THE SUSTAINABILITY OF POLYCENTRIC INFORMATION COMMONS

Vitali Mindel

Pamplin College of Business, Virginia Tech, 1030 Pamplin Hall,
Blacksburg, VA 24061 U.S.A. {vitalimindel@gmail.com}

Lars Mathiassen and Arun Rai

Robinson College of Business, Georgia State University,
Atlanta, GA 30303 U.S.A. {lmathiassen@ceprin.org} {arunrai@gsu.edu}

Appendix

Reviewed IS Research

In the 1980s, Elinor Ostrom and her colleagues at Indiana University's Workshop in Political Theory and Policy Analysis set out to inform CPR theorization by collecting, sorting, and analyzing more than 5,000 empirical field studies of local resource management arrangements around the world. The scrutinized field studies did not use CPR or polycentricity language, and they came from many different research domains. To unify this diverse body of empirical work from various research domains, the workshop scholars chiefly focused on identifying the structural characteristics of the observed resource system, the attributes and behaviors of its members, the rules it used, and the reported outcomes (Ostrom 1990). This grounded theory approach was complemented by the use of existing taxonomy and terminology from polycentricity research on public-goods governance (Ostrom 1972; Ostrom et al. 1961). The resulting framework became the theoretical foundation that was used over the next 30 years in CPR governance research (also known as collective-action research). The framework was constantly refined by new insights from the field, but its core remained intact.

On a much smaller scale, we emulated this process. Using core taxonomy and terminology from CPR governance research to guide our effort, we systematically reviewed 73 studies of crowdsourcing, social media, online communities, electronic word of mouth, peer-to-peer networks, and open source software (OSS) development published in *Information Systems Research* and *MIS Quarterly* between 2005 and 2014. We specifically focused on extracting and translating insights on rules and their use, stakeholders and their derived value, evidence on collective-action threats, evidence of Ostrom's eight governance principles, infrastructure and design features (*environmental conditions* in CPR research), and outcomes (direct effects and indirect externalities). We knew that we would not be able to reach the scope of Ostrom and her colleagues; we therefore explicitly focused our effort on the leading IS research journals to provide a solid foundation. To frame our discussion, we also branched to other sources for additional evidence and perspectives. Although our primary goal is theory development and not a literature review, we did use literature review methodologies to find relevant research on decentralized online information systems. We followed Jane Webster and Richard Watson's (2002) guidelines for performing effective literature reviews and examined reference sections to identify many other important papers published in *Information Systems Research* or *MIS Quarterly* prior to 2005, as well as in other IS (and related fields') journals. To avoid saturation, we cast our net wide (but not too wide), using standard search engines such as Ebscohost and Google Scholar to find additional relevant material. This inclusive strategy gave us additional evidence and insights to substantiate the many theoretical claims and propositions presented in this manuscript.

Table A1. Overview of the Reviewed IS Research				
Paper	**Focus**	**Findings**	**Adaptation**	**Coding**
Aggarwal and Singh 2013	Examines the impact of technology blog content on venture capitalist investor decision-making	Blogs impact decision-making in the initial screening stage, but less so in subsequent stages. Blog exposure gave better negotiation leverage to the entities featured.	Information commons reduce appropriators' search costs and impact their decision-making. In some contexts, information commons increase competition between appropriators for information, leading to increased transaction costs.	appropriation; appropriator value; exploration
August et al. 2013	Examines different strategies available to firms that sponsor OSS development	When contributors are efficient, sponsors should pursue an open software license and focus on capitalizing through support services sales. When contributors are inefficient, sponsors should pursue a proprietary license and sell each software unit separately to prevent contributors from spreading the software code to competitors.	Producers of information commons are often profit motivated and must determine the best strategy when seeking a balance between attracting effective providers and preventing free-ridership from competitors who benefit from sitting on the sidelines.	production; producer value; provision; free-riding
Bapna et al. 2008	Examines how much surplus consumers receive from eBay auctions	Consumers extract a median surplus of at least $4 per eBay auction. In 2003, eBay's auctions generated at least $7.05 billion in total consumer surplus.	Transaction information commons directly benefit appropriators.	appropriation; appropriator value
Bartelt and Dennis 2014	Examines how instant messaging and discussion boards are utilized and subsequently impact quality of outcomes	Genre rules can have powerful effects that significantly impact team behavior and performance.	Operational rules are as important as infrastructure for the sustain-ability of information commons. Language used and built into a commons' features influence its operational rules, and those rules become increasingly entrenched in the fabric of the commons over time.	operational rules; infrastructure; incremental adaptation
Bateman et al. 2011	Presents a model to unify conflicting explanations as to why people engage in discussion forums	Members may have psycho-logical bonds to a particular online community based on need, affect, and obligation. Each form of community commit-ment has a unique impact on each behavior, with need-based commitment predicting thread reading; affect-based commit-ment predicting reply posting and moderating behaviors; and obligation-based commitment predicting only moderating behavior.	The need for information drives appropriation. The need to make an impact drives provision. A sense of obligation to the commons drives certain providers to monitor their peers.	provision; provider value; appropriation; appropriator value; operational rules; shared accountability
Browne et al. 2007	Examines why people stop searching for information online	Mental list and single criterion rules are used more often when people search for relatively straightforward information (such as product information); people use magnitude threshold and representational stability rules when searching for complex information.	Appropriation of information depends on the appropriator's task. More complex and abstract tasks, such as diagnosis, adhere to the representational stability rule. Other rules for stopping information searches are: mental list, difference threshold, single criterion, and magnitude threshold.	appropriation; appropriation value

