

Defining, Understanding and Supporting Open Collaboration: Lessons from the Literature

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The past twenty years have seen broad popularization of a relatively novel kind of human enterprise: open collaboration. Open collaboration projects are distributed, collaborative efforts made possible because of changes in information and communication technology that facilitate cooperative activities. The groundswell of open collaboration could be felt in the open source movement of the 90s but became unmistakable with the growth of projects like Wikipedia and, in particular, the maturation of research to help explain how and why such systems work, who participates, and when they might fail. By now thousands of scholars have written about open collaboration systems, many hundreds of thousands of people have participated in them, and millions of people use products of open collaboration every day. This special issue of *American Behavioral Scientist* assembles interdisciplinary scholarship that examines different aspects of open collaboration and the diverse systems that support it.

The goal of this short introductory piece is to define open collaboration and contextualize a set of articles that span multiple disciplines and methods in a common vocabulary and history. We provide a definition of open collaboration and situate the phenomenon within an interrelated set of scholarly and ideological movements. We then examine the properties of open collaboration systems that have given rise to research and review major areas of scholarship, including the works in this issue, and close with a summary of consistent findings in open collaboration research to date.

Definition of Open Collaboration

The diversity of goals, cultures and infrastructures that support open collaboration rest atop a core set of common characteristics. The prototypical open collaboration system is an online environment that (1) supports the collective production of an artifact (2) through a technologically mediated collaboration platform (3) that presents a low barrier to entry and exit, and (4) supports the emergence of persistent but malleable social structures. Combined, these characteristics yield complex socio-technical systems that offer new opportunities for people to form ties with others and create things together.

People have used varied terms to refer to open collaboration systems. The term *wiki* has been used to describe not just wiki software, but also an ethos of openness and meritocracy (Leuf & Cunningham, 2001). In this collection, we reserve the term *wiki* to describe an editable web site. Riehle et. al. used the term *open collaboration* to refer to principles common in the open source software community (2009); we believe these represent an important subset of possible cultures of open collaboration. Benkler's *peer production* (2006), which draws heavily on Ostrom's work on self-organizing communities (2000), is perhaps the most theoretically robust characterization of open collaboration, and clearly describes many of the open collaboration systems in place today; however, it describes a set of economic and legal concerns that go beyond the features of the collaborative systems themselves and that are not strictly necessary for open collaborations to prosper. Though they are often used to refer to open collaboration systems, *crowdsourcing* and *wisdom of the crowd* approaches describe systems where tasks are

distributed among a great many individuals but differ from open collaboration in important ways. In crowdsourcing, control of task allocation and goals are generally defined apriori, administered by a person or organization, and “workers” may not ever interact with one another; in open collaborations, social interaction among participants is persistent enough that social structures emerge, and participants define and maintain these structures and collective goals in an ongoing fashion. Finally, in order to function wisely, *wisdom of the crowd* suggests contributions by individual members of the crowd should be aggregated without opportunity for individuals to influence one another (Surowiecki, 2004). In open collaborations like Wikipedia, it is precisely this opportunity for consensus building and social innovation that defines the collaborative experience.

We provide a definition of open collaboration with four dimensions that can serve as a *prototype* for identifying examples of open collaboration systems (Bruckman, 2006); however, not all open collaboration systems will be strong examples of all four dimensions. In this collection, Haythornthwaite and Budhathoki similarly identify a spectrum of organizational forms ranging from light-weight approaches like wisdom of the crowd and crowdsourcing to the more heavy-weight arrangements associated with prototypical examples of open collaboration.

Open collaboration doesn’t happen in a vacuum. Collaboration generally happens within the context of a particular production goal; in other words, open collaboration is about people trying to *make something* together. The product of open collaboration can take many forms, from reference works, to videos, software, news resources, and annotated maps. The two most prolific contexts for open collaboration research to date are Wikipedia and free/libre open source software. (See also (Crowston, Wei, Howison, & Wiggins, 2012; Jullien, 2012) for reviews of these literatures.) Examples of Wikipedia and F/LOSS research pervade this introduction and Wikipedia research in particular is well represented in this special issue.

Beyond encyclopedia writing and software development, many domains have witnessed the emergence of successful open collaboration projects. One such domain is news production. Some collaborative news production happens within the context of Wikipedia, as exemplified by Keegan, Gergle and Contractor’s paper in this collection, in which they examine the unique circumstances surrounding the documentation of breaking news events and how the community negotiates time-sensitive coordination demands. Also in this issue, Ananny unpacks the role of news APIs in offering a technological infrastructure that supports the public in repurposing, reorganizing and giving new meaning to news’ organizations’ content and data. Once news has begun to circulate, news commenting communities play an important role in creating and maintaining repositories of community interest and opinion. Most online news sites offer user comments, but some systems allow for the emergence of social organization that leads to open collaboration, in this case with the creation of either news stories or comments to news stories. Sites like Reddit, Slashdot, Digg, and Fark, among others, use pseudonyms and reputation systems to create the sense of history necessary for social structure to emerge. However, persistent identities are not always necessary for organizing. For example, 4chan famously does not have any identity information attached to users, so they rely heavily on sanctioning site norms and shared repertoire to engage in organization (Bernstein et al., 2011).

