Why Do User Communities Matter for Strategy?

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Abstract

In this essay, we explore how strategic management research and practice could benefit from considering the benefits and challenges obtainable through working with user communities. User communities represent a unique organizing structure for the exchange of ideas and knowledge: they are composed primarily of users working collaboratively, voluntarily, and with minimal oversight to freely and openly develop and exchange knowledge around a common artifact. The prevalence of user communities appears to be on the rise, as evidenced by communities across a variety of fields including software, Legos, sports equipment, and automobiles. The innovation literature has begun to document the power of user communities as a source of open innovation, yet the broader strategic implications of user communities remain underexplored: existing research coupled with examples suggests that user communities can be used to enact both differentiation and low-cost strategies. We discuss the benefits that user communities can provide and the challenges they can create for firms, develop a framework for understanding the differences between how user communities and firms are organized and operate, and theorize the conditions under which user communities will emerge and function, thereby illustrating the relevance and import of user communities to firms and the strategic management literature.

Introduction

Projects undertaken by user communities have achieved remarkable success. User communities provide participants with the social context and resources to create useful and publicly available designs for physical products and copies of digital products that have inspired, extended, and even threatened to displace commercially produced products (Allen, 1983; Antorini, Muñiz Jr, & Askildsen, 2012; Baldwin, Hienerth, & von Hippel, 2006; Benkler, 2002; Gambardella & von Hippel, 2018; Mody, 2011; Shah & Tripsas, 2007; Valloppillil, 1998; von Hippel & von Krogh, 2003). User communities are distinct from other models of organizing for innovation—such as firms and academic labs—in that they rely on the efforts of a community of volunteer participants distributed across space and time rather than on paid managers and employees to develop and refine artifacts. Free and open source software (FLOSS) development is a prominent and frequently studied example of the community-based model, but it is far from the only one. User communities have been influential in a diverse array of fields including sports equipment (Baldwin *et al.*, 2006; Franke & Shah, 2003; Lüthje, Herstatt, & von Hippel, 2005), astronomy (Ferris, 2002), personal computers (Freiberger & Swaine, 2000), video games (Jeppesen & Frederiksen, 2006), automobiles (Lucsko, 2008), and probe microscopes (Mody, 2011).

Intrigued by both the innovative outcomes generated by user communities and their unique processes, interest from scholars from a variety of disciplinary lenses surged in the late 1990s as the FLOSS movement took hold: "the behavior of individual programmers and commercial companies engaged in open source projects is initially startling… Why should thousands of top-notch programmers contribute freely to the provision of a public good? (Lerner & Tirole, 2002: 197)." Issues pertaining to the functioning of user communities have been examined by scholars from technology and innovation management (e.g., Franke & Shah, 2003; von Hippel & von Krogh, 2003), organization theory (e.g., Dahlander & Frederiksen, 2012; Felin & Zenger, 2014; O'Mahony & Ferraro, 2007; Puranam, Alexy, & Reitzig, 2014), the history and sociology of science (e.g., Mody, 2011), law (Benkler, 2006; Frischmann, Madison, & Strandburg, 2014; Lessig, 2006), and, occasionally, marketing (e.g., Muñiz & Schau, 2005) and anthropology (Coleman, 2012). In particular, scholars have investigated participant motives (e.g., Franke & Shah, 2003; Hann, Roberts, & Slaughter, 2006; Hertel, Niedner, & Hermann, 2003; Jeppesen &

Frederiksen, 2006) and the governance practices that shape interaction patterns amongst participants (e.g., O'Mahony & Ferraro, 2007; Shah, 2006).

However, to date user communities have not attracted as much attention from strategic management scholars despite their relevance to key strategic concepts such as generating sustainable competitive advantage (Porter, 1985), the boundaries of the firm and transaction cost economics (Hart & Holmstrom, 2010; Leiblein, Reuer, & Dalsace, 2002; Poppo & Zenger, 1998; Walker & Weber, 1987; Williamson, 1975), organizing for innovation (Chesbrough & Teece, 1998; Tushman & Nadler, 1986; Yoo, Boland, Lyytinen, & Majchrzak, 2009), and the resource- and knowledge- based views of the firm (Barney, 1991; Grant, 1996; Penrose, 1959; Peteraf, 1993; Wernerfelt, 1984). However, the open innovation literature—at the intersection of the strategic management and innovation literatures—provides a conduit connecting the study of strategic management to the study of user communities. User communities are considered a viable source of ideas to fuel the corporate innovation process—that is, they are a source of open innovation (Allen, 1983; Antorini *et al.*, 2012; Chesbrough & Bogers, 2014; Dahlander & Wallin, 2006; Henkel, 2006; Nagle, 2018b).[1] Therefore, our goal in this essay is to investigate the practical implications of embracing user communities for both firms and strategic management scholars.

User communities have much to teach such scholars about the limits and nuances of existing theory, precisely because they represent an alternative means for achieving some central and complex functions of the firm, *e.g.,* innovation creation, reproduction, diffusion, and more. And, in turn, strategic management and organizational theory scholars possess the theoretical perspectives and methodological tools to improve our understanding of user communities (Leiblein, Reuer, & Zenger, 2018; Schendel, Teece, & Rumelt, 1994).

We ground our work in the rich empirical literature on user communities. We begin by providing a working definition of user communities. We then detail the various ways in which firms have benefitted from working with user communities (*i.e.,* have successfully harnessed user communities to create value). We then review what is known about how user communities function—contributing a simple framework that highlights key differences in how user

[1] Open innovation initially focused on various relationships between firms. However, the conceptualization of open innovation has recently been updated to be inclusive of non-firm actors (Chesbrough & Bogers, 2014), which is critical as such actors contribute to innovation and the technical and social change that innovation ignites. Examples of non-firm actors include (but are not limited to) user communities, independent inventors (Dahlander & Piezunka, 2014; Hargadon & Douglas, 2001), academic scientists and universities (Bercovitz & Feldman, 2008; Merton, 1973; Murray, 2009), foundations (Feldman & Graddy-Reed, 2014; Murray, 2013), and standalone research institutes.

communities and firms are organized and operate—and theorize a set of boundary conditions for when user communities will successfully function. We then turn to better understanding the relationships between user communities and firms; because user communities and firms are organized and operate so differently, tensions and challenges can arise, however these differences also create opportunities that can result in mutual benefit. We conclude by suggesting a set of open questions investigating the implications of user communities for firms.

What Are User Communities?[2]

Historically, firms, independent inventors, and research institutions have been considered the engines of innovative activity, value creation, and industrial change. The research and development efforts of firms and independent inventors are generally based on a proprietary benefit model where property rights provide the basis for capturing value from innovative efforts. In contrast, the research and development activities of universities and research institutions are based on an academic model where the diffusion of knowledge through publication is valued, and status and prestige are the rewards for innovative activity. Across both firms and academic institutions, dedicated, professionally trained, and compensated individuals expend efforts towards specific goals within a hierarchical system.

However, another model—the "community-based" model—exists. The community-based model, in contrast to the proprietary and academic models, relies neither on exclusive property rights nor hierarchical control. User communities represent a fundamentally different organizational model for knowledge development (Benkler, 2002; Raymond, 1999a)—one that has been referred to as collective invention (Allen, 1983), private-collective innovation (von Hippel & von Krogh, 2003), and community-based innovation (Franke & Shah, 2003; Lee & Cole, 2003). User communities provide a forum for users to aggregate and interact, generating and diffusing numerous innovations that we have come to use on a daily basis.

[2] A rich literature exists around the process of user innovation, which includes innovation by individual users, firms who are users, and user communities. Here we focus on issues related to *user communities* and firms, while acknowledging that more work linking user innovation in all its forms to firm strategy is necessary. We believe that a focus on user communities is warranted as user communities provide a forum in which many users (and firms) can interact, and thus provide a means of accessing multiple users and their insights. Note also that the importance of user innovation has been well documented across industries e.g., von Hippel (1988) and data on user innovation across populations and countries will likely be available soon as, in 2018, the OCED began measuring "household sector innovation"—a proxy for user innovation (de Jong, 2016; Gault, 2018).

User communities dating back to the early 1800s have been documented in industrial equipment and automobiles (Allen, 1983; Franz, 1999; Nuvolari, 2004; Nuvolari, 2005). For example, the history of the auto industry is filled with users, some of whom formed robust user communities nearly 100 years ago and continue to do so (Franz, 1999; Lucsko, 2008). In the digital world, user groups have been a critical part of the ecosystem that has allowed digital technologies to flourish from the very beginning: for example, in 1955, a group of IBM mainframe users formed SHARE, a community for users of some of the earliest commercial computers to communicate their experiences, answer questions, and share code modifications they made to the operating system, an early example of FLOSS (SHARE, 2019).[3] The advent of communication technologies like the Internet has enabled people to communicate more quickly and less expensively, decreasing the costs of participation and possibly increasing the size and number of communities in both physical and digital product domains. Today, there are numerous user communities that operate largely online in product classes spanning from LEGOS to software.

Although a number of studies have investigated user communities from various perspectives, user communities have, to our knowledge, yet to be precisely defined. Therefore, we provide a working definition that takes three key characteristics of user communities—knowledge development and exchange, participation, and control and governance—into account: user communities are organizations composed primarily of users working collaboratively, voluntarily, and with minimal oversight to freely and openly develop and exchange knowledge in an area of common interest around an artifact. The artifact may be a design, physical object, product, good, or service. A short overview of each of these characteristics appears immediately below and a more detailed discussion appears in the section titled "Understanding the Inner Workings of User Communities."