Butler et al. 2014	Presents a model of key latent constructs influenced by technology choices and the possible causal paths by which they dynamically effect communities	Community size and resilience directly affect the community's sustainability over time. The lower the participation costs and the more focused the issue, the better chances for sustainability.	Critical mass of provision and appropriation directly impact the sustainability of the information commons. The lower the opportunity cost of provision and appropriation and the more focused the subject, the more likely the commons is to be sustainable.	provision; appropriation; boundary regulation
Butler and Wang 2012	Examines the extent to which boundary reshaping in an online discussion community impacts member dynamics and responsiveness	An inherent tension exists between content boundary management and reshaping the community. Reshaping behaviors within a discussion forum affect member dynamics and community responsiveness in both positive and negative ways.	Information commons content boundaries impact information governance. Flexible boundaries afford more engaged provisioning, while greater engagement leads to changes in the commons that potentially drive other providers away.	boundary regulation; provision; operational rules; constitutional rules; provision; pollution; rebellion
Chan and Ghose 2014	Examines the connection between Craigslist and spread of HIV	Entry of Craigslist is related to a 15.9 percent increase in HIV cases. The analysis suggests that the site entry produces an average of 6,130–6,455 cases of HIV infection in the United States each year. Analyses reveal that nonmarket-related casual sex is the primary driver of the increase in HIV cases.	Example of a direct effect of a polycentric information commons that is also a social externality.	appropriation; appropriation value
Chau and Xu 2012	Proposes a framework for gathering business intelligence from blogs by automatically collecting and analyzing blog contents and bloggers' interaction networks	Networks of bloggers have different centers of influence. The networks are decentralized and do not exhibit pattern structures, such as star and hierarchical structures. These implicit communities have been formed spontaneously.	Polycentric information commons are decentralized and spontaneously arising.	provision; polycentricity
Chua et al. 2007	Examines how community members monitor fraud on auction sites	Communities monitor for fraudulent behavior. Engaged community members can often detect suspicious activity better then outside official authorities. Tactics are: direct intervention against those who commit fraud, notification of other community members, and involvement of outside authorities.	Opportunistic providers can pollute information to gain at the expense of other members in the information commons. Members of the information commons often combat pollution directly and by involving outside authorities.	pollution; violation; provision; shared accountability
Claussen et al. 2013	Examines how rule modification by Facebook that rewarded quality app developers with access to Facebook's users impacted application development	The rule change led to the development of new applications with significantly higher user satisfaction.	Producers have control over rules and infrastructure design that impact information provision and subsequent appropriation. Loosening control and increasing polycentricity, for example, can lead to improved provision and more satisfied appropriators.	production; provision; infrastructure; constitutional rules; incremental adaptation; boundary setting

Daniel et al. 2013	Examines the impact of diversity among developers on engagement and market success	Variation in participants' contribution-based reputation is positively associated with success. Diversity in the spoken language and country of participants has a negative impact on community engagement, but a positive effect on market success. Dispersion in project participant roles positively influences community engagement and market success. Diversity's impact on market success is conditional on the project stage; it is most important at the very beginning and toward the end.	Polycentric governance of information facilitates greater diversity that, in turn, enhances outcomes. Diversity is especially important in the birth stage and when reaching maturity. During the growing stage, diversity is less desirable.	provision; polycentricity
Dellarocas 2005	Presents a theoretical analysis of reputation mechanism design in trading environments with pure moral hazard	Reputation mechanisms on eBay mitigate moral hazard and adverse selection, thus increasing efficiency in markets. No one-size-fits-all set of guide-lines exists for reputation mechanism design. Depending on the context, reputation mech-anisms can act as a sanctioning tool or as a signaling mechanism.	An externality of reputation information commons is increased efficiency in markets. No one-size-fits-all set of guidelines exists for reputation mechanism design. Depending on the context, reputation mechanisms can act as a sanctioning tool or as a signaling mechanism.	pollution; producers; shared accountability
Dewan and Ramapras 2012	Examines the relation-ship between music blogs and music sales	Music sharing reduces the sales of songs.	P2P sharing causes an economic externality.	appropriation; appropriator value
Dewan and Ramapras 2014	Examines the impact of music blogs on music consumption	Niche music receives substan-tially more attention in blogs. This increased exposure leads to more consumption of niche music.	Polycentric information commons produce more diverse information; that, in turn, leads to a decrease in the influence of monocentric information sources.	appropriation; appropriator value; exploration
Duan et al. 2009	Examines whether individuals exhibit a herd behavior pattern when choosing software online	Individuals do exhibit herd behavior when choosing soft-ware; online reviews have particular impact on the demand for lesser known products.	The opportunity cost of information search impacts the intensity of appropriation. Online reviews improve the odds of marginal products and services at the expense of more established products and services; this displacement can be viewed as an externality.	appropriation
Feller et al. 2008	Examines how a network of firms manages OSS development	Infrastructure impacts social interactions. Shared goals and norms drive collaboration, along with the ability to impose collective sanctions on those who violate the shared norms.	Polycentric governance of informa-tion commons is a sociotechnical process in which social interactions that drive governance of information depend on the physical architecture of the commons. Shared norms and goals drive collaboration between providers.	production; provision; boundary setting; shared accountability
Fitzgerald 2006	Challenges the notion that open source is driven by volunteers and the notion of collective intelligence	The open source model moved toward greater "professionalism" with more planning and less spontaneous and paid contributors.	Open source moves from open access regime to common property regime.	regimes