Open mapping, or volunteered geographic information systems, represent another important domain for open collaboration work with unique constraints. Instead of collaborating on text or code, mappers work together to create accurate representations of geographic spaces, often annotated with data the community finds interesting or important ranging from bicycle routes (Panciera, Masli, & Terveen, 2011) to, in the case of activist cartographers, disaster response needs (Norheim-Hagtun & Meier, 2010). In its most simple form, maps can be generated by the public without an open collaboration system by people acting as “citizen sensors”; however, as noted by Haythornthwaite and Budhathoki in this issue, a wide array of social arrangements are possible.

The list of domains where forms of open collaboration systems have emerged is long and heterogeneous and we don’t attempt to be exhaustive here. We include the above examples to contextualize the dimensions of open collaboration in concrete examples of the phenomenon. Much more could be written about efforts in domains like open education, citizen science, software modding, participatory archives, and open data. We turn our attention now to the dimensions of open collaboration systems and the scholarship that shapes what we know.

Implications of the definition

The four aspects of open collaboration systems all have significant implications for how these socio-technical systems are designed, managed, and understood by researchers.

1. Support the collective production of an artifact

In open collaboration systems, participants are working to create one or more shared artifacts, usually with the knowledge that the product will be consumed by some future unknown audience.

Two common issues raised regarding the content created by open collaboration systems are its quality and completeness. Researchers often assess quality of content as a comparison to comparable edited collections (Giles, 2005; Mordechai, 2010), to comparable platforms of multiple types (Emigh & Herring, 2005), or by establishing metrics based on internal characteristics like quantity and diversity of contributors, or content longevity (Adler et al., 2008; Lih, 2004). Completeness of the content has likewise been assessed both by using other reference works as a baseline for comparison (Halavais & Lackaff, 2008) and by examining features of Wikipedia itself. For example, the finding that Wikipedia has an imbalance between male and female contributors (Lam et al., 2011) has led to a discussion of how topics over interest to males get more attention than topics that may be of more interest to women. Similarly, there have been studies that look at how different language versions of Wikipedia describe overlapping but non-identical content areas, as an opportunity both to identify gaps in the encyclopedia and to learn from these gaps about cross-cultural differences (Bao et al., 2012).

Originality is a less commonly examined characteristic of content that is generated in open collaboration systems; however, it can be an important feature of collaborative works. In studies of Newgrounds, an online animation community that supports open collaboration, Luther and colleagues have observed that producing highly original works is a primary goal (Luther & Bruckman, 2008). In some communities, reuse and remixing provide an important vehicle for people to build upon one another’s ideas (Tuite & Smith, 2012). In this issue, Monroy-Hernandez and Hill examine how remixing in an online community

engenders the creation of new artifacts and what factors lead to the production of more or less “original” works.

Creating the shared artifact requires not just collaboration around the creation of the artifact, but also around its administration and curation. In open collaboration systems, there is significant work done by participants to curate content, which can include editing the work of others, discussing which content to include in a collection, identifying content missing from the collection, making editorial contributions like reference addition or spellchecking in the case of text, or providing feedback to other users about the content they’ve created. (Kriplean, Beschastnikh, & McDonald, 2008) identified types of “wikiwork” on Wikipedia that are highly valued by the community, which included not only content creation but also administrative and curation activities. (Welser et al., 2011) found that most contributions by editors engaged in administrative “wikiwork” were of an administrative nature; these editors did not branch out into other kinds of work like creating new pages. Masli, Priedhorsky, and Terveen similarly found that in Cyclopath, a geo-wiki, contributors specialized in particular kinds of tasks and only about one third of users shifted their specialization as they grew more experienced (2011).

2. Technologically mediated collaboration platforms

Interactions within open collaboration systems take place using networked computing tools, which have affordances that affect the types of interactions that can take place. Part of what makes open collaboration systems compelling is that these tools enable participation in a shared activity by massive numbers of users whose interactions are almost entirely mediated. Many researchers have studied the effects of technology mediation on collaborative processes. The general finding has been that for work that is “tightly coupled”, meaning that it requires a lot of iterative feedback between participants, the often-reduced number of communication channels in online systems can be a hindrance (Olson & Olson, 2001). However, for tasks that require less iterative feedback between participants, mediating technologies can reduce the costs of communication by enabling large-scale participation. These affordances of technologies that can reduce the friction between large groups of participants, or support collaboration through new tools for organization and communication, may enable forms of collaboration that would have been impossible before the tools became available. (Hollan & Stornetta, 1992) referred to this capacity of technology to enable new modes of interaction as “Beyond Being There”, inferring that mediated communication wasn’t just an unsatisfactory replacement for offline interaction in all instances. Resnick (2001) and Wellman, Haase, Witte, & Hampton (2001) described specific features of technical systems that support social interaction and organization. For example, Resnick noted that socio-technical systems allow for a record of social interactions to be stored, which can support new types of social processes based on those records and Wellman et. al. explored how online communication fit into the broader context of human interactions as people maintained and participated in social networks.

