Information technology design, identity verification, and knowledge contribution in online communities. *Inform. Systems Res.* **18**(1) 42–67.

Majchrzak, A., J. Maloney. 2008. Enterprise mashups. Report, Society for Information Management's Advanced Practices Council, Chicago.

Majchrzak, A., L. Cherbakov, B. Ives. 2009. Harnessing the power of the crowds with corporate social networking tools: How IBM does it. *MIS Quart. Executive* **8**(2) 103–108.

Markus, M. L., M. S. Silver. 2008. A foundation for the study of IT effects: A new look at DeSanctis and poole's concepts of structural features and spirit. *J. Assoc. Inform. Systems* **9**(10) 609–632.

Marx, G. T. 1999. What's in a name? Some reflections on the sociology of anonymity. *Inform. Soc.* **15**(2) 99–112.

Mol, A., J. Law. 1994. Regions, networks and fluids: Anaemia and social topology. *Soc. Stud. Sci.* **24**(4) 641–671.

Multisilta, J., M. Mäenpää. 2008. Create a mobile video story. *Proc. Third Internat. Conf. Digital Interactive Media Entertainment Arts,* ACM, New York, 522–523.

Murray, F., S. O'Mahony. 2007. Exploring the foundations of cumulative innovation: Implications for organization science. *Organ. Sci.* **18**(6) 1006–1021.

Nambisan, S., R. A. Baron. 2010. Different roles, different strokes: Organizing virtual customer environments to promote two types of customer contributions. *Organ. Sci.* **21**(2) 554–572.

Nonnecke, B., J. Preece. 2000. Lurker demographics: Counting the silent. *Proc. SIGCHI Conf. Human Factors Comput. Systems,* ACM, New York, 73–80.

Nunamaker, J. F., Jr., A. R. Dennis, J. S. Valacich, D. R. Vogel. 1991. Information technology for negotiating groups: Generating options for mutual gain. *Management Sci.* **37**(10) 1325–1346.

O'Connor, K. M., W. L. Adair. 2003. Integrative interests? Building a bridge between negotiation research and the dynamic organization. R. S. Petersen, E. A. Mannix, eds. *Leading and Managing People in the Dynamic Organization.* Lawrence Erlbaum Associates, Mahwah, NJ, 163–184.

Oh, W., S. Jeon. 2007. Membership herding and network stability in the open source community: The Ising perspective. *Management Sci.* **53**(7) 1086–1101.

Oldenburg, R. 1989. *The Great Good Place: Cafes, Coffee Shops, Bookstores, Bars, Hair Salons, and Other Hangouts at the Heart of a Community.* Marlowe & Company, New York.

O'Mahony, S., B. A. Bechky. 2008. Boundary organizations: Enabling collaboration among unexpected allies. *Admin. Sci. Quart.* **53**(3) 422–459.

O'Mahony, S., F. Ferraro. 2007. The emergence of governance in an open source community. *Acad. Management J.* **50**(5) 1079–1106.

O'Reilly, III, C. A., M. L. Tushman. 2004. The ambidextrous organization. *Harvard Bus. Rev.* **82**(4) 74–81.

Orlikowski, W., S. Scott. 2008. Sociomateriality: Challenging the separation of technology, work and organization. *Acad. Management Ann.* **2**(1) 433–474.

Osborn, A. F. 1953. *Applied Imagination: Principles and Procedures of Creative Problem-Solving.* Scribner's & Sons, New York.

Parent, M., R. B. Gallupe, W. D. Salisbury, J. M. Handelman. 2000. Knowledge creation in focus groups: Can group technologies help? *Inform. Management* **38**(1) 47–58.

Peddibhotla, N. B., M. R. Subramani. 2007. Contributing to public document repositories: A critical mass theory perspective. *Organ. Stud.* **28**(3) 327–346.

Pentland, B. T. 1999. Building process theory with narrative: From description to explanation. *Acad. Management Rev.* **24**(4) 711–724.

Pinsonneault, A., N. Heppel. 1997–1998. Anonymity in group support systems research: A new conceptualization, measure, and contingency framework. *J. Management Inform. Systems* **14**(3) 89–108.

Postmes, T., M. Lea. 2000. Social processes and group decision making: Anonymity in group decision support systems. *Ergonomics* **43**(8) 1252–1274.

Powell, W. W. 1990. Neither market nor hierarchy: Network forms of organization. B. M. Staw, L. L. Cummings, eds. *Research in Organizational Behavior,* Vol. 12. JAI Press, Greenwich, CT, 295–336.

Preece, J. 2000. *Online Communities: Designing Usability, Supporting Sociability*. John Wiley & Sons, Chichester, UK.

Preece, J., B. Nonnecke, D. Andrews. 2004. The top five reasons for lurking: Improving community experiences for everyone. *Comput. Human Behav.* **20**(2) 201–223.

Qian, H., C. R. Scott. 2007. Anonymity and self-disclosure on weblogs. *J. Comput.-Mediated Comm.* **12**(4) 1428–1451.