Forman et al. 2008	Examines the relationship between identity disclosure and perceived usefulness of reviews	Community norms impact disclosure of personal identity. Disclosure of identity of review contributors increases the perceived helpfulness of the review. In addition, prevalence of identified reviewers increases sales.	Information commons' operational rules and norms impact providers' choice to disclose their identity. Appropriators tend to value information from non-anonymous providers. A culture of transparency adds value to the information commons.	operational rules; provision; appropriation; appropriator value
Ghose 2009	Examines how online reviews impact seller and product uncertainty, consequently impacting information asymmetry	Reputation signals do not mitigate seller or product uncertainty.	This contradicts other findings. Online reviews do not mitigate information asymmetry; information does not relate a positive externality.	externalities
Goes et al. 2014	Examines the change review writers undergo as users subscribe to them	As review writers become more popular, they produce more reviews and more objective reviews; however, their numeric ratings also systematically change and become more negative and more varied.	Information providers are motivated by demand from appropriators. As time passes, they learn to provide more objective information.	provision; provider value; appropriation
Goh et al. 2013	Compares the impact of both user-generated content and marketed content on purchasing behavior	User-generated content is significantly more influential in driving purchasing behavior.	Polycentric information can have a direct economic impact on its subject source.	direct effect; appropriation; appropriator value
Gu et al. 2007	Examines how users value virtual communities and how virtual communities differ in their value propositions	Quality of information is more important than quantity for the growth of virtual investment communities.	Information quality is more important than quantity because of the cognitive cost associated with processing information. High-quality information is more likely to lead to externalities.	appropriation; appropriator value
Gu et al. 2012	Examines the difference in impact of reviews on sales of a "high-involvement" product (cameras) between reviews found on the retailer site and external review sources	External sources play a greater role in impacting sales of high-involvement products compared to reviews posted on the retailer site.	Appropriators triangulate information from different information commons prior to making major purchasing decisions.	appropriation
Hahn and Wallsten 2008	Examines how OSS development teams are formed and how individuals make decisions about which teams to join	Past ties between initiator and collaborator impact present participation.	Past relationships between core providers and peripheral providers play a role in the formation of provision network on a polycentric information commons.	provision
Han et al. 2012	Examines the business and strategic value of an open, collaborative organizational form in which participating firms co-create economic value by jointly developing and co-marketing of IT innovations	Participating firm's market valuation increased; not participating benefited rivals due to knowledge spillover. Heterogeneity is not associated with value creation. Development of radical innovation adds more value to the firm. Limited access and decision authority is better than unlimited access and decision authority.	Polycentric governance of information creates synergy, especially when rules and boundaries are well defined. Stakeholders' level of heterogeneity is irrelevant to quality. Information created spills over— and other firms benefit as well.	production; boundary setting

Hann et al. 2013	Examines whether open source programmers get higher wages due to their experience in open source	Credentials obtained from programming OSS are associated with up to an 18% increase in wages.	Volunteer information providers can potentially benefit financially.	provision; provider value
Hardaway and Scamell 2012	Proposes changes in the academic research publication process to incorporate greater transparency, inclusivity and openness in reviews as well as publication decisions.	An inclusive review process that is open to participants (but not too open) will improve the quality of published research and the fairness of the publication process.	Polycentric information commons of academic information will increase the suitability and quality of academic research over time.	production; producer value; provision; provider value
Hildebrand et al. 2013	Examines how feedback from other users impacts the satisfaction and creativity of individuals designing their own products	Early feedback from community members reduces the boldness of the design and reduces creativity.	Providers check and balance each other to a point of reducing creativity and individual expression.	provision
Howison and Crowston 2014	Presents a theory about building artifacts out of information and the organizational affordances of those artifacts	OSS development is more about work redesign than about how to run an effective virtual team, and more about task work in context than generic team work processes. Layerability, open distribution, irrevocable contribution, and time are conditions that contribute to open source success.	Polycentric information commons is individual rather than team driven. Polycentric information commons are characterized by compartmentalization and incremental improvements that can take time. Information providers respect the autonomy of other providers.	provision; production; incremental adaptation
Jabr et al. 2013	Examines the factors driving contribution in online technical support forums	Peer feedback mechanisms are associated with better quality and technical support compared to quantity feedback (just a count of contribution). The results indicate that problem solvers are partially motivated by the need to be recognized by their peers.	Information providers value the feedback from other providers and are partially motivated by it. Existence of peer feedback mechanisms thus increase the likelihood of long-term sustainability of the information commons.	provision; provider value; provider recognition; infrastructure
Jarvenpaa and Majchrzak 2010	Commentary on how trust asymmetry, deception, and novelty impact collaboration online	Participants manage vigilant interactions in different ways.	Conflict between providers impacts relationships in information commons.	provision; violation; shared accountability
Johar et al. 2011	Examines how P2P congestion impacts propensity to share	Sharing increases as the network grows, reducing congestion. The community can reduce the impact of free-riding by increasing individual sharing.	Information is a resource that can be subjected to congestion and free-riding.	free-riding; congestion; provision
Johnson et al. 2014	Examines the emergence of power law distributions via the mechanisms of preferential attachment, least efforts, direct reciprocity, and indirect reciprocity	No single unitary motivation drives participation in online communities but many different—sometimes competing, sometimes complimentary—motivations exist. New participants can become popular at any time, replacing previously popular participants as social centers.	Polycentric governance of information is dynamic, and new autonomous centers of authority emerge and disappear constantly without a pattern. Multiple individual motivations drive information provision.	provision; provider value; polycentricity