The ways that technological platforms both enable and constrain collaboration has been an important area of research. For example, reputation and recommender systems have been offered as a technological solution to problems associated with supporting social interaction that encourages high-quality artifact production. In Wikipedia, content-driven editor reputation systems can be used to help editors focus their attention on reviewing edits from non-vetted editors and to assess and improve the accuracy of contributions to crowdsourced information systems like Google maps business locations (Alfaro,

Kulshreshtha, Pye, & Adler, 2011). Recommender systems have likewise been developed to suggest tasks to Wikipedia editors either to infer and capitalize on their interests (Cosley, Frankowski, Terveen, & Riedl, 2007) or draw attention to tasks that the community deems important (Krieger, Stark, & Klemmer, 2009).

Technological mediation has also enabled emergent organization in other types of open collaboration systems. In Slashdot, comment rating may act as a type of feedback system that socializes new users of that site (Lampe, Johnston, & Resnick, 2007). In this collection, Ananny examines the role of application programming interfaces (APIs) that mediate collaboration between news organizations that generate journalistic data and content, and members of the public who use and repurpose it. When news organizations provide the necessary tools and licensing, APIs can provide an infrastructure for generative communities that help the press meet its goals of supporting informed public discourse.

Although technological mediation is the enabler of open collaboration, technology design for group systems is not straightforward, and it can be difficult to architect systems to achieve particular outcomes. This has been recognized in groupware systems, where Grudin (1988, 1994) noted that technical systems intended to support groups within organizations often ran afoul of unintended consequences when they interrupted existing social structures, or didn't account for differing motivations and incentives between stakeholders. Ackerman (2001) has pointed out that a continued challenge for the design of socio-technical systems is that social systems are nuanced and continuously evolve, while technical systems are often inflexible, creating a "socio-technical gap" that can be difficult to overcome. Participants in open collaboration systems can resolve this issue by coopting existing affordances of a site that have been design for one purpose to meet their own needs; for example, by using the affordances of templates in MediaWiki, intended to standardize content, Wikipedians have created an array of awards called Barnstars to recognize exemplary work on the site (Kriplean et. al., 2008).

3. Low Barrier to Entry and Exit

In any sociotechnical system, barriers exist to entry and exit. People must possess or learn the skills necessary to participate in a meaningful way and understand what kinds of participation are valued. In open collaboration systems, barriers to entry and exit are relatively low.

Precisely because open collaboration systems present few barriers to new participants, a consistent challenge is the socialization of these newcomers. One place to start is by understanding their motivation to join in the first place. Research on open source communities has uncovered diverse motivations for participation including reputation building, a need for software, and enjoyment (Hertel, Niedner, & Herrmann, 2003), some of which can help explain why people get involved in open source projects; however, initial motivations do not always reflect long-term experience with the project (Shah, 2006). Initial motivations have been demonstrated to have a lesser effect on sustained participation than the identity development and learning that comes after participants join (Fang & Neufeld, 2009). In this issue, Budhathoki and Haythornthwaite examine how motivation is linked with forms of participation in the OpenStreetMap project where "casual mappers" are motivated by commitment to the idea of open access whereas "serious mappers" are driven by community, learning, and professional development.

Some Wikipedia research has suggested that learning and enculturation play critical roles as certain editors become central members of the community (Bryant, Forte, & Bruckman, 2005). Other research has offered counter evidence that both in Wikipedia and Cyclopath, a geo-wiki for cyclists, “elite editors” engage in distinctive kinds of activity from their very first edit with little or no measurable transformation of participation that would suggest they are learning new skills (Panciera, Priedhorsky, Erickson, & Terveen, 2010). This may be further explained by the interpretation that, once engaged, participants rely on habit to guide their future contributions (Wohn, Velasquez, Bjornrud, & Lampe, 2012). The effect of early experiences as *barriers* to further participation has also been investigated in Wikipedia and researchers have revealed that the effect of negative feedback--having initial edits removed from the encyclopedia--diminishes the likelihood of newcomers returning to the project (Halfaker, Kittur, & Riedl, 2011). This line of research has been continued in this issue with Halfaker et. al.’s paper that demonstrates how the Wikipedia community has reinforced such barriers and how this has led to quick egress among newcomers who would likely have become prolific editors and good community members.

