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REVIEW ARTICLE

Crowdsourcing and open source software participation

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Abstract Crowdsourcing is a phenomenon involving the use of volunteers to accomplish a goal or objective (often work). Individuals, businesses, and government agencies find it possible to harness the participation of volunteers to design products and complete project work. Simply stated, Open Source Software (OSS) is crowdsourcing applied to software development. OSS-based systems have become an important source of computing products, through operating systems such as Linux, Web services through Apache, or desktop environments such as Gnome. This study affords a through literature review developed within a discussion of the common motivations and relationships between crowdsourcing and OSS. It contributes to the literature by providing useful insights which researchers and organizations can utilize to leverage crowdsourcing and OSS concepts in addressing their efforts.

Keywords Crowdsourcing · Open source software · Web participation

1 Introduction

Virtually every great endeavor in history involves the cooperative efforts of many people. Today, great buildings are constructed through the paid work of organizations with many employees. Historically, not all such labor was paid; some of this was voluntary, others coerced. The pyramids of Egypt (as well as those

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of other civilizations) are evidence of massive projects, involving unpaid workers (not all voluntary). It has been reported that the Great Wall of China's labor force was coerced for the most part. The magnificent cathedrals of medieval Europe were constructed in part with voluntary labor motivated by religious factors (possibly some pyramids were as well). What is clear is that a variety of motives have been present for such massive undertakings, some involving volunteer labor.

Today, we see resurgence in voluntary work in many fields with the Internet enabling much of this work. Service activities such as answering questions have been supported by Internet sites manned by volunteers, for example Wikipedia and Amazon.com. Some of these voluntary efforts have been focused in the software development field. Many other activities provide opportunities for people to participate in getting things done through collaboration over the Internet. This paper investigates crowdsourcing and open software development[1] providing a literature review within a discussion of participants' motivations for taking part in these ventures. It seeks to contribute to the literature by providing useful insights which researchers and organizations can utilize to leverage crowdsourcing and Open Source Software (OSS) concepts in addressing their efforts and offers a means to increase participation.

2 Crowdsourcing

"Crowdsourcing is the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call" (Howe 2006). The idea of using customers to do work for a business has been around for a long time (Kleemann et al. 2008). Vending machines appeared in the United States late in the 19th century. Self-service grocery stores took over in the 1950s, with the same principle expanding into fast food chains in the 1970s. IKEA, a Swedish furniture vendor, also utilized this concept to facilitate its impressive growth. Researchers refer to the "IKEA effect [as] the increase in valuation of self-made products" (Norton et al. 2012).

One of the benefits of drawing upon crowds of people for solutions is that crowds offer the potential for creativity. Florida (2003) cited the role of creativity as a fundamental source of economic growth, true from historic times through the agricultural revolution, the industrial revolution, and now the information revolution. This creativity is exhibited through increased spending on research, high-tech startups, a venture capital system that feeds these startups, and what Florida calls a new social milieu, all converging in an age of pervasive creativity permeating all sectors of society.

Cook (2008) viewed increased participation as a contribution revolution, seeing volunteers performing more and more of the work of businesses. Examples included Hyatt's online concierge service, where users provide local travel tips that other users rate and Unilever's user forum where mothers share experiences and vote on

[1] The term OSS as used in this paper refers to voluntary OSS development.

plot lines for online comedy series, thereby increasing brand awareness and loyalty for Unilever's products. Amazon.com has heavily relied upon user contributions, in terms of ratings of products purchased as well as many other functions. Frito Lays rewards fans that submit popular video commercials via their Crash to the Super Bowl contest. And, television today seems to be dominated by shows based on user participation, including reality and participation shows such as American Idol and Dancing with the Stars.

3 Web participation using crowdsourcing

One of the earliest examples of Web user participation is Wikipedia. It was developed by people performing tasks that computers cannot easily do, while linking that with computer technology to provide a highly successful and effective encyclopedia that has overtaken and overshadowed cultural icons such as Britannica (Tapscott and Williams 2006). Wikipedia has a full-time staff of five, while tens of thousands of volunteers contribute to the content. Wikipedia sprang from Nupedia, an effort to entice unpaid contributors to provide articles without a lengthy review process. Participants would edit each other's contributions online. At some point, wiki software was introduced as a means to make contribution and editing easier (wiki is Hawaiian for quick). By January 2001, Wikipedia was running in parallel with Nupedia, but quickly grew to stand on its own, while Nupedia essentially stagnated (Zittrain 2008). Rules for Wikipedia are few, in the spirit of open contribution. Anyone can author or edit content at any time, which is risky, but mitigated by the wiki software's ability to track each change and recover prior versions if needed. A discussion page tracks every main page of the encyclopedia where contributors can explain their changes and those who disagree can express alternative points of view.