Kane et al. 2014	Outlines a set of theoretically distinct questions raised by the introduction of social media in and by organizations to formulate a research agenda	Social media introduces questions of platform design into social network analysis. Social media gives users capabilities that they do not possess in traditional offline social networks; these capabilities include visualizing network structure and searching for content in a network without using relational ties.	The architectural features of the polycentric information commons directly impact stakeholders and indirectly impact the prospects of long-term sustainability. Polycentric information commons characterized by transparency and open access to information.	production; appropriation;
Kumar and Benbasat 2006	Examines how an infrastructure that facilitates consumer reviews and recommendations impacts the perceived usefulness and social presence of the website incorporating them	Infrastructure that facilitates consumer reviews and recommendations impacts positively the perceived usefulness and social presence of the website incorporating them.	Producers of platforms that facilitate provision of eWOM benefit because appropriators of eWOM information see the websites as more useful and pleasing.	appropriation; appropriator value
Levina and Arriaga 2014	Presents an analytical lens for studying social status production processes across different user-generated content platforms	Content production is a social process that occurs in different specific contexts in which different status signals play a role.	Provision of information is a context-dependent social process.	provision; provider value; provider recognition
Li and Hitt 2010	Tests whether online reviews more closely reflect a product's quality or its price value	Online review are biased towards the product value—that is, ratings reflect price more than they reflect value.	An example of unintentional information pollution.	provision; appropriation; pollution
Ludwig et al. 2014	Examines to what extent communication-style alignment impacts participation quantity and quality	Stronger trend of alignment leads to greater participation quantity and quality. At a community level, greater synchronicity in the linguistic style across all community members fosters individual members' participation behavior.	Operational rules (norms) of communication impact provision.	operational rules; provision
Lukyanenko et al. 2014	Examines the impact of modeling decisions on information quality in amateur content-creation settings	Participants provide more accurate information when classifying phenomena at a more general level. In addition, we found greater overall accuracy when participants could provide free-form data compared to a condition in which they selected from constrained choices.	Polycentric information provision benefits from freedom of action.	provision; autonomy
Ma and Agarwal 2007	Examines a feature that supports reputation and identity management, as well as archives of past interactions, to assess the impact on online community members' satisfaction and willingness to contribute	IT artifacts that allow reputation management improve perceived identity verification, cause greater satisfaction, and increase contributions by members.	Appropriators and peer providers prefer to interact with those who have an online persona (not complete transparency or complete anonymity) and also need to have an online persona to feel validated by others. Interaction with those who have an online persona leads to greater satisfaction with the commons and increases the likelihood of provision.	provision; provider value; appropriation; operational rules; peer recognition

Ma et al. 2014	Examines the impact of pre-release movie piracy on movie sales	Sales decrease approximately 20 percent due to piracy.	Example of an economic externality that impacts the film industry.	appropriation; appropriator value; externalities
Meservy et al. 2014	Examines how individuals filter knowledge encountered in online forums	Peripheral cues (source expertise and validation) have a greater influence on knowledge filtering decisions than does the content quality of the solution.	Appropriators rely on heuristics when evaluating information. Provider's status and perceived expertise are used as a proxy for quality of information.	appropriation
Moon and Sproull 2008	Examines the role of feedback on participation in online communities	In forums that incorporate a systematic quality feedback system, answer providers contribute more often and technical problem resolution is more effective. Volunteers who produce higher-quality contributions have longer participation duration, and participation duration is positively associated with community maintenance contributions.	Feedback from appropriators and peer providers motivates provision and increases its overall quality.	provision; provider value; provider recognition
Nan and Lu 2014	Examines patterns of crisis management arising unintentionally from decentralized and spontaneous actions in an online community during an earthquake	Fluctuation of message content themes in this online community served to energize continuous input from ordinary organization members. Self-organization is a viable source of organizational order that complements the traditional centralized plan-and-control approach.	Polycentric information governance is characterized by diverse provision patterns that attract further diverse provision, resulting in synergy.	polycentricity; provision
Oh et al. 2013	Examines the factors causing rumors on twitter	Source ambiguity is the most important factor in creating rumors, followed by personal involvement; anxiety is the least yet marginally important rumor-causing factor.	Information source ambiguity impacts information provision.	provision; pollution
Park et al. 2013	Examines the impact of information on expectation and trading behavior in the context of a stock investment discussion forum	Investors tend to cluster with similar investors and generally do not benefit from the diversity offered by the community.	Appropriators do not always benefit from the diversity of information found in the information commons, as different biases lead them to primarily seek information that suits their preconceived knowledge.	appropriation
Pavlou and Dimoka 2006	Examines the impact of written reviews on trust in sellers and the price premiums they receive from their online reputation	Written reviews explain 50 percent of the variance in price premiums, suggesting that reviews act a information asymmetry-mitigating mechanism.	Polycentric governance of reputation information mitigates information asymmetry in markets, subsequently increasing market efficiency.	appropriation; shared accountability
Ransbotham and Kane 2011	Examines longitudinally how retention and turnover of contributors impacts the status of Wikipedia articles	Membership retention relates in a curvilinear fashion to effective collaboration: it's important in initial stages, but becomes less important and turnovers become more important; moderate levels of membership turnover are desirable.	Polycentric information provision is dynamic as providers replace previous core providers in a continuous manner.	provision; polycentricity