Knowledge Development & Exchange. We characterize the general purpose of user communities as knowledge development and exchange. Most studies conducted to date focus on knowledge development and exchange that results in innovation, design, or, more generally, the improvement of the artifact. However, user communities can also contribute knowledge towards

[3] We use the term "free and open source software" to encapsulate the related terms "free software" and "open source software," which are similar but slightly different. While both refer to software that can be used, adapted, and distributed freely, the term "free software" is more broadly thought of as a social movement for freedom and justice centered around the Free Software Foundation. Importantly, in all cases, the word "free" does not refer to a lack of price, but instead the liberty to do what one wants with the software. This concept has been pithily captured by free software advocate Richard Stallman in the phrase "free as in free speech, not free beer" (Lessig, 2006; Stallman, 2001).

other ends, such as building identity, excitement, brands; providing tips for use and maintenance; and/or supporting entrepreneurship around the artifacts developed by participants.

Participation. User communities are composed largely of users—enthusiasts, tinkerers, amateurs, everyday people, and even firms that derive benefit from an artifact or service by *using* it (von Hippel, 1988). Participants work collaboratively by sharing knowledge, information, and occasionally resources with other participants (Franke & Shah, 2003).[4] In addition, participants work voluntarily.[5] Voluntary participation encompasses three dimensions: no remuneration from the community, self-chosen work, and relatively unrestricted entry (and exit) into the community.

Control & Governance. Governance structures within user communities are aimed at establishing a context in which individuals who want to participate can do so, protecting the ability of individuals to use knowledge that has been contributed to the commons, and maintaining some control over the integrity of shared resources (often designs) while keeping communication and organizational costs low.

Differentiating User Communities from Other Forms of Organizing

A variety of unique organizational forms around knowledge exchange and innovation exist; not all, however, are user communities. By our definition, FLOSS communities would be representative of user communities. Wikipedia would also be considered a user community. An online group of music pirates, however, would not be an example of a user community because, although they seek to diffuse an artifact (music), they do not create it. A volunteer organization, like the Red Cross, would also not be an example of a user community as its goals transcend knowledge exchange, participation is selective, and control and governance structures are very different in order to support the organization's goals.

User communities are also distinct from similar concepts like crowdsourcing, crowdfunding, and multi-sided platforms (MSPs). Although all three are enabled by technology and make firm boundaries more porous (Altman, Nagle, & Tushman, 2019), crowdsourcing is focused on seeking solutions to a problem from individuals outside the boundaries of the

[4] We note that collaboration does not mean *always* working within a group: much problem identification, trial-and-error problem solving, and prototyping also occurs as an individual works independently on finding a solution to his or her particular need and then communicates with others in the group.

[5] On occasion, a firm may pay an employee to participate. This is discussed later as an opportunity for additional research.

organization (not just users), and, in general, participants do not interact with one another or share information (exceptions exist, such as the Netflix Progress Prize where solution information was shared; however, conversation amongst competitors was not encouraged and presumably limited). In contrast, in a user community, the focus is on sharing ideas and/or sharing the experience of doing something together. Crowdfunding is different as the focus is on raising funds rather than spreading knowledge and users do not interact with each other. That said, if a crowdsourcing or crowdfunding platform included spaces for participants to share ideas and knowledge, those platforms could become user communities. MSPs are focused on bringing two (or more) distinct groups, frequently a producer or advertiser and some sort of customer or user, together on the platform. Therefore, while some crowdsourcing and crowdfunding efforts may take on the features and characteristics of user communities, and some user communities are part of an MSP, the three are distinct concepts that can sometimes appear together.

How Can Working with User Communities Benefit Firms?

Scholars have documented a number of ways in which user communities can create value for firms (e.g., Chesbrough, Lettl, & Ritter, 2018). Broadly speaking, firms can build competitive advantage through a differentiation strategy or a low-cost strategy—and user communities can be utilized, in different ways, to achieve either of these ends. User communities can be used to differentiate a firm's offerings through innovation, branding, increasing integrity/identifying recurring problems.[6] User communities can also be used to lower costs through the provision of product support (especially for products and services that are or have been phased out) or informal support for hiring and training. Below, we detail each of these five benefits, noting that others may exist.

While working with user communities holds promise for firms, user communities do not exist to support firms: participants can and do choose what tasks to engage in and, outside of the

[6] User communities are also distinct from other methods whereby firms seek to gain information from consumers, such as focus groups and customer surveys in several ways. User communities are composed primarily of users—individuals with a need related to the artifact or its use, whereas the average consumer may be relatively satisfied with commercial products on the market. User communities are much more than a conduit for providing firms with information; communities can and are created by users to achieve their own goals—whatever they may be (see section on motivations)—and do not exist to benefit firms, although they may provide a firm with benefits. In addition, traditional methods of interacting with consumers tend to be structured as one-off events, whereas user communities are organizations that continue over time. As well, focus groups and customer surveys tend to be focused on a small number of explicit features or ideas, in contrast, user communities are open-ended, and can provide feedback on current products as well as ideas and prototypes for novel features that might be integrated into a future version of a commercially produced product.

power of suggestion, firms do not have control over participants' decisions. There are areas in which communities may not be able to support firms, such as the collection of marketing data (communities will tend to provide data on what community participants—not the market at large––value, although in some cases, community innovations foreshadow general market trends), refinement of designs, scaling production, and the distribution of physical goods. A firm's marketing, engineering, and operations divisions may be far better equipped and incentivized to handle such tasks. For example, drone manufacturer, 3DR attempted to "outsource" many activities to the community and specific community members with little success (Bremner & Eisenhardt, 2019). More generally, communities and firms each have different strengths and capabilities. As a result, firms will need to put processes in place to ensure that knowledge from the community is incorporated into the firm's activities and that tasks that the community does not complete are taken on by employees. Further, these processes need to take into account the knowledge flow should be bi-directional – both to and from the firm. To point, in both the windsurfing and probe microscopy industries, user communities and firms existed side-by-side and some of the same individuals were active in both—choosing to undertake some activities within communities and others within firms (Shah & Mody, 2016).

Innovation & Product Development

Innovation and product development have long been known to be critical to the success of firms (Teece, 2010), and user communities have been shown to be able to contribute to the generation of innovations in a variety of different industries. Firms can leverage user communities to gain access to novel artifacts, new features and functionality, and/or gain feedback on design. For example, user communities have created altogether new product categories such as probe microscopes (Mody, 2011), therapies for a variety of ailments (Zejnilovic, Oliveira, & Canhao, 2015), and the first windsurfing board, skateboard, and snowboard (Shah, 2005). User communities can also be used to harness ideas for new features for existing artifacts, as users will often seek to use existing artifacts in novel ways or contexts not originally envisioned by the manufacturer and requiring the creation of novel or strengthened functionality (von Hippel, 1988). Firms can accelerate this process by providing innovation toolkits to their users (Franke, 2004; Franke & von Hippel, 2003; Kankanhalli, 2015; von Hippel & Katz, 2002; Ye & Kankanhalli, 2018). There are many cases of new products and new product features first being developed within user communities and only later commercialized (Baldwin *et al.*, 2006; Bremner &

Eisenhardt, 2019; Mody, 2011; Shah, 2005; Shah & Tripsas, 2007); in some cases, communities even helped evolve and identify dominant designs, which were used as a starting point for the earliest firms in the industry.

User communities can also be a valuable place to seek feedback on innovative designs developed *inside* the firm (Aksoy & Shah, 2018; Goldman & Gabriel, 2005). As mentioned above, user communities are different from traditional focus groups in that they are made up of individuals who are already interested and engaged users of an artifact and who have often tinkered with or made copies of the artifact and hence possess the ability to understand and advance a design. Engaging feedback from such individuals can provide the firm with information to improve the artifact prior to commercialization.

Firms seeking to integrate user communities into their development efforts will need to shift their view of product development from a linear one involving the firm as the starting point and the customer as the end point to a more nuanced one where users are an integral part of the development process; this involves both acknowledging the role of users and making room to integrate feedback over time and multiple product generations or updates. Firms should also consider the importance of creating modular designs (Baldwin & Clark, 2000): modularity may make it easier for the firm to incorporate user ideas into commercial products and make it easier for users to tinker with existing designs as they generate new ones.[7]

Branding

Firms can harness user communities to help strengthen their brand at limited cost (Muñiz Jr. & O'Guinn, 2001). In particular, users' enthusiasm towards a product can be supported and cultivated to allow users to help advertise a product. For example, LEGO allows its users to create their own designs and share them with other users. Users can also submit their designs to a contest sponsored by LEGO, who commercializes winning designs (Antorini *et al.*, 2012). This can lead to an increase in word-of-mouth advertising as users promote designs that they created or find attractive, as well as lead to the creation of novel and/or authentic product lines that complement

[7] Franz's (1999) historical study of automotive tinkerers in the early 1900s illuminates the costs and benefits of working with user communities. Automakers became frustrated with users' requests for novel features—features whose designs were circulating in upwards of two dozen hobbyist auto magazines in the period before the Great Depression—and warranty requests (after all, tinkering can also result in damage!) and Franz argues that the design of the one-piece autobody in the 1950s served as a means of *inhibiting* user innovation. Over the years, Franz suggests, U.S. cars became increasingly complex and less modular, which resulted in poorer design and difficulty in competing with Japanese automakers.

the firm's existing offerings. Similarly, Starbucks offers a forum for its customers to share and discuss ideas to improve the Starbucks experience. The company highlights those customer ideas that are adopted, leading to increased consumer loyalty. Even for products that are only purchased every decade (rather than every day), firms can use user communities to build brand loyalty and encourage the purchase of branded complements and peripherals. For example, the motorcycle companies Harley-Davidson and Ducati both nurture their user communities and sell various complements (clothing, patches, etc.) that enthusiastic consumers purchase and wear, increasing brand awareness—loyal consumers are literally paying the company for the privilege of advertising for them.[8] In this way, user communities can serve as an interactive channel to the customer (Goh, Heng, & Lin, 2013).