Rafaeli, S., Y. Ariel. 2008. Online motivational factors: Incentives for participation and contribution in Wikipedia. A. Barak, ed. *Psychological Aspects of Cyberspace: Theory, Research, Applications*. Cambridge University Press, Cambridge, UK, 243–267.

Rains, S. A. 2007. The impact of anonymity on perceptions of source credibility and influence in computer-mediated group communication: A test of two competing hypotheses. *Comm. Res.* **34**(1) 100–125.

Ren, Y., R. Kraut, S. Kiesler. 2007. Applying common identity and bond theory to design of online communities. *Organ. Stud.* **28**(3) 377–408.

Rheingold, H. 2000. *The Virtual Community: Homesteading on the Electronic Frontier*. MIT Press, Cambridge, MA.

Roberts, J. A., I.-H. Hann, S. A. Slaughter. 2006. Understanding the motivations, participation, and performance of open source software developers: A longitudinal study of the Apache projects. *Management Sci.* **52**(7) 984–999.

Santos, F. M., K. M. Eisenhardt. 2005. Organizational boundaries and theories of organization. *Organ. Sci.* **16**(5) 491–508.

Schrage, M. 1995. *No More Teams! Mastering the Dynamics of Creative Collaboration*. Doubleday, New York.

Scott, C. R. 2004. Benefits and drawbacks of anonymous online communication: Legal challenges and communicative recommendations. S. Drucker, ed. *Free Speech Yearbook*, Vol. 41. National Communication Association, Washington, DC, 127–141.

Sheremata, W. A. 2000. Centrifugal and centripetal forces in radical new product development under time pressure. *Acad. Management Rev.* **25**(2) 389–408.

Silva, L., L. Goel, E. Mousavidin. 2008. Exploring the dynamics of blog communities: The case of metafilter. *Inform. Systems J.* **19**(1) 55–81.

Sproull, L., M. Arriaga. 2007. Online communities. H. Bidogli, ed. *Handbook of Computer Networks*, Vol. 3. John Wiley & Sons, New York.

Stewart, K. J., S. Gosain. 2006. Impact of ideology on effectiveness in open source software development teams. *MIS Quart.* **30**(2) 291–314.

Sy, T., S. Côté, R. Saavedra. 2005. The contagious leader: Impact of the leader's mood on the mood of group members, group affective tone, and group processes. *J. Appl. Psych.* **90**(2) 295–305.

Tanis, M., T. Postmes. 2007. Two faces of anonymity: Paradoxical effects of cues to identity in CMC. *Comput. Human Behav.* **23**(2) 955–970.

Tapscott, D., A. D. Williams. 2006. *Wikinomics: How Mass Collaboration Changes Everything*. Portfolio, New York.

Tsoukas, H. 2009. A dialogical approach to the creation of new knowledge in organizations. *Organ. Sci.* **20**(6) 941–957.

von Hippel, E., G. von Krogh. 2003. Open source software and the "private-collective" innovation model: Issues for organization science. *Organ. Sci.* **14**(2) 209–223.

von Krogh, G., E. von Hippel. 2006. The promise of research on open source software. *Management Sci.* **52**(7) 975–983.

Wagner, C., A. Majchrzak. 2006–2007. Enabling customer-centricity using wikis and the wiki way. *J. Management Inform. Systems* **23**(3) 17–43.

Walther, J. B. 1996. Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. *Comm. Res.* **23**(1) 3–43.

Wasko, M. M., S. Faraj. 2000. "It is what one does": Why people participate and help others in electronic communities of practice. *J. Strategic Inform. Systems* **9**(2–3) 155–173.

Wasko, M. M., S. Faraj. 2005. Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *MIS Quart.* **29**(1) 35–58.

Wasko, M. M., R. Teigland, S. Faraj. 2009. The provision of online public goods: Examining social structure in an electronic network of practice. *Decision Support Systems* **47**(3) 254–265.

West, J., K. Lakhani. 2008. Getting clear about communities in open innovation. *Indust. Innovation* **15**(2) 223–231.

Woodman, R. W., J. E. Sawyer, R. W. Griffin. 1993. Toward a theory of organizational creativity. *Acad. Management Rev.* **18**(2) 293–321.

Yates, D., C. Wagner, A. Majchrzak. 2010. Factors affecting shapers of organizational wikis. *J. Amer. Soc. Inform. Sci. Tech.* **61**(3) 543–554.

Yeow, A., S. L. Johnson, S. Faraj. 2006. Lurking: Legitimate or illegitimate peripheral participation? *Proc. 27th Internat. Conf. Inform. Systems, Milwaukee,* AIS Electronic Library, 967–982.

Zammuto, R. F., T. L. Griffith, A. Majchrzak, D. J. Dougherty, S. Faraj. 2007. Information technology and the changing fabric of organization. *Organ. Sci.* **18**(5) 749–762.

Zittrain, J. 2008. *The Future of the Internet—And How to Stop It*. Yale University Press, New Haven, CT.

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