Ray et al. 2014	Develops the concept of engagement in online communities as key variable for driving knowledge contribution and diffusion across the community through word of mouth. Engagement and satisfaction are parallel mediating forces at work in online communities	Engagement is a key factor driving knowledge contribution, but not necessarily satisfaction. Engagement and satisfaction together drive positive word of mouth and subsequent growth.	Providers and appropriators must feel a sense of engagement to gain a sense of collective purpose that leads to information provision and appropriation. Engagement motivates providers of information and, together with satisfaction, is associated with being a member of the information commons and drives positive word of mouth, contributing to its growth.	provision; provider value; appropriation
Ren et al. 2012	Examines how identity and communication features impact the attachment of online community members over time	Group identity features that allow members to see profiles and facilitate repeated exposure to the group activities impact traffic twice as much as interpersonal bond features.	Providers and appropriators are more motivated by group identity than personal ties.	provision; provider value; appropriation; provider recognition
Rice 2012	Examines how reputation is evolving and how it affects transactions	Reputation mechanisms are significant for purchase decisions regarding specific sellers, while specific reputation information is associated with the overall decision of whether to transact in the marketplace. When reputations are increasingly noisy, buyers are less likely to react negatively to poor ratings and are more likely to give sellers the benefit of the doubt.	Polycentric governance of reputation information mitigates information asymmetry in markets, subsequently increasing markets efficiency. Pollution of reputation information confuses appropriators and decreases efficiency.	appropriation; pollution; shared accountability
Setia et al. 2012	Examines the role of peripheral developers in the creation of OSS	Peripheral developers are instrumental, especially when the project reaches maturity.	While core information providers are important at the beginning, as time passes, peripheral providers become increasingly important.	provision
Shi et al. 2014	Examines patterns of information diffusion on Twitter	Unidirectional (weak) rather than bidirectional social ties exhibit the fastest pattern of information diffusion as users pass content to other users.	Information diffusion is the fastest through encounter dynamics of provision and appropriation in information commons.	provision; appropriation; relationship dynamics
Singh et al. 2014	Examines how text characteristics attract readers of blogs	Sentimental textual characteristics (negative, positive, or controversial tone) attract and retain readers, while quality textual characteristics (grammar, readability, and comprehensiveness) have no impact on attracting readers, but do impact retention.	Appropriators care more about the content of the information than about how well it presented; however, presentation plays a role in retaining appropriators.	appropriation; appropriator value
Singh et al. 2011	Examines to which extent individuals involved in OSS development learn from their own experience and from interacting with peers	Learning from peers is most important for developers. Developers benefit from discussions they initiate in the middle of the project; at the beginning and end of the project, developers benefit more from participating in discussions initiated by others.	Providers learn both from other providers (especially in the middle of the project) as well as from their own experiences.	provision; operational rules

Smith and Telang 2009	Looks at the effect of piracy on sales of movies	Giving away content in one channel can stimulate sales in a paid channel if the free content is sufficiently differentiated from its paid counterpart.	Piracy (information commons) can have a positive effect of sales if the content is sufficiently differentiated.	externalities; direct effect
Stewart and Gosain 2006	Examines the role of ideology in OSS	Generally, team members' adherence to the tenets of the OSS community ideology impact trust and communication in teams, which positively relates to effectiveness.	Provision outcomes in relationship dynamics are impacted by ideological alignment between providers.	provision; provider value; shared goal
Stewart et al. 2006	Develops and tests a model of the impacts of license restrictiveness and organizational sponsorship on two indicators of success: user interest in, and development activity on, OSS development projects	Users are mainly attracted to OSS projects initiated by noncommercial interests that do not employ restrictive licenses. Identity of the sponsor of the projects impacts developer participation.	Ideological synchronization between producers and providers is a condition for an information commons' ability to attract providers and achieve sustainability. Providers prefer constitutional rules that are flexible.	provision; provider value; production; producer value; constitutional rules; rebellion
Tsai and Bagozzi 2014	Examines the factors driving contribution in virtual communities	Social identity and group norms drive decisions to contribute.	Information providers in the commons assume a certain collective identity relating to the information's subject matter.	provision; provider value; shared goal; provider recognition
Turel et al. 2011	Examines how user cognition and ultimately usage intentions toward an information technology are distorted by addiction to the technology	The level of online auction addiction distorts the way the IT artifact is perceived.	Over appropriation can lead to addiction.	appropriation
von Krogh et al. 2012	Reviews the literature on the motivations of OSS developers	Current research on the motivation of software developers does not go deep enough.	Provision of information is motivated by multiples variables.	provision; provider value
Wasko and Faraj 2005	Examines why people contribute to discussion forums	People contribute their knowledge when they perceive that it enhances their professional reputations, when they have the experience to share, and when they are structurally embedded in the network. Surprisingly, contributions occur without regard to expectations of reciprocity from others or high levels of commitment to the network.	Provision of information is driven by mostly personal reasons and not by social motivations. Polycentric information commons tolerate free-riding.	provision; provider value free-riding