Increasing Integrity/Identifying Recurring Problems

User communities have been helpful in bringing systematic design and manufacturing flaws to light by showing that a number of users are experiencing the same issue. This can occur, when, for example, an individual discusses a problem they have had—and then others echo the same issue. For example, Microsoft's Xbox Ambassador Program is an user community sanctioned by the company where users interact with one another and bring issues experienced by multiple users to Microsoft's attention (Harrison, 2016). More cynically, this function of user communities might be seen as a way of keeping companies honest.

Product Support

User communities can and have provided product support, for both existing products and discontinued ones. For existing products, community participants will often interact to ask various questions, ranging from general product support (which can also be addressed, presumably by a firm making a product) to how to use the product in special conditions or contexts, which might involve design modifications or changes in how the product is used. For example, Stata, the statistical software package, relies heavily on the Statalist user community as a place for product users to go for technical support, reducing the costs associated with hiring full-time customer

[8] Although motorcycle user communities may not be as innovative as some other user communities, e.g. FLOSS and the hot rod community (Lucsko, 2008), but there is still a great deal of knowledge creation and diffusion within these communities on the topics of safety, maintenance, and modifications. For example, the Rahway, NJ Harley-Davidson Owners Group website highlights the ability of new members to learn from "the vast knowledge of our experienced members who eagerly share valuable information on safe riding procedures and proper maintenance of your Harley." (http://www.libertyhog.com/about-us.html, retrieved August 30, 2019). For our purposes, these examples are particularly interesting given the role the firm itself plays in the community.

support employees (although standard support options continue to exist). User communities also provide product support for discontinued products. For example, a user community formed around the Apple Newton, an early personal digital assistant, shortly after the product was launched in 1993. Users were enthusiastic about the project and shared a variety of tricks and uses for the product. At the height of its popularity this community had nearly 200,000 members (Muñiz & Schau, 2005). When Apple discontinued the Newton in 1998, the community also began providing product support: individuals who could no longer query Apple, could find answers within the community; individuals seeking spare parts could source them from others with parts to spare or a PDA to sell. The user community was so strong that it continues meeting in person and online even though the product was discontinued 20 years ago (Pierini, 2016). Companies may even open source an internal product to ensure it will be supported if the engineers that designed it leave the company. Cisco Systems did exactly that with a print-driver it developed for internal use across its organization ensuring it would be continually maintained (Raymond, 1999b).

Hiring & Training

User communities can also be leveraged to identify and train employees. A number of examples exist of firms hiring individuals who distinguished themselves and/or their skills while working in (or founding) user communities, and a few examples exist of startups being founded by community members and recruiting from the community as well (Bremner & Eisenhardt, 2019; Mody, 2011). By using communities to identify potential employees, firms can gain greater insight into the candidate's skills and increase the chances that they are hiring someone with a true passion for the activity and artifact. Other companies have begun to use user communities as part of their employee training programs, where new technical or customer support employees can see—in real time—the kinds of issues that customers are experiencing and try to resolve those, learning more about both the firm's customers and product, in the process (author interviews).

Trade-offs Involved with Working with User Communities

We now turn to two tradeoffs that firms will encounter when working with user communities: decreased control and a potentially limited participant set.

Limited or No Formal Control

User communities are rooted in a voluntary participation model and often exist outside the boundaries of a firm—leaving firms with little or no formal control over the actions of the community or its members. Even in cases where a community organizes around a firm's core

products, user communities rely on voluntary efforts and often operate outside the boundaries of the firm (Argyres & Zenger, 2012; Zenger, Felin, & Bigelow, 2011). As a result, firms cannot control communities. The benefits of working with communities may far outweigh the decrease in control relative to problem-solving within consensus-based hierarchies. In particular, novel ideas can emerge from the efforts of a large and diverse set of participants and the firm can choose amongst those ideas: "the clear advantage of communities over consensus-based hierarchies, however, is the capacity to access an abundance of otherwise hidden information. The governance attributes of the user community render it somewhat more versatile in terms of the scope of problems it can efficiently solve… user communities… support problem solving for relatively complex problems, with significant levels of hidden knowledge… [and] simple, decomposable problems (Felin & Zenger, 2014, p. 922)." Tapping user communities as a resource requires firms to adopt alternative methods of influence and communication than those used within their internal, corporate hierarchy (Altman *et al.*, 2019; Goldman & Gabriel, 2005; Nagle, Seamans, & Tadelis, 2018; Nickerson, Wuebker, & Zenger, 2017). Firms can, however, adopt (or, in the case of firm-controlled communities, establish) behaviors that allow for influence without control—what Altman et al. (2019) refer to as "shepherding" communities. Doing so, however, requires firms to understand and abide by the community ethos.

Central to communities is the idea that individuals participate on their own accord, and they choose when and how they will contribute. This type of organizational environment can be difficult for firms and employees used to managing both the content and timeline of projects. One large software firm, for example, uses a process that might be described as an interlinked chain to guide their work within FLOSS communities: a set of employees who work closely with the firm's clients identify changes and additions to be made to the FLOSS code base, those ideas are then communicated to a manager who relays these ideas to a separate set of employees whose job it is to work on code within the FLOSS community (author interviews). Working within a FLOSS community requires a special kind of employee: one comfortable with sharing their (even initial) ideas, open to receiving feedback from the outside, and willing to accept and improve based on this feedback (author interviews). Many employees are uncomfortable sharing early-stage work products publicly and soon ask to be reassigned to other software-related positions.

Scholars suggest that firms pay careful attention to the governance and control practices used by communities (Altman *et al.*, 2019; Shah, 2006; West & O'Mahony, 2008). Firms acting

counter to the community ethos might face resistance or rejection from the community. One area where this has been documented relates to fairness and the use of intellectual property. For example, user communities are based on the premise of making knowledge free for others to use, adapt, and share. Not surprisingly, efforts by firms to exercise intellectual property rights over ideas developed by users have met with resistance and have even led communities to reject firms, as happened to Santa Cruz Operations (SCO) when it argued it owned portions of Linux and attempted to extract license fees from all users of Linux. Participants have also been observed reducing effort to the minimum required to serve their personal needs and being less likely to contribute improvements in corporate-sponsored communities where they believe the corporate sponsor is acting in its own—rather than the community's—self-interest (Shah, 2006). Consistent with findings from evolutionary psychology and behavioral game theory, perceptions of fairness weigh heavily into participants' decisions to work with others.[9] More generally, studies have established that governance choices influence users' participation behaviors (Shah, 2006; West & O'Mahony, 2008), however, there are many governance-related issues whose effects have yet to be examined (see section on Research Opportunities).

Participants May Not be Representative of Customers

For firms looking to user communities for product development feedback, there may be another downside as well: community members may be different from the average consumer in numerous ways. In addition to being ahead of the curve, more innovative, or more enthusiastic, they might reflect only a subsegment of the firm's consumer population. For example, user communities in a number of fields are largely male, whereas product users may not be so skewed (*e.g.,* operating system software or communities of auto or sports equipment enthusiasts); or participants may be extreme users along multiple dimensions (*e.g.,* using the artifact in extreme conditions, using the artifact in ways that non-mainstream users may not, in their ability to work with a complex rather than simple or streamlined design, etc.). This has occurred in many

[9] Experimental work on crowdsourcing has documented and delved deeply into these patterns, finding that expectations of fairness with respect to both the division of value between the firm and contributors (distributive fairness) and the procedures by which the division is made (procedural fairness) affect the likelihood of participation (Franke, Keinz, & Klausberger, 2013). The study's authors state "potential contributors not only want a good deal, they also want a fair deal."

industries, including software, sports-equipment, and drones. This might result in product ideas useful to only a subsegment of customers or that need to be adapted.

Understanding the Inner Workings of User Communities

Firms and user communities are organized and operate in very distinct ways. This may prove puzzling for firms seeking to work with user communities, as well as for scholars seeking to use user communities as a context for studying a wide array of phenomena. However, user communities also present an opportunity for firms and scholars (discussed above and below, respectively). Therefore, we delve deeper into two high-level characteristics of user communities here that have puzzled scholars precisely due to their distinctiveness from other modes of organizing: the motives driving participation and the governance structures used to bring together ideas and coordinate actions. Table 1 summarizes our framework for understanding the key differences between user communities and firms; these differences are both the source of challenges that firms might encounter when working with user communities, as well as the source of opportunities. The unique attributes of user communities are described and discussed below.

Insert Table 1 Here

Participation

Expectations. Communities tend to embrace new members and various levels of participation with members participating once or a few times, sporadically, regularly, or even taking on significant and time-consuming tasks. In fact, individual contribution levels in user communities frequently follow a power-law distribution where a few users contribute a great deal and a majority of users contribute only a small number of times or not at all (Rullani & Haefliger, 2013).[10] Overall, the time an individual contributes to a community may not always square with the value of their contributions: individuals possessing novel problems or knowledge or strong problem-solving skills may be very valuable, despite generally low levels of participation.[11]

[10] Those who contribute more (and also tend to participate over longer periods of time) have a greater say in decision-making (Rullani & Haefliger, 2013). They are also likely to better understand the design of the artifact itself and therefore be instrumental in suggesting how new ideas be integrated into the overall design.

[11] Users can build knowledge through a variety of experiences, including being involved in multiple user communities. For example, "cosmopolitans" are not necessarily in the core of the community, but they are involved in *multiple* user communities and can bring lessons learned in one community to others and are hence critical to the success of communities (Dahlander & Frederiksen, 2012).