The implications of low barrier to exit are not straightforward. It has been proposed that, due to herding effects, open source communities may suffer attrition when one member leaves (Oh & Jeon, 2004). Other researchers have found evidence that suggests low barrier to exit may actually help engender participant commitment in online communities as high levels of “churn” create the sense that there is a vibrant community available to join (Dabbish, Farzan, Kraut, & Postmes, 2012).

4. Support the emergence of persistent but malleable social structures

Another consistent feature of open collaboration systems is that they have stable enough communication flows between participants to support the emergence of social structures that can adapt over time as needed. For example, public narrative about Wikipedia suggests it is radically open and even anarchic, but in reality the complex and evolving administrative structure of the site has been well documented (Butler, Joyce, & Pike, 2008; Kriplean, Beschastnikh, McDonald, & Golder, 2007). Likewise, in the open source community a wide range of governance structures has been observed and studied from more centralized to less centralized models (Crowston & Howison, 2006). In this issue, Butler Joyce and Pike build on their earlier work to examine how some of Wikipedia’s policies allow for the long-term emergence and evolution of social structures as individuals negotiate community norms.

An important aspect of social organization in open collaboration projects is the role of leaders. Leadership has been identified as a critical factor in the success of open source projects (Weber, 2004) and Wikipedia (Reagle, 2007). In Wikipedia, governance structures have become increasingly decentralized (Forte, Larco, & Bruckman, 2009); Zhu, Kraut, and Kittur have demonstrated how leadership is shared by many editors and established the effectiveness of shared leadership in motivating and influencing contributions of editors (2012). Luther’s work has examined the phenomenon of distributed leadership in the context of creative collaboration on Newgrounds, a community of Flash animators, and explains how leadership is distributed not only among people, but also infrastructural features of online spaces that facilitate successful leadership (Luther, Fiesler, & Bruckman, 2013).

Consistent Findings in Open Collaboration

Given the range of types of open collaboration systems that have been studied, and the variety in their technical affordances and organizational structures, we still find some remarkable regularities in what we know about open collaboration systems. Those who study open collaboration systems have found the following consistent patterns, which are of use to those who are just beginning to explore this area.

Participation is unequal. Often referred to as “the power law of participation,” in all open collaboration systems people who consume information provided by the site, those who participate a very few times, and those who do the bulk of the work on the site exhibit starkly different behaviors. In Wikipedia, for example, it’s long been shown that a few editors provide the bulk of contributions to the site (Ortega, Gonzalez-Barahona, & Robles, 2008), and this distribution has been demonstrated in a range of other types of open collaboration as well (Wilkinson, 2008). This finding underscores the need to cultivate a strong core of power participants in open collaborations.

There are special requirements for socializing new users. In open collaboration systems, low barriers to entry often means that new users may join any time. Most new users are not founding members; they enter a socio-technical system in progress where social structures, practices, and norms already exist. It can be hard for new users to discern what those norms and social structures are, what needs to be done, and to receive feedback about how their contributions are valued (Choi, Alexander, Kraut, & Levine, 2010; Lampe et al., 2007). Since projects can be expected to experience attrition over time, designing for the socialization of new users is important for long-term sustainability.

Users are massively heterogeneous in both how and why they participate. As one might expect in large-scale collaborations, users enter these systems with extremely varied reasons for participating and types of activities they engage in. Even more importantly, the type of work they do, the site features they use, and the reasons they maintain their activity are highly dependent on those motivations (Lampe, Wash, Velasquez, & Ozkaya, 2010; Panciera et al., 2010; Welser et al., 2011). Divergent forms of participation implies that, to be sustainable, open collaboration systems not only need to attract and socialize *enough* participants, but to attract and support participants who specialize in critical types of activities (Preece & Shneiderman, 2009).

Future Research on Open Collaboration

This introduction frames critical questions and findings about open collaboration that span multiple domains; however, there is an ongoing need for empirically driven research and continued interdisciplinary discussion about the nature of such systems. Open collaboration systems represent new ways of organizing the production of artifacts and knowledge in many critical domains of human activity. Researchers have begun to assemble a vast body of scholarship on existing systems, yet we have only begun to make inroads when it comes to understanding the possible ways of designing for new collaborative experiences. Open collaboration systems are a moving target; as Internet access and participation become more diverse and as open collaboration systems become more commonplace, it has become possible to attract increasingly heterogeneous participants in online activities. In a dynamic landscape that has matured beyond features of early adoption, mechanisms for sustaining open collaboration systems need continuing investigation. The importance of open collaboration systems in

enabling new kinds of human accomplishments requires that research in this area continue and that scholars build upon the kinds of discussions highlighted in this special issue.

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