Wen et al. 2013	Examines the effect of copyright infringement lawsuits both on the open source development projects being sued and on related projects that employ the disputed technology	Projects that exhibit high technology overlap with the disputed OSS experienced a 15% greater decline in user interest and 45% less developer activity than projects in the control group; OSS projects that are intended for business and specific to the disputed OSS platform had a 34% greater decline in user interest and 86% less developer activity than the control group.	Challenge from the outside by powerful interests threatens the sustainability of a polycentric information commons. The impact is stronger on providers than on appropriators.	provision; appropriation
Xu and Zhang 2013	Examines the impact of firm information on Wikipedia on insider trading	Information on Wikipedia causes firm bosses to disclose negative news about the firm's financial performance faster, reducing the potential gain from insider trading.	An example of market externality of an information commons.	appropriation; externalities
Yan and Tan 2014	Examines whether social support exchanged in an online healthcare community benefits patients' mental health	Patients benefit from learning from others, and their participation in the online community helps them improve their health and better engage in their disease self-management process. Evidence exists that informational support is the most prevalent type in the online healthcare community, but emotional support plays the most significant role in helping patients move to a healthier state.	An example of a direct effect of a polycentric information commons; appropriation can be psychologically beneficial.	appropriation; appropriator value
Ye et al. 2014	Examines how sellers respond to changes in the design of eBay's reputation systems	Coercing buyers to revoke their negative feedback through retaliation enables low-quality sellers to manipulate their reputations and masquerade as high-quality sellers. Low-quality sellers exerted additional efforts to improve their reputation scores after the system changed.	Opportunistic information providers pollute the information in the commons to advance their interests. Change in constitutional rules by producers changed the balance of power between providers and appropriators, and subsequently reduced pollution.	provision; appropriation; pollution; violation boundary regulation; incremental adaptation, shared accountability
Zhang et al. 2013	Examines the factors that influence online innovation and community members' continued participation	Both users and software modifiers are influenced by community response, but users seem to be influenced by it more. Participation is primarily moti-vated by software needs, the enjoyment of programming, the desire to improve the software, the opportunity to learn about others' improvements to the software, and the gratification of helping others and giving back to the community.	Engagement of appropriators leads to continuous appropriation. Providers are partially motivated by feedback from appropriators, but mostly by personal reasons.	provision; provider value; provider recognition; appropriation

References

Aggarwal, R., and Singh, H. 2013. "Differential Influence of Blogs Across Different Stages of Decision Making: The Case of Venture Capitalists," *MIS Quarterly* (37:4), pp. 1093-1112.

August, T., Shin, H., and Tunca, T. I. 2013. "Licensing and Competition for Services in Open Source Software," *Information Systems Research* (24:4), pp. 1068-1086.

Bapna, R., Jank, W., and Shmueli, G. 2008. "Consumer Surplus in Online Auctions," *Information Systems Research* (19:4), pp. 400-416.

Bartelt, V. L., and Dennis, A. R. 2014. "Nature and Nurture: The Impact of Automaticity," *MIS Quarterly* (38:2), pp. 521-538.

Bateman, P. J., Gray, P. H., and Butler, B. S. 2011. "Research Note–The Impact of Community Commitment on Participation in Online Communities," *Information Systems Research* (22:4), pp. 841-854.

Browne, G. J., Pitts, M. G., and Wetherbe, J. C. 2007. "Cognitive Stopping Rules for Terminating Information Search in Online Tasks," *MIS Quarterly* (31:1), pp. 89-104.

Butler, B. S., Bateman, P. J., Gray, P. H., and Diamant, E. I. 2014. "An Attraction–Selection–Attrition Theory of Online Community Size and Resilience," *MIS Quarterly* (38:3), pp. 699-728.

Butler, B. S., and Wang, X. 2012. "The Cross-Purposes of Cross-Posting: Boundary Reshaping Behavior in Online Discussion Communities," *Information Systems Research* (23:3, Part 2), pp. 993-1010.

Chan, J. and Ghose, A., 2014. "Internet's Dirty Secret: Assessing the Impact of Online Intermediaries on HIV Transmission," *MIS Quarterly* (38:4), pp. 955-976.

Chau, M., and Xu, J. 2012. "Business Intelligence in Blogs: Understanding Consumer Interactions and Communities," *MIS Quarterly* (36:4), pp. 1189-1216.

Chua, C. E. H., Wareham, J., and Robey, D. 2007. "The Role of Online Trading Communities in Managing Internet Auction Fraud," *MIS Quarterly* (31:4), pp. 759-781.

Claussen, J., Kretschmer, T., and Mayrhofer, P. 2013. "The Effects of Rewarding User Engagement: The Case of Facebook Apps," *Information Systems Research* (24:1), pp. 186-200.

Daniel, S., Agarwal, R., and Stewart, K. J. 2013. "The Effects of Diversity in Global, Distributed Collectives: A Study of Open Source Project Success," *Information Systems Research* (24:2), pp. 312-333.

Dellarocas, C. 2005. "Reputation Mechanism Design in Online Trading Environments with Pure Moral Hazard," *Information Systems Research* (16:2), pp. 209-230.

Dewan, S., and Ramaprasad, J. 2012. "Music Blogging, Online Sampling, and the Long Tail," *Information Systems Research* (23:3), pp. 1056-1067

Dewan, S., and Ramaprasad, J. 2014. "Social Media, Traditional Media, and Music Sales," *MISQuarterly* (38:1), pp. 101-121.

Duan, W., Gu, B., and Whinston, A. B. 2009. "Informational Cascades and Software Adoption on the Internet: An Empirical Investigation," *MIS Quarterly* (33:1), pp. 23-48.

Feller, J., Finnegan, P., Fitzgerald, B., and Hayes, J. 2008. "From Peer Production to Productization: A Study of Socially Enabled Nusiness Exchanges in Open Source Service Networks," *Information Systems Research* (19:4), pp. 475-493.

Fitzgerald, B. 2006. "The Transformation of Open Source Software," *MIS Quarterly* (30:3), pp. 587-598.

Forman, C., Ghose, A., and Wiesenfeld, B. 2008. "Examining the Relationship Between Reviews and Sales: The Role of Reviewer Identity Disclosure in Electronic Markets," *Information Systems Research* (19:3), pp. 291-313.

Ghose, A. 2009. "Internet Exchanges for Used Goods: An Empirical Analysis of Trade Patterns and Adverse Selection," *MIS Quarterly* (33:2), pp. 263-292.

Goes, P. B., Lin, M., and Yeung, C. M. A. 2014. "'Popularity Effect' in User-Generated Content: Evidence from Online Product Reviews," *Information Systems Research* (25:2), pp. 222-238.