Communities do often set expectations for behavior, maintaining a short set of rules or norms of expected behavior aimed at establishing basic standards regarding how to participate and how participants should interact with one another.[12]

Motivation. Participants generally do not receive remuneration from the community as a direct result of their work. What, then, motivates their efforts? Scholars, noting that talented participants engage in significant work within user communities without pay have investigated participant motives in a variety of communities. Studies find that participants often possess multiple motives; that motives differ amongst participants; that motives propelling different activities—e.g., asking questions, answering questions, creating a feature, contributing knowledge, working to integrate others' work into the master design—may differ;[13] and that motives can evolve over time (Lakhani & Wolf, 2005; Shah, 2006). A wide variety of intrinsic and extrinsic motivations have been proposed and investigated. Below, we review motives that have received empirical support, discuss what is known about the evolution of motives, and describe what is known about participation paid for by third parties.

Intrinsic motivation reflects a desire to seek out new things and new challenges, to analyze one's capacity, to observe and to gain knowledge (Ryan & Deci, 2000). It includes benefits gained directly from engaging in the task itself. For example, participating may allow an individual a means for fulfilling a need for creative, challenging, and enjoyable work (Brabham, 2010; Shah, 2006) or self-efficacy (Hsu, Ju, Yen, & Chang, 2007). Individuals may also participate in a user community simply because they want to learn more about the artifact that the community is focused on (Handley, Sturdy, Fincham, & Clark, 2006) or have a specific need (Shah, 2006). Reciprocity can also be a motivator in user communities—both for those heavily involved in the community and for those that participate less frequently (Chan & Li, 2010; Lakhani & Hippel, 2003; Shah, 2006). Reciprocity represents a sense of obligation to contribute when others have helped a user in the past. Additionally, belief in the mission of the user community is a frequently

[12] For example, FLOSS communities often suggest that new users search the list servs before asking questions, so as not to ask repetitive questions that have been answered and would both overtax those with knowledge and likely not receive a response; some communities maintain dual communication channels—one for new users asking questions and one for engaging in actual development work; some, but not all, communities, have guidelines suggesting mutual respect.

[13] And, more generally, that motives propelling different activities—e.g., asking questions, answering questions, creating a feature, working to integrate others' work into the master design—may differ.

cited reason for participation, although this is a much stronger motivation for individuals who participate frequently than individuals who participate occasionally (Lakhani & Hippel, 2003).[14]

While intrinsic motivation refers to doing something because it is inherently interesting or enjoyable, extrinsic motivation, refers to doing something because it leads to a separable outcome (Ryan & Deci, 2000). Extrinsically motivated activities often include a reward for demonstrating the desired behavior, coupled with the threat of punishment for misbehavior. User communities can allow an individual to find like-minded people that share a common interest in a particular artifact. For some, this generates a sense of belonging that leads to continued active participation in the community (Lampe, Wash, Velasquez, & Ozkaya, 2010). Status enhancement and career benefits have been documented in user communities. Status within the community can serve as an extrinsic motivator: in many communities, there are no official status measures, but members get to know who provides knowledge, insights, and work effort over time; while in others "scores" documenting participation levels or the usefulness of answers to others may be used as status indictors (Chen, Harper, Konstan, & Li, 2010). For example, on TopCoder, a software development platform, and StackOverflow, a coding question and answer site, individuals frequently contribute their time and effort to see their name climb the ranks of various leaderboards (Archak, 2010; Immorlica, Stoddard, & Syrgkanis, 2015). In the context of Wikipedia, status enhancements—even when purely symbolic and not extending beyond the boundaries of the community, such as having a digital badge next to one's name—have been shown to increase the number of contributions a participant makes and can also increase commitment to the community (Gallus, 2016). Lab experiments have shown similar results (Samek & Sheremeta, 2014).

Career benefits can also serve as an extrinsic motivator: by participating in a user community, an individual can signal the possession of existing skills to employers, as well as learn (and signal) new skills. Studies have shown that participation in user communities can lead to valuable learning experiences that enhance an individual's ability to get a job in the future in fields as disparate as graphic design (Brabham, 2010) and programming (Hann, Roberts, Slaughter, & Fielding, 2002). While career benefits occur, it is an open question as to whether individuals

[14] Social identity plays a critical role in the continued success of user communities. If at least some members of the community do not feel a strong tie to the community, such that it becomes an important part of their identity, the ability of the community to grow and flourish may be diminished (Bagozzi & Dholakia, 2006). This sense of identity becomes particularly important as a community changes over time (Brandtzæg & Heim, 2008), as firms exert more control over the community (Johri, Nov, & Mitra, 2011), or as a firm (or other external organization) begins to engage more with external actors (Lifshitz-Assaf, 2018).

participate to gain those benefits or if those benefits come as a result of participation pursued for other reasons.

Evolution of Motives. Participants' motives often evolve, with the reason for continued participation being different from the reasons for joining the community (Lampe *et al.*, 2010; Shah, 2006). Several such patterns have been documented. For example, a comparative study of two FLOSS communities found that many participants joined because they needed to use the software (for work or personal use) and using the software required having some questions answered or components built; individuals who continued to participate often did so because they enjoyed the act of coding and participating in the community Shah (2006). As they did so, they generally increased the scope of their participation, fulfilling more community support and organization tasks rather than focusing only on their own needs.

Paid Participation. Paid participation is increasingly common in FLOSS communities. Paid participation usually occurs when an individual's employer pays them to contribute as part of their job or when the organization behind the community pays an individual for them to participate (Nagle, 2018b). Paid participation in the Linux kernel appears to have risen over time, with rates around 40% in the early 2000s[15] (Herrmann *et al.*, 2003) and 92.3% in 2016 (Corbet & Kroah-Hartman, 2016). Paid participation rates for communities in other product domains are not known, but are presumed to be lower. A number of motives have been documented and/or suggested to explain the choice of firms to support participation in FLOSS development, however these reasons are likely distinct from the reasons that employees of these firms engage in the work, although they may shape the work that employees take on and the decisions they make.[16] Hence individuals

[15] The study found that 20% of the developers were paid to contribute as part of their regular job and another 23% were sometimes paid for their Linux work (Herrmann, Hertel, & Niedner, 2003).

[16] These include gaining innovation-related knowledge and feedback (Dahlander & Magnusson, 2008; Feller & Fitzgerald, 2002; Franke & Shah, 2003; Goldman & Gabriel, 2005; Harhoff, Henkel, & von Hippel, 2003; Henkel, 2006; Henkel, Schöberl, & Alexy, 2014), standard setting (Goldman & Gabriel, 2005; West & Gallagher, 2006), gaining adopters (Henkel *et al.*, 2014; Raymond, 1999a; von Hippel & von Krogh, 2003; West, 2003), increasing demand for complementary products and services (Feller & Fitzgerald, 2002; Fosfuri, Giarratana, & Luzzi, 2008; Henkel, 2009; Lerner, Pathak, & Tirole, 2006; Lerner & Tirole, 2002; von Hippel & von Krogh, 2003) or proprietary versions of the software (Goldman & Gabriel, 2005), helping consumers avoid lock-in (Goldman & Gabriel, 2005; Grand, von Krogh, Leonard, & Swap, 2004; Henkel *et al.*, 2014; Raymond, 1999a; Zhu & Zhou, 2012), displacing existing products (Aksoy & Shah, 2018), enabling compatibility (Henkel *et al.*, 2014; Mustonen, 2005), reducing maintenance costs (Henkel *et al.*, 2014), reducing production costs (Henkel *et al.*, 2014), training and education (Goldman & Gabriel, 2005), and scouting for potential employees (Lerner *et al.*, 2006) Unfortunately, it is also possible that payments may be made by those with disingenuous motives, such as competitors within an industry (Luca & Zervas, 2016; Mayzlin, Dover, & Chevalier, 2014).

employed by firms to work on FLOSS projects may experience not just a variety of motives, but conflicting directives as well; to our knowledge, no research exists on this issue.

Control & Governance

Because user communities are very different from traditional firms and organizations, their social structure has been a frequent topic of study within the literature. Elinor Ostrom's work on governing the commons (Ostrom, 1990) has strongly influenced and shaped the study of user communities, with legal scholars characterizing user communities as a type of commons (Benkler, 2006; Frischmann *et al.*, 2014).[17] Several characteristics of community governance have been suggested as important and have been highlighted in the literature.

Information Access: Transparency. Communities also tend to embrace transparency in both their development efforts and their communications. Transparency refers to the practice that all participants in the community can access shared information and identify the source of that information. Transparency helps encourage the future growth of the community (Demil & Lecocq, 2006). Transparency promotes trust amongst community participants, which in turn encourages participation (Benlian & Hess, 2011). To achieve this end, communities use various communication technologies, ranging from newsletters and magazines to searchable mailing lists and repositories.

Membership: Open & Fluid. User communities are generally based on open participation, allowing anyone who wants to participate (or observe) to do so; all communities that we have observed welcome new users. Participation is often also fluid in that we often witness participants freely flowing into and out of the community (Kane, Johnson, & Majchrzak, 2014). Openness and fluidity benefit the community, because new participants bring in new problems to be solved, as well as new knowledge that might be helpful in generating solutions to existing problems, thereby fueling development: "given enough eyeballs, all bugs are shallow (Raymond, 1999a)." Extending this concept, we suggest that users with different knowledge bases can often complement one another, leading to the pooling of information that can then be used to generate solutions.

Property Rights: Free & Open, Devoted to Maintaining the Commons. A key characteristic of user communities is their dedication to maintaining and building the commons. All communities that we have observed expect that contributed content will remain available for all to use. Some

[17] Although both are commons, user communities are quite different from Ostrom's commons (Frischmann *et al.*, 2014).

communities take this as a given, but uncodified rule, while others have taken concrete steps to codify this concept. A number of communities have adopted the notion of copyleft. Copyleft is a subversive use of intellectual property law and a play on the term copyright (Coleman, 2012; Lessig, 1999; Stallman, 2001). *Copyright* law is used by authors to prevent others from reproducing, adapting, or distributing copies of their work. In contrast, by using copyleft, an author gives others the permission to reproduce, adapt, or distribute their work—with the requirement that any resulting copies or adaptations are also bound by the same licensing agreement. Communities do, however, take different approaches regarding whether the additional content an actor builds needs be contributed back to the commons.[18]

Key Organizing Mechanisms: Master Designs & Maintainers. Some communities keep master designs that have been well tested for individuals to access and use. Individuals can then use these designs as is or alter them as they wish. Maintaining the integrity of master designs, particularly in light of continuing development, is also critical. In general, additional or newer features and functionality are readily shared within the community, but are not integrated into the master design until vetted. Vetting may involve testing and/or briefly assessing whether the addition is useful to multiple users by trusted participants with the authority and technical ability to integrate the feature into the master design.