Goh, K. Y., Heng, C. S., and Lin, Z. 2013. "Social Media Brand Community and Consumer Behavior: Quantifying the Relative Impact of User-and Marketer-Generated Content," *Information Systems Research* (24:1), pp. 88-107.

Gu, B., Konana, P., Rajagopalan, B., and Chen, H.-W. M. 2007. "Competition among Virtual Communities and User Valuation: The Case of Investing-Related Communities," *Information Systems Research* (18:1), pp. 68-85.

Gu, B., Park, J., and Konana, P. 2012. "The Impact of External Word-of-Mouth Sources on Retailer Sales of High-Involvement Products," *Information Systems Research* (23:1), pp. 182-196.

Hahn, R. W., and Wallsten, S. 2006. "The Economics of Net Neutrality," *The Economists' Voice* (3:6).

Han, K., Oh, W., Im, K. S., Chang, R. M., Oh, H., and Pinsonneault, A. 2012. "Value Cocreation and Wealth Spillover in Open Innovation Alliances," *MIS Quarterly* (36:1), pp. 291-316.

Hann, I.-H., Roberts, J. A., and Slaughter, S. A. 2013. "All Are Not Equal: An Examination of the Economic Returns to Different Forms of Participation in Open Source Software Communities," *Information Systems Research* (24:3), pp. 520-538.

Hardaway, D. E., and Scamell, R. W. 2012. "Open Knowledge Creation: Bringing Transparency and Inclusiveness to the Peer Review Process," *MIS Quarterly* (36:2), pp. 339-346.

Hildebrand, C., Häubl, G., Herrmann, A., and Landwehr, J. R. 2013. "When Social Media Can Be Bad for You: Community Feedback Stifles Consumer Creativity and Reduces Satisfaction with Self-Designed Products," *Information Systems Research* (24:1), pp. 14-29.

Howison, J., and Crowston, K. 2014. "Collaboration Through Open Superposition: A Theory of the Open Source Way," *MIS Quarterly* (38:1), pp. 29-50.

Jabr, W., Mookerjee, R., Tan, Y., and Mookerjee, V. 2013. "Leveraging Philanthropic Behavior for Customer Support: The Case of User Support Forums," *MIS Quarterly* (38:1), pp. 187-208.

Jarvenpaa, S. L., and Majchrzak, A. 2010. "Research Commentary-Vigilant Interaction in Knowledge Collaboration: Challenges of Online User Participation Under Ambivalence," *Information Systems Research* (21:4), pp. 773-784.

Johar, M., Menon, S., and Mookerjee, V. 2011. "Analyzing Sharing in Peer-to-Peer Networks Under Various Congestion Measures," *Information Systems Research* (22:2), pp. 325-345.

Johnson, S. L., Faraj, S., and Kudaravalli, S. 2014. "Emergence of Power Laws in Online Communities: The Role of Social Mechanisms and Preferential Attachment," *MIS Quarterly* (38:3), pp. 795-808.

Kane, G. C., Alavi, M., Labianca, G., and Borgatti, S. P. 2014. "What's Different About Social Media Networks? A framework and Research Agenda," *MIS Quarterly* (38:1), pp. 275-304.

Kumar, N., and Benbasat, I. 2006. "Research Note: The Influence of Recommendations and Consumer Reviews on Evaluations of Websites," *Information Systems Research* (17:4), pp. 425-439.

Levina, N., and Arriaga, M. 2014. "Distinction and Status Production on User-Generated Content Platforms: Using Bourdieu's Theory of Cultural Production to Understand Social Dynamics in Online Fields," *Information Systems Research* (25:3), pp. 468-488.

Li, X., and Hitt, L. M. 2010. "Price Effects in Online Product Reviews: An Analytical Model and Empirical Analysis," *MIS Quarterly* (34:4), pp. 809-831.

Ludwig, S., de Ruyter, K., Mahr, D., Wetzels, M., Brüggen, E. C., and Ruyck, T. D. 2014. "Take Their Word for it: The Symbolic Role of Linguistic Style Matches in User Communities," *MIS Quarterly* (38:4), pp. 1201-1217.

Lukyanenko, R., Parsons, J., and Wiersma, Y. F. 2014. "The IQ of the Crowd: Understanding and Improving Information Quality in Structured User-Generated Content," *Information Systems Research* (25:4), pp. 669-689.

Ma, M., and Agarwal, R. 2007. "Through a Glass Darkly: Information Technology Design, Identity Verification, and Knowledge Contribution in Online Communities," *Information Systems Research* (18:1), pp. 42-67.

Ma, L., Montgomery, A. L., Singh, P. V., and Smith, M. D. 2014. "An Empirical Analysis of the Impact of Pre-Release Movie Piracy on Box Office Revenue," *Information Systems Research* (25:3), pp. 590-603.

Meservy, T. O., Jensen, M. L., and Fadel, K. J. 2013. "Evaluation of Competing Candidate Solutions in Electronic Networks of Practice," *Information Systems Research* (25:1), pp. 15-34.

Moon, J. Y., and Sproull, L. S. 2008. "The Role of Feedback in Managing the Internet-Based Volunteer Work Force," *Information Systems Research* (19:4), pp. 494-515.

Nan, N., and Lu, Y. 2014. "Harnessing the Power of Self-Organization in an Online Community During Organizational Crisis," *MIS Quarterly* (38:4), pp. 1135-1157.

Oh, O., Agrawal, M., and Rao, H. R. 2013. "Community Intelligence and Social Media Services: A Rumor Theoretic Analysis of Tweets During Social Crises," *MIS Quarterly* (37:2), pp. 407-426.

Ostrom, E. 1990. *Governing the Commons*, Cambridge, UK: Cambridge University Press.

Ostrom, V. 1972. "Polycentricity," paper presented at the 1972 Annual Meeting of the American Political Science Association, Washington, DC.

Ostrom, V., Tiebout, C. M., and Warren, R. 1961. "The Organization of Government in Metropolitan Areas: A Theoretical Inquiry," *American Political Science Review* (55:04), pp. 831-842.

Park, J., Konana, P., Gu, B., Kumar, A., and Raghunathan, R. 2013. "Information Valuation and Confirmation Bias in Virtual Communities: Evidence From Stock Message Boards," *Information Systems Research* (24:4), pp. 1050-1067.

Pavlou, P. A., and Dimoka, A. 2006. "The Nature and Role of Feedback Text Comments in Online Marketplaces: Implications for Trust Building, Price Premiums, and Seller Differentiation," *Information Systems Research* (17:4), pp. 392-414.

Ransbotham, S., and Kane, G. C. 2011. "Membership Turnover and Collaboration Success in Online Communities: Explaining Rises and Falls from Grace in Wikipedia," *MIS Quarterly* (35:3), pp. 613-627.

Ray, S., Kim, S. S., and Morris, J. G. 2014. "The Central Role of Engagement in Online Communities," *Information Systems Research* (25:3), pp. 528-546.

Ren, Y., Harper, F. M., Drenner, S., Terveen, L. G., Kiesler, S. B., Riedl, J., and Kraut, R. E. 2012. "Building Member Attachment in Online Communities: Applying Theories of Group Identity and Interpersonal Bonds," *MIS Quarterly* (36:3), pp. 841-864.

Rice, S. C. 2012. "Reputation and Uncertainty in Online Markets: An Experimental Study," *Information Systems Research* (23:2), pp. 436-452.

Setia, P., Rajagopalan, B., Sambamurthy, V., and Calantone, R. 2012. "How Peripheral Developers Contribute to Open-Source Software Development," *Information Systems Research* (23:1), pp. 144-163.

Shi, Z., Rui, H., and Whinston, A. B. 2014. "Content Sharing in a Social Broadcasting Environment: Evidence From Twitter," *MIS Quarterly*, (38:1) pp. 123-142.

Singh, P. V., Sahoo, N., and Mukhopadhyay, T. 2014. "How to Attract and Retain Readers in Enterprise Blogging?" *Information Systems Research* (25:1), pp. 35-52.

Singh, P. V., Tan, Y., and Youn, N. 2011. "A Hidden Markov Model of Developer Learning Dynamics in Open Source Software Projects," *Information Systems Research* (22:4), pp. 790-807.

Smith, M. D., and Telang, R. 2009. "Competing with Free: The Impact of Movie Broadcasts on DVD Sales and Internet Piracy," *MIS Quarterly* (33:2), pp. 321-338.

Stewart, K. J., and Gosain, S. 2006. "The Impact of Ideology on Effectiveness in Open Source Software Development Teams," *MIS Quarterly*, pp. 291-314.

Stewart, K. J., Ammeter, A. P., and Maruping, L. M. 2006. "Impacts of License Choice and Organizational Sponsorship on User Interest and Development Activity in Open Source Software Projects," *Information Systems Research* (17:2), pp. 126-144.

Tsai, H.-T., and Bagozzi, R. P. 2014. "Contribution Behavior in Virtual Communities: Cognitive, Emotional, and Social Influences," *MIS Quarterly* (38:1), pp. 143-163.

Turel, O., Serenko, A., and Giles, P. 2011. "Integrating Technology Addiction and Use: An Empirical Investigation of Online Auction Users. *MIS Quarterly* (35:4), pp. 1043-1062.

Tuttle, B. 2016. "Angie's List Just Announced a Huge Change," Fourtune.com, March 3 (http://fortune.com/2016/03/03/angies-list-subscription/).

Von Krogh, G., Haefliger, S., Spaeth, S., and Wallin, M. W. 2012. "Carrots and Rainbows: Motivation and Social Practice in Open Source Software Development," *MIS Quarterly* (36:2), pp. 649-676.

Wasko, M. M., and Faraj, S. 2005. "Why Should I Share? Examining Social Capital and Knowledge Contribution in Electronic Networks of Practice," *MIS Quarterly* (29:1), pp. 35-57.

Webster, J., and Watson, R. T. 2002. "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly* (26:2), pp. xiii-xxiii.

Wen, W., Forman, C., and Graham, S. J. 2013. "Research Note-The Impact of Intellectual Property Rights Enforcement on Open Source Software Project Success," *Information Systems Research* (24:4), pp. 1131-1146.

Xu, S. X., and Zhang, X. M. 2013. "Impact of Wikipedia on Market Information Environment: Evidence on Management Disclosure and Investor Reaction," *MIS Quarterly* (37:4), pp. 1043-1068.

Yan, L., and Tan, Y. 2014. "Feeling Blue? Go Online: An Empirical Study of Social Support Among Patients," *Information Systems Research* (25:4), pp. 690-709.

Ye, S., Gao, G. G., and Viswanathan, S. 2014. "Strategic Behavior in Online Reputation Systems: Evidence from Revoking on eBay," *MIS Quarterly* (38:4), pp. 1033-1056

Zhang, C., Hahn, J., and De, P. 2013. "Research Note–Continued Participation in Online Innovation Communities: Does Community Response Matter Equally for Everyone?," *Information Systems Research* (24:4), pp. 1112-1130.