In some communities, a subset of participants are elected or appointed to the position of being able to alter the master design (*e.g.,* "administrators" in Wikipedia, "committers" or "maintainers" in FLOSS projects); for example, in the Apache open source software community, "election" requires three individuals to proclaim support for the candidate on the mailing list with no objections from others. Even Linux—a community in which approximately 15,600 developers worked on a complex codebase between 2005-2017 (The Linux Foundation, 2017)—has only two types of participants: maintainers and everyone else.[19] Overall, user communities tend to have

[18] For example, in the context of software, a number of FLOSS licensing arrangements exist (all have certain key features in common, as defined by the Open Source Definition: they allow software to be freely used, modified, and shared (Open Source Initiative, 2018)). Some have copyleft provisions requiring that derivative work be contributed back to the community. Other FLOSS licenses, however, do not include the requirement that resulting copies or adaptions also be released under copyleft. These are referred to as "permissive licenses." Permissive licenses are, according to the Open Source Initiative, "non-copyleft licenses": while they also guarantee the freedoms to use, modify, and redistribute, they allow proprietary derivatives. Communities appear to thrive under both styles of licenses: the Linux community utilizes a non-permissive license (the Gnu General Public License or GPL) and the vibrant Apache software community utilizes a permissive license (the Apache License).

[19] Although there are technically only two roles, in some communities there is some hierarchy amongst maintainers in that some maintainers have approval authority over larger sections of the code base.

fairly flat organizational structures. Moreover, user communities generally do not have paid staff, organizers, or managers to take on organizational tasks, so the design of the community as an organizing structure must be used to keep organizational costs relatively low.[20]

Decision-Making & Conflict Resolution. Decision-making in communities often centers on what changes are made to the master design; this is because individual users can readily alter their private copies of the artifact and are encouraged to do so. In general, decision-making in communities is distributed, however, communities do have different ways of handling critical decisions: some communities may hold votes amongst key or all members, whereas others might rely on a central authority or "benevolent dictator."

Distributed decision-making can be supported through the use of modularity (Baldwin & Clark, 2000). Some user communities, particularly those centered around complex artifacts, use modular design as a tool to support the coordinated actions of multiple participants without a centralized decision maker (Baldwin & Clark, 2000). Modules are smaller, self-contained pieces that are designed to work together according to a formal architecture or plan. Modularity also allows for more flexibility and easier reuse of prior efforts in future projects within the user community. For example, FLOSS is frequently more modular than its closed-source proprietary software counterpart which allows for more flexibility when building future iterations of a project (MacCormack, Rusnak, & Baldwin, 2006). The decision-making process can change over time: often when a community emerges, a central individual(s) makes decisions, and over time more democratic mechanisms evolve (O'Mahony & Ferraro, 2007).

When disagreements arise in communities, they tend to be resolved through discussion and actual prototyping to investigate the merits of different directions. There are times when disagreements are so severe that they lead to a split of the community into two separate communities. In FLOSS this is often referred to as forking; forking has led to hundreds of different versions of Linux.

Under What Conditions Will User Communities Operate?

[20] There may be some exceptions to this, particularly when firms organize user communities and pay an individual or staff to take care of some functions. Additionally, when some user communities become very large, like Linux and Apache, they require a formal organization with paid employees to add structure to the community (e.g., The Linux Foundation and The Apache Software Foundation). However, the vast majority of contributors actually writing code are users that are not paid by the organization.

We now consider the conditions under which user communities will operate. This question is critical as user communities are so different from firms and academic institutions: one might expect a firm to form when the opportunity to profit exists and this objective can be better met by organizing in a hierarchy rather than through the market (e.g., Barney, 1991; Coase, 1937; Wernerfelt, 1984). However, in the absence of a direct road to profit, what conditions will support the continued functioning of a user community?

To investigate this question, we first illuminate the pattern of exchange that occurs in user communities: generalized exchange. Imagine an exchange between two actors—a recipient and a donor—where the donor provides something of value to the recipient. In systems predicated on generalized exchange, no obligation to the specific donor is created and the recipient repays the obligation to someone other than the original donor.[21] These systems comprise three or more actors.[22] To support innovation/knowledge development, knowledge needs to flow from those who have it to those who need it. However, because not all knowledge is the same, nor equally distributed, and not all community participants will seek information, a matching process based on restricted exchange would likely collapse, whereas one based on generalized exchange can allow ideas and knowledge to circulate where needed (and, because most user communities put open communication channels in place, knowledge, once shared, tends to be accessible to many).

Existing theory provides three reasons for why individuals might engage in generalized exchange: altruism, group norms, and rational action and enforcement (Dawes, 1991; Olson, 1965; Sahlins, 1965). In altruism-based explanations, concern for the well-being of others leads to participation and support of others. In group norms-based explanations, cooperative norms, trust, and/or solidarity leads individuals to give without expecting. Finally, in rational action and enforcement-based explanations, economically rational players cooperate to achieve instrumental goals, under strong supervision and a system of incentives. However, these explanations do not fit our understanding of how user communities function. There is little evidence of altruism in user communities (Lancashire, 2001). There is little evidence that group norms mandating that

[21] In contrast, we are accustomed to thinking of "restricted" or bilateral exchange: transactions between two actors where an obligation to the donor is created when the donor provides something of value to a recipient (Ekeh, 1974; Yamagishi & Cook, 1993).

[22] Several flavors of generalized exchange exist. In individual-focused generalized exchange one individual reaps the benefits of the group's effort (*e.g.,* barn raising). In group-focused generalized exchange, individuals work together to create a shared resource that all will benefit from (*e.g.,* digging a well). In network generalized exchange, an individual or group help someone in a manner that benefits only that person, but they expect that the recipient of the benefit will "pay it forward" to others that are in a similar situation (*e.g.,* helping a stranded driver).

individuals give without expecting exist in user communities (although communities do have norms about process and how participants will treat and interact with one another) and, moreover, most communities are composed primarily of "peripheral" participants (Rullani & Haefliger, 2013), hence it is unlikely that trust or solidarity is supporting contributions. Finally, there is little or no evidence of strong supervision and enforcement around contributing in user communities.[23] And, to underscore that point, free-riding (using the product or service without giving back) is generally accepted and even encouraged in many communities and can be beneficial to the overall health of the community. This lack of evidence in support of existing explanations for generalized exchange suggests a need to build additional theory to better explain the conditions that will support the generalized exchange of knowledge within user communities.

Building on observations and the existing literature on user communities, we suggest three conditions that appear to support supporting generalized exchange within user communities: heterogenous needs and knowledge, a focus on the exchange of non-rival goods, and participation by at least a few individuals who benefit from the act of contributing to the community.

Heterogeneous needs and knowledge are needed. Knowledge development is at the core of user communities: participants join user communities to search for information that they need. To the extent that a variety of unaddressed needs related to the artifact exist, a user community will thrive. As the level of unaddressed needs declines, the community may no longer have a reason for existing. For example, the user community played a critical role in the early development of probe microscopes and contributed to the development of features and the scientific vetting of the instrument over many years (Mody, 2011). However, as critical and minor features were developed and their accompanying problems addressed, the community waned.

To point, we tend to see a great deal of diversity in user communities; with individuals using the artifact in different ways or contexts. In the case of probe microscopes, the early community that duplicated and verified Binnig and Rorer's design were scientists, but came from a variety of scientific fields (Mody, 2011). In Luthje, et al.'s 2005 study (2005), participants all enjoyed bicycling, but had different careers. And, seen from this perspective, user communities' openness to new participants and encouragement of use—even through "free-riding"—is valuable, serving to draw a greater variety of people in, a few of whom will contribute to knowledge development.

[23] The closest we observe to this is the practice, used with some FLOSS programs, of having direct error-reporting.

Exchange of non-rival goods. User communities tend to focus on the exchange of knowledge, a non-rival good. By definition, a non-rival good is one that can be consumed without reducing the amount for others to consume. This condition means that sharing will not decrease the benefits that an individual obtains from their own use or consumption of the information (in contrast sharing a rival good, like a cookie, would result in the loss of a few bites). In addition, many of the goods produced by user communities could be considered network goods that either have direct or indirect network effects such that the more users that use the good, the more value the good provides for every user. For example, as more people use the Linux operating system, more applications will be developed for it, which makes it more valuable.

Gaining by contributing. Communities are able to collectively develop and improve artifacts only through the contributions of participants. However, the act of contributing—documenting and communicating knowledge—requires additional time and effort, and hence some individuals may forego this time and investment, while others undertake it. Why? Scholars have suggested that, for a robust user community to form, some individuals must expect to gain from contributing knowledge (Allen, 1983; Nuvolari, 2005). Gains may arise directly through the exchange and development of knowledge (*e.g.,* the individual becomes known as the creator of the knowledge and benefits from reputation, the individual commercializes the knowledge, or others build on and refine the idea such that the individual can benefit from those developments), from the process of contributing and interacting within the community (*e.g.,* enjoyment, self-efficacy, sense of belonging, status, etc.), or from learning how to more efficiently use the good produced by the user community (Nagle, 2018b). With respect to the latter, research on user communities in the fashion industry has shown that it takes time for contributors to learn from others who contribute, but when they do, they learn from both good and bad examples of quality products (Riedl & Seidel, 2018).

Relationships Between Firms & User Communities[24]

Working with user communities requires firms to change their frame of reference—moving from a hierarchical, employment-based model of interaction to a community-based model. Firms

[24] We focus on firm engagement with user communities, however we believe that many of the issues and patterns discussed will apply to other types of organizations engaging user communities (e.g., non-profits, government agencies, universities).

must learn to work with user communities, but not stifle their activity so that both can grow in a healthy symbiotic relationship (Shaikh & Levina, 2019); more specifically, Altman *et al.* (2019) suggest working to leverage communities without exploiting them and sharing intellectual property. This can be very challenging for firms engaging with communities for the first time; it may be more natural for firms that are born from the community, but even then, it may become challenging as both the community and the firm grow and change over time. Below, we describe the general ways in which firms can participate in a community and provide some examples of how relationships between firms and communities transitioned over time.

Roles Firms Play in User Communities

Firms and user communities can interact in a variety of ways. Here we acknowledge three very general categories of participation to illustrate the choices that firms have when interacting with user communities. *Participant.* Some firms choose to simply participate in a user community. They might pay employees to participate in the community and guide those employees and their work, but, officially, each of those employees enters and participates in the community in the same way as an independent participant would. *Organizer/Supporter.* Firms can also take on strong organizing or support roles within a community. For example, firm employees might act as moderators or managers of the user community. Firms might also provide resources for communities. *Founder***.** User communities can be actively founded by a firm (or other organization) that produces the artifact for commercial sale, or they can arise organically, with users self-organizing to improve an existing artifact or create an altogether new one. Communities, such as Threadless and LEGO IDEAS, were purposefully created by firms. As an example of a community that arose organically, consider Linux. In 1991, Linus Torvalds sent out a message requesting help from fellow software developers (Torvalds, 1992):

> *Hello everybody out there using minix -*
> *I'm doing a (free) operating system (just a hobby, won't be big and professional like gnu) for 386(486) AT clones. This has been brewing since april, and is starting to get ready. I'd like any feedback on things people like/dislike in minix, as my OS resembles it somewhat (same physical layout of the file-system (due to practical reasons) among other things).*
> *I've currently ported bash(1.08) and gcc(1.40), and things seem to work. This implies that I'll get something practical within a few months, and I'd like to know what features most people would want. Any suggestions are welcome, but I won't promise I'll implement them :-)*
> *Linus (torv...@kruuna.helsinki.fi)*

PS. Yes - it's free of any minix code, and it has a multi-threaded fs.
It is NOT protable (uses 386 task switching etc), and it probably never
will support anything other than AT-harddisks, as that's all I have :-(.

Relationships Change Over Time

The role a firm plays in a community, as well as the level of control it attempts to exert, can change over time. For example, The Harley Davidson Owners Group was initially created by enthusiastic Harley owners and not affiliated with the firm. For many years, Harley-Davidson motorcycle enthusiasts would regularly get together in their local community to go for rides, spend time together, offer mentorship to new riders, and exchange knowledge about safety, motorcycle modifications, and maintenance best practices. Harley-Davidson decided to formalize these groups and offer them support by creating the Harley Owners Group (HOG) in 1983 to allow users an even more intimate experience with the brand and product (Harley-Davidson, 2019). However, Harley-Davidson chose to exert a limited amount of organizational control over HOG in an effort to maintain the group's authentic feel. Users continued to embrace HOG; the community grew and thrived and was an important part of the revitalization of the Harley-Davidson brand in the 1980's and 1990's. Further, this low-level of involvement limited the resources required for Harley-Davidson to support and help grow the community.

In contrast, we see a less successful example in the relationship between MakerBot, a company that makes 3D printers, and Thingiverse, the user community it created to allow users to post 3D designs. When first launched, Thingiverse allowed users to maintain control over their designs. However, in 2012, MakerBot announced plans to change the terms of use such that MakerBot would own all of the intellectual property rights associated with the designs (West & Kuk, 2016). This claim of legal ownership caused an outrage amongst existing Thingiverse users to the point where many left the community to go elsewhere so they could retain ownership of their designs. Similarly, in the context of drones, the relationship between the community and a manufacturer, 3DR, was disrupted when the firm received venture financing and obtained proprietary protections for its intellectual property (Bremner & Eisenhardt, 2019). It is often such changes in levels of organization and control over ideas by the firm that can lead to a downfall of a user community. Therefore, the levels of organization and control must be thought of as dynamic and not static. When a firm takes over an existing user community, or when it changes the level of organization and control associated with the community, there is a risk for upsetting users and destroying the community.

Research Opportunities for Strategy and Organization Scholars: Measuring Impact & Uncovering Process

There are a number of opportunities for strategy and organization scholars to contribute to the study of user communities, as well as a number of ways in which the study of user communities can contribute to theoretical insights within the field of strategic management. In this section, we detail those avenues. This section is organized around two central issues: understanding the processes underlying firm-community interactions and measuring the impact of user communities. Additionally, within each of the subsections below, we highlight how the study of user communities can contribute to broader theories of interest in the field of strategy.

We believe that empirical research is critical to improving our understanding of user-community and firm relationships: as described above, user communities are very different from more frequently studied organizations such as firms and academic institutions. Such differences require scholars to carefully consider their assumptions as they craft, execute, and present their studies. Scholars need to be alert to the fact that user communities are complex and hence attempts to explain patterns with a single overarching mechanism may not be accurate.

To understand how firms can work within user communities, we need to observe how communities and firms operate individually and together. Doing so can be challenging on several dimensions. Scholars wishing to study these issues will need to develop novel study designs that allow for examination of the processes at play (general templates for study designs have not emerged, although the number of empirical studies is growing). Throughout this paper, we have tried to highlight empirical work that may be useful as a starting point. Table 2 classifies the empirical studies discussed throughout this article by their methodology to give examples of the variety of methods already in use for studying user communities. We see scholars bringing a variety of methodological tools and theoretical perspectives; we see this as a sign that user communities are both a unique and intriguing phenomenon and have a great deal to teach us. Notably, there have been few experiments (lab, field, or natural) employed for user community research and this remains an open opportunity. The paucity of lab experiments may reflect the reality that the study of user communities inherently requires examining interactions occurring between many people in a social context with rules and norms for behavior, and this can be difficult to replicate in the lab or convince actual communities to serve as contexts for field experiments.

Finally, changing knowledge around user communities is leading to changing patterns: as firms engage more with communities—either as users themselves or as "consumers" and "commercializers" of community-developed knowledge—theoretical relationships and participation patterns may change.

Insert Table 2 Here

Understanding Process

Here, we focus on suggesting ideas for future research investigating how user communities and firms can effectively work together. We structure our suggestions around four general areas.

Understanding How Interactions Shape Firms and User Communities

Firms often work with user communities to gain information, or more specifically, feedback on a particular product, idea, or feature—or, to shape the designs created by communities. However, we know little about how these interactions—and the information flows and feedback that they engender—impact user communities or firms. Yet, as firms increasingly engage with user communities, understanding the effects of these interactions becomes increasingly important. Specifically, there is little to no existing research that helps understand how community-firm interactions shape the work processes of either communities or firms. Below, we breakdown this issue into four component parts: information flows and feedback, governance and control, transparency, and legitimacy.

Information flow and feedback on ideas are critical to communities, both as processes and as outcomes. When firms become involved with communities, their processes and outcomes can be affected and vice versa. Scholars might ask: how does feedback from user communities shape a firm's commercial products, experimentation patterns, and decision-making processes? How does feedback from firms—or from community participants who are paid to work within the community by firms—shape a community's designs, experimentation patterns, decision-making processes, and participation patterns? For example, in the context of the Stata user group, it appears that the participation patterns of voluntary users are altered when they receive feedback from a Stata employee (Nagle, Seo, & Shah, 2019). Such research can contribute to the long-running discussion in the strategy literature on how to best drive sustainable competitive advantage. What levels of user community involvement firms should utilize to obtain optimal competitive advantage – either from differentiation or cost advantage – remains an open question.

As discussed earlier, governance and control are critical to ensuring the health of user communities. However, only a few studies conducted to date investigate the impact of firm involvement on the health and functioning of user communities, and often do so indirectly. This is a critical area for research. Scholars might, for example, more deeply examine how each community governance mechanism shapes various outcomes and how contextual factors affect these relationships. They might also begin to investigate which of the suggested mechanisms are most central and if and how changes in each mechanism affect community functioning and growth. Scholars might also seek to understand the effect of increasing numbers of paid contributors in a community (as has occurred in the Linux community over the past ten years), particularly on the activities of voluntary participants. More broadly, the questions of how firm involvement shapes which volunteers join and the extent to which they participate are ripe for investigation. With respect to the latter, for example, recent work in the context of digital mapping suggests that the entry of firms may disrupt the growth and activity of existing user communities (Nagaraj & Piezunka, 2018). The mechanism(s) underlying these patterns, is, however, unclear: as a product and its design matures the community may be less critical, as occurred over time in the probe microscopy community (Mody, 2006); specific actions by firm(s) might deter voluntary participation, as occurred in a FLOSS community that was firm-sponsored with restrictions on how participants could use the code (Shah, 2006); and/or users may simply choose not to engage in the work as the firm is doing it and shift their attention elsewhere. Specifically, more research is needed to understand *how* firm employees can work effectively within user communities—the types of behaviors and ways of organizing they need to adopt or avoid[25] and how the use and sharing of information should be approached in order to maintain the integrity and trust of the community (see also the subsection titled "Decreased Control").

Transparency is also a critical issue. Within any collaboration, it is important to understand each actors' motives, as those motives will likely shape their ideas and the direction of the project. Issues of transparency around participants' identity become increasingly important as firms become increasingly involved in user communities. For example, in the mid-late 1990's, IBM was quietly contributing to Linux, and only made public announcements about these efforts in 2000. When these efforts were uncovered, members of the Linux user community were concerned that

[25] For example, what are the behaviors and ways of organizing that are used within firms and can be used within communities as well? That should not be?

IBM had exerted undue influence over the project. Today many companies contribute to Linux and appear to do so openly, yet it is not known how many "cloaked" participants—participants trying to hide or mask their identity—exist. This could lead to potentially damaging effects for both the community and firm, with respect to trust between participants, as well as outcomes.

From the perspective of the community, it remains unclear as to whether or not firm participation enhances or detracts from a community's legitimacy both in the eyes of its participants and outsiders. In some cases, firm involvement appears to add to a community's legitimacy and reach. For example, both Harley Davison and Stata became involved in preexisting user communities around their products, providing limited resources and official branding that appears to have increased legitimacy and reach of the communities (note that both communities continue to be managed by users): Harley-Davidson formalized existing user groups into the HOG community; StataCorp agreed to host the existing Statalist forum and allowed its developers to contribute to the Statalist forum and travel to international user group meetings. However, it is also quite possible that a firm takeover of an existing user community could be seen as delegitimizing and it could anger members of the community. This has been seen in the 3D printing context when MakerBot changed its licensing approach toward the open source hardware site Thingiverse (West & Kuk, 2016) as well as the FLOSS context when Oracle (a proprietary database manufacturer) acquired Sun Microsystems, which owned the FLOSS database MySQL. MySQL users feared Oracle would no longer offer it under an open license and decided to leave MySQL and create a new FLOSS database (TechCrunch, 2012). However, it is still not clear why in some cases firm participation is well-received by the community and in others it is not. The conditions under which firm involvement with a user community is legitimizing or delegitimizing have gone underexplored and are a fruitful area for research. Scholars might begin by examining the effects of the role played by the firm—participant, organizer/supporter, or founder—and the firm's compliance (or lack thereof) with community governance and control practices (actions that contradict practices are unlikely to be well-received and may lead users to leave the community or engage the community in only very limited and instrumental ways (Shah 2006, West & O'Mahony 2008); see also media coverage of conflicts between Makerbot and community principles (Biggs, 2014; Smith, 2012). Digging into such issues could also shed light on the increasingly complex notion of resource ownership and the resource-based view of the firm (Barney, 1991; Penrose, 1959; Peteraf, 1993; Wernerfelt, 1984) in the digital economy.

Collaboration with User Communities & the Changing Organizational Structure of the Firm

When a firm begins working with a community, it is likely to have an impact on the organization of the firm, necessitating changes in culture, incentives, and formal and informal structures within the firm. It is feasible that entire departments (*e.g.,* customer support, R&D) could be offloaded to a user community, which would necessitate significant shift in organization. More likely is a partial shift to reliance upon a user community such that the firm would need to manage dual and competing governance structures (Altman *et al.*, 2019). More broadly, the ways in which firms search the innovation landscape (Chesbrough, 2006; Levinthal & March, 1981; Rosenkopf & Nerkar, 2001) and organize for innovation (Chesbrough & Teece, 1998; Tushman & Nadler, 1986; Yoo *et al.*, 2009) will evolve and strategy research on these topics may need to be revisited. Although there have been many theoretical explorations of how opening the firm to user communities may impact organization and governance (Appleyard & Chesbrough, 2017; Felin & Zenger, 2014; Gulati, Puranam, & Tushman, 2012), there is almost no empirical work in this area so our understanding of how this plays out in the real world is limited. Additionally, the evolution of user communities and the role they play in the firm leads to new questions at the core of strategy related to the scope of the firm, where the appropriate boundaries of the firm are, and when an organization should make inputs vs. buying them (or, as the efforts of user communities are generally not bought, sourcing or partially "sourcing" some knowledge or work externally) (Hart & Holmstrom, 2010; Leiblein *et al.*, 2002; Poppo & Zenger, 1998; Walker & Weber, 1984, 1987; Williamson, 1975).

Changing the Nature of the Work: Tasks & Identities

As firms engage with user communities, the nature of work begins to shift. This has important implications for both employees of the firm and members of the community. When firms utilize community members to perform tasks that would have otherwise been completed by paid employees, the nature of work begins to change. As Coleman (2012) argues, by *organizing work* in radical ways, FLOSS development shows that the assumption that economic incentives are necessary for vibrant creative production is false. For example, when Facebook wanted to translate its site from English to nearly a hundred other languages, instead of hiring translators, it asked the user community to help translate the site for free. Users got the benefit of having Facebook available in their native language, and Facebook benefitted from an increase in usage at little cost. Taking an example from the related context of crowdsourcing, when NASA started using

innovation contests to solve complicated problems, internal employees at NASA felt their identity as "problem solvers" was being called into question as their job evolved into "solution seekers" (Lifshitz-Assaf, 2018). The impact of firms-user community interactions on employees and the nature of their work requires further examination.

Seeding New Ventures & New Industries

Scholars examining the process of user entrepreneurship have observed that feedback and interest from user communities leads some users to found firms to produce and sell copies of an innovation to consumers (Baldwin *et al.*, 2006; Shah, 2005; Shah & Tripsas, 2007). Scholars interested in understanding user entrepreneurship might examine how various characteristics of the community and how it operates stimulates or dampens entrepreneurship.

Scholars seeking to understand the genesis of new industries point out that many new industries stem from one of three sources: user needs, scientific discoveries, or mission-oriented grand challenges (see review in Agarwal, Moeen, & Shah, 2017). Understanding the relative effects of users versus these other sources on the process by which a new industry emerges and the early structure of the industry is also a ripe area for study. And, regardless of the trigger event, there is much to be learned about the role user communities play in industry emergence and change. For example, does the presence of a strong user community accelerate or decelerate the rise in the number of firms in an emerging industry—and under what conditions? What role do user communities play in reducing demand uncertainty? Can the existence of strong user communities early in an industry's development lead to better financial support for the industry?

Measuring the Impact of User Communities

Now we turn our attention to the impact of user communities. As with many areas of the economy, measurement is a critical aspect of understanding user communities. However, the very nature of user communities—their limited organization, the free availability of information, and their independence from traditional organizations—makes their effects difficult to measure with traditional tools (Greenstein & Nagle, 2014).[26] Therefore, in this section we consider various open areas for exploration of how to measure the activity and impact of user communities.

[26] A few studies have examined the effects of working with individual users and/or user entrepreneurs on corporate innovation and revenue projections for new products (Adams, Fontana, & Malerba, 2015; Bayus, 2013; Chatterji & Fabrizio, 2012; Chatterji & Fabrizio, 2014; Lilien, 2002; Shah, Winston Smith, & Reedy, 2012; Smith & Shah, 2013). These studies provide a useful starting point in thinking about *how* to gather data to measure the effects of user communities.

Measuring the Economic Effects of User Communities on Firms

Perhaps the most important strategy-related question for firms with respect to working with user communities is whether or not engagement will benefit bottom line performance and the ability of the firm to sustain its competitive advantage. A number of reasons for engaging with user communities have been suggested (Goldman & Gabriel, 2005; Henkel, 2006), and scholars have just begun to measure the effects of some of these strategies. To date, the evidence collected suggests that engaging with user communities to develop better products and internal systems has a positive effect on profitability. For example, working with user communities also appears to improve a firm's own internal productivity through learning; scholars have just begun to precisely measure these benefits (Huang, Ceccagnoli, Forman, & Wu, 2016; Nagle, 2018b, 2019; Riedl & Seidel, 2018). And, preliminary evidence suggests that working with user communities benefits corporate product innovation and can result in stock price increases when firms contribute in order to garner product-related feedback from users (Aksoy & Shah, 2018). More studies—across contexts and outcome measures—are needed to complement these few existing studies. Efforts to measure the effects of working with user communities on firms will play an important role in understanding how value creation and value capture are changing as a result of user communities.

Future research might also seek to document and measure the benefits of engaging user communities for reasons other than differentiation through product development. For example, to measure a potential cost advantage from offloading key components of the firm's value creation process to user communities (*e.g.,* technical support). Another fruitful area of research lies in examining the competitive implications of a firm's engagement with user communities on rivals and other ecosystem actors. It has been argued that firms at one level of the value chain can band together to create open source alternatives to the products provided by an upstream supplier (Gambardella & von Hippel, 2018), thereby reducing industry-wide value capture opportunities; but, scholars have yet to investigate this issue empirically. Finally, the cost-side of community participation has yet to be assessed: there are costs to working with or cultivating a community and these need to be better understood and measured.

Measuring the Economic Effects of User Communities: Entrepreneurship, Product Development & Industry Evolution

As discussed, user communities have served as the development site of a number of altogether new artifacts, ranging from probe microscopes and medical devices to sports equipment

and juvenile products, *and* of some (and, in some cases, *all*) of the early firms that commercialized these artifacts (Baldwin *et al.*, 2006; Mody, 2006; Shah & Mody, 2014; Shah & Tripsas, 2007). In these cases, user communities *seeded* the industry and, by doing so, laid the groundwork for economic activity. In other cases, user communities contribute to existing industries by providing product ideas, branding, etc. The value of this activity—in terms of economic profit, job creation, consumer surplus, etc.—has yet to be measured.

Existing data suggests that the role played by users, user entrepreneurs, and user communities in industry evolution is worthy of further study.[27] A review of the literature on industry evolution suggests that user entrepreneurship is more frequent in the early and late stages of an industry (cf. review in Agarwal & Shah, 2014).[28] Scholars have yet to investigate why this is. Other issues worthy of study include: the role of user communities in nurturing entrepreneurship at different stages of the industry life cycle; the effects of user communities on product evolution; and how and when users use of various forms of organizing—originator's circles, user communities, *innovation nexus*, and commercial production—to meet their goals (Shah & Mody, 2014). Relatedly, user communities likely play an underexplored role in traditional strategic management topics like industry evolution and disruption (Audretsch, 1995; Christensen, 1997; Klepper & Graddy, 1990; Reinganum, 1985).

Understanding the Competitive Implications of User Communities

Communities can introduce artifacts that compete with or displace existing products, creating a free competitive threat against firms that may (or may not) be limited to specific market segments as they may first appear as substitutes, but then compete more directly (Porter, 1980). For example, in the Halloween documents (Harmon & Markoff, 1998). Microsoft discusses the threats posed by Linux. However, scholars have also argued that, in some situations, it is possible

[27] In this subsection, we again try and focus on issues central to user communities. However, it is worth pointing out that the effects of users (in general) and user entrepreneurship are still in the early stages of study.

[28] While data on user-founded firms supported by user communities is not available, we do have data on the prevalence of user entrepreneurship. Overall, according to Kauffman Foundation data, 46% of U.S.-based start-ups that survive to age 6 are founded by users (14% of all startups) (Shah *et al.*, 2012). In the medical device industry, 52% of startups receiving corporate venture capital (CVC) investment and 29% of firms overall are founded by physician (user) innovators (Smith & Shah, 2013). In the juvenile products industry, that number rises to 84% and in probe microscopy all new firms were founded by users (Mody, 2006; Shah & Tripsas, 2007). In the semiconductor industry, 34% of firms are founded by user entrepreneurs (Adams *et al.*, 2015). Very limited data are available on the relative survival of user entrepreneurs (Adams *et al.* 2015; Agarwal & Shah, 2014). Our understanding of how firms from different knowledge sources—users, academic science, or established firms—each contribute to the industrial ecosystem and interact with each other is limited (Agarwal & Shah, 2014); more research is needed.

for such duopolies to coexist (Casadesus-Masanell & Ghemawat, 2006). Communities can also revolt against firms, choosing to recreate products that firms produce. For example, ideologically-driven FLOSS developers claim to be doing just this—making software and code that is free from corporate control by creating free versions of commercial products (O'Mahony, 2003). Understanding the extent to which communities pose a threat—and how firms can respond—is worthy of investigation. We suggest that this threat is greater—at the moment—in digital goods than in physical goods, however the rise of 3D printing may alter this in time (Davis, 2016); greater for the segment of consumers with technical knowledge and skills, particularly those who enjoy "tinkering"; and greater in cases where designs can be made easy to use or easier to alter through toolkits (Franke, 2004; von Hippel & Katz, 2002) and/or modularity (Baldwin & Clark, 2000; von Hippel & Katz, 2002).

Understanding the Weaknesses of User Communities

Much of the existing literature on user communities examines the positive effects of user innovation and user communities, as do we in this essay. However, user communities can have a darker side as well. As discussed above, some user communities are heavily skewed with respect to their gender composition, even when the artifact is used by or of interest to a heterogenous set of users. Research is needed to understand why this is. Scholars might begin to investigate the conditions that result in more balanced communities. Insights gleaned might also be applied to more traditional forms of organizing.

Some user communities can also have a more perilous dark side that has yet to be explored. For example, in the 3D printing world, where users create and openly publish design documents, there has been a long-running legal battle between the United States government and Cody Wilson. Wilson published plans for a 3D printed gun and was then forced to take them down due to arms control export restrictions. However, he sued the United States government on the basis of free speech and won the court case in 2018 (Greenberg, 2018).

Conclusion

Communities of innovative users contribute to the innovations and knowledge that we use on a daily basis and shape the industrial landscape. Research documents interactions between firms and user communities since the early 1800s (Allen, 1983; Franz, 1999; Nuvolari, 2004; Nuvolari, 2005). Since then, the number and size of user communities appears to have increased as the costs

of communication has decreased, leading to the creation of communities across a wide variety of fields and opportunities for firms across industries to work with communities as a source of open innovation and more (Chesbrough & Bogers, 2014). This increase in prevalence suggests a need to further investigate both how communities function and their relationships with firms.

We expect that the effects of user communities on innovation, firms, industries, and society will continue to grow. The decreasing cost of information is allowing user communities to use modularity on increasingly complex projects (Altman, Nagle, & Tushman, 2015). For example, open source principles have been utilized by user communities, combined with 3D printing technology, to make complex physical objects—including cars (Norton & Dann, 2011), houses (Wu, Wang, & Wang, 2016), and even space ships (Aaronson, 2012). Further, it has been posited that eventually every town could have its own 3D printing setup, allowing locals to download plans from a user community and locally print every physical good they need (Davis, 2016). These changes would allow for the separation of the form and function of an artifact (Yoo, 2013); that is to say, the design and manufacture of artifacts could be easily separated. If this were to play out, a fundamental shift in production and distribution models would result (Nagle, 2018a); after all, "it's easier to ship recipes than cakes and biscuits."[29]

Suggesting that firms could be completely replaced by user communities is a far stretch for the reasons discussed above. However, it is reasonable to consider the impact of FLOSS on proprietary software firms as a harbinger of what is to come for companies in the physical manufacturing space. In some areas—particularly those with a large fraction of expert users—FLOSS has taken considerable market share from proprietary products. However, in many cases, consumers do not appear to be willing to undertake the added effort involved in understanding and using FLOSS, so ample space for firms exists. In short, there is space for firms, communities, and joint work by the two (Shah & Mody, 2016), but how much "space" each consumes is not fixed; that is to say, while there can be cooperation, there can also be competition.

User communities represent an alternative model by which knowledge is developed. This model is characterized by the free and transparent exchange of knowledge, providing a striking alternative to firms which traditionally operate through hierarchical and price mechanisms. While communities have a great deal to offer firms, they have clear limits and exist for their own

[29] This statement is often attributed to economist John Maynard Keynes, but there is limited evidence he actually originated it.

purpose(s)—not to serve firms. Participants choose which tasks to take on and firms do not have control over what directions and actions the community or its members take; the loose coordination in communities appears to benefit knowledge development over execution (i.e., production, distribution, etc.). Some firms—cognizant of the limits of communities and their participants—have benefited from user communities by working within the structure of these communities. Such "partnerships" are distinct from the contractual forms of partnerships that managements scholars are used to considering (*e.g.,* alliances, joint ventures), yet they can be effective and bring unique benefits to firms. Our understanding of how firms can work with communities is still developing. Our goal in this this article was to discuss the relationship between user communities and firms and to help shine light on the many promising avenues for future research in the strategy domain.

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Tables

Table 1: Framework for Understanding Key Differences Between User Communities & Firms

Dimension	Typical User Community	Typical Firm
Participation		
Actors	Volunteers	Employees
Expectations	None beyond abiding by basic norms	Multiple implicit and explicit tasks to be completed
Motivation	Highly varied; largely non-pecuniary	Pecuniary benefits are key, although non-pecuniary motives also play a role
Control & Governance		
Information Access within the Organization	Transparent	Generally restricted/need-to-know basis
Membership	Open & fluid membership	Restricted through hiring processes
Property Rights	Based on principles of free(dom) and openness. Geared towards maintaining the commons	Geared towards creating competitive advantage for the firm via exclusive ownership
Key Organizing Mechanisms	Master designs & maintainers	Hierarchy and organizational structure
Decision-Making & Conflict Resolution	Generally distributed (exceptions may occur when changes that affect the entire project/community or when a community is very small/young)	Power and authoritative hierarchy

Table 2: Methodological Approaches Employed in Studies of User Communities

Empirical Method	Example Studies
Ethnography	Lifshitz-Assaf (2018); Muñiz and O'Guinn (2001); Muñiz and Schau (2005); O'Mahony (2003); O'Mahony and Ferraro (2007)
Single Case Study	Antorini, Muñiz, and Askildsen (2012); Brabham (2010); Kane, Johnson, and Majchrzak (2014); Lakhani and Hippel (2003); Lee and Cole (2003); Lerner, Pathak, and Tirole (2006); Luca and Zervas (2016); Norton and Dann (2011)
Multiple Case Study	Bremner and Eisenhardt, (2019); Dahlander and Magnusson (2008); Franke and Shah (2003); MacCormack, Rusnak, and Baldwin (2006); Puranam, Alexy, and Reitzig (2014); Shah (2006); West (2003); West and O'Mahony (2008)
Natural Experiment	Johri, Nov, and Mitra (2011); Nagaraj and Piezunka (2018)
Field Experiment	Chen et al (2010); Gallus (2016)
Lab Experiment	Samek and Sheremeta (2014)
Quantitative Archival Data in One Community	Archak (2010); Chan and Li (2010); Dahlander and Wallin (2006); Goh, Heng, and Lin (2013); Greenstein and Nagle (2014); Hann, Roberts, Slaughter, and Fielding (2002); Nagle, Seo, and Shah (2019); Riedl and Seidel (2018)
Quantitative Archival Data in Multiple Communities	Aksoy and Shah (2018); Benlian and Hess (2011); Brandtzæg and Heim (2008); Dahlander and Piezunka (2014); Fosfuri, Giarratana, and Luzzi (2008); Huang, Ceccagnoli, Forman, and Wu (2016); Kankanhalli, Ye, and Teo (2015); Mayzlin, Dover, and Chevalier (2014); Nagle (2018b, 2019); Roberts, Hann, Slaughter, (2006); Ye and Kankanhalli (2018)
Quantitative Survey Data in One Community	Bagozzi and Dholakia. (2006); Hertel, Niedner, and Herrmann (2003); Jeppesen and Frederiksen (2006); Lakhani and Wolf (2005)
Quantitative Survey Data in Multiple Communities	Hsu, Ju, Yen, and Chang (2007); Lampe, Wash, Velasquez, and Ozkaya (2010)
Multiple/Mixed Methods	Dahlander and Frederiksen (2012); Henkel (2009)