Wikipedia is a free service, altruistically providing content in conjunction with minimal revenue generation. There are many other examples of the use of the Internet for gain in a variety of forms. Howe (2008) identifies four fundamental developments as leading to the phenomenon of crowdsourcing within the Internet environment:

1. A renaissance in amateurism
2. The emergence of OSS as a movement
3. Greater availability of tools to produce content
4. The rise of vibrant online communities

The vibrant online communities referred to by Howe are often termed as Web 2.0, a buzzword referring to the use of the Internet for collaborative efforts with some common purpose. The impetus of the Web 2.0 movement came from the open source movement, with Web 2.0 specifically aiming to integrate Internet users for specific purposes. Kleemann et al. (2008) systematically categorized Web 2.0 crowdsourcing examples (see Table 1):

Eli Lilly created InnoCentive in 2001 as a way to outsource problems that were not making progress in-house (Maxmen 2010). In 2005, the website spun off from Eli Lilly, and expanded beyond pharmaceuticals to other industries. Factors relating

Table 1 Categorized examples of crowdsourcing

Type	Organization	Application
Consumers participate in developing product	Fiat	Fiat 500—obtained 170,000 designs in a few months
Consumers participate in developing product	Dell	Idea storm—call for comments & suggestions for all Dell products
Consumers participate in developing product	American Idol	Public contribution of content for cheap television programing
Product design	Spreadshirt.net	Consumers upload text, graphics, and photos to create t-shirts
Product design	Threadless.com	Users submit designs, vote, winner gets free t-shirts
Product design	Frito-Lay	Public suggests names for new flavors—2006 competition to create Doritos TV ads
Competitive bidding	Proctor & Gamble	InnoCentive.com—unresolved research questions posted, over 100,000 researchers registered, solver receives remuneration
Competitive bidding	Moviebakery	Amateur film directors/producers accept commissions for internet advertising, receive commission
Permanent open calls	CNN, BBC, Gannet, Reuters	Amateur reporters submit photographs, short articles, some via cell phone—no compensation
Permanent open calls	BILD newspaper	Offers up to 500 Euros to nationally published reader-reporters
Permanent open calls	Converse Gallery	Ad campaign solicited 24-s spots, in 3 weeks received 750 submissions, thousands before discontinued in early 2007
Community reporting	Trendwatching.com	Over 8,000 worldwide notify site of observed changes in market supply or consumer demand—site sells annual report or current information
Product rating/profiling	Amazon.com	Unpaid product reviews, suggestion by profile
Customer-to-customer support	Nike	Users can upload running times via iPod, use data to compete with other users
Mass customization	Dell	Customer can alter a few preconfigured computer models
Creation of limited access markets	Amazon's Mechanical Turk	Buyers pay for answers to queries
Creation of limited access markets	e-Bay & Amazon	Run platforms allowing sellers & buyers to make purchases
Creation of limited access markets	Online markets	For tasks, jobs
Creation of limited access markets	iStockPhoto.com	Photographers contribute their photos, site provides access to customers at much reduced prices
Creation of limited access markets	YouTube	Users post cinema
Creation of limited access markets	Ezine Articles	Takes articles from amateur authors, catalogs into searchable database, offers to online magazines for free
Creation of limited access markets	Flickr	Photo sharing site

Table 1 continued

Type	Organization	Application
Open source/Open content	Wikipedia	Users participate in generating encyclopedia entries
Open source/Open content	News platforms	Users evaluate articles submitted by others, software ranks by popularity

Adapted from Kleemann et al. (2008), Howe (2008)

to crowdsourcing effectiveness in the InnoCentive site have been reported (Lakhani and Jeppesen 2007). InnoCentive posts research and development problems with monetary prizes offered. Analysis has revealed that of those problems that evaded solution by corporate research staffs, the public solved 30 percent. Over the period 2001–2004, each problem posted received attention from over 200 people, and on average about ten solutions were submitted. Inferences drawn were that effectiveness increases with diversity of the pool of solvers and that while prizes are important, enjoyment seemed to be a more important motivator. There seemed to be no relationship between prize size and the likelihood of solution.

4 Crowdsourcing issues

Like everything, crowdsourcing has positive and negative aspects. Lynch and Borchok (2009) presented the advantages and disadvantages of crowdsourcing (see Table 2):

These views were offered within the context of marketing brand identity. The pros presented, however, are generic, applying to practically any activity. The cons are germane more to the specific context of creating a program of brand identity; however, several generic potential problems are identified. As to the value of a continuous stream of creative activity, some crowdsourcing activities have been applied to long-term domains. Fiat, Dell, and American Idol are all examples (see Table 1) where crowdsourcing was successfully applied to product development. The Trendwatching.com example demonstrates how thousands of participants have been gathered to work together in an area of shared interest. And, while it is true that

Table 2 Pros and cons of crowdsourcing in market branding programs

Pro	Con
Crowdsourcing taps the world to work on your design	Complexity: a successful marketing identity program arises from a chain of carefully thought out activities
It eliminates risk of groupthink	Distance: dispersed crowds cannot have the same depth and intimacy as a small group of experts
Works well when tasks require high levels of creativity but little time	Imprecision: crowds are good at producing average results
	Chance: crowds have highly variable quality

Adapted from Lynch and Borchok (2009)

crowds will generate a wide distribution of idea quality, the point is and the pathway to success is in selecting the best of the group. In general, crowds have a big advantage in widening the pool of potential good ideas.

This tapping of many people to accomplish work is becoming evident in governmental activities as well. President Obama directed federal agencies to increase their use of incentive prizes to stimulate technological innovation (Maxmen 2010). The National Institutes of Health (NIH) has sponsored a number of grants in collaborative, cross-sectorial efforts (Shen 2008). In 2004, the Defense Advanced Projects Research Agency (DARPA) used prizes to stimulate the creation of an unmanned ground vehicle. They offered a $1 million prize to the first team that could drive a robot over 142 miles of rugged terrain in the California desert. DARPA estimated gaining $155 million worth of free labor from participants (Singer 2009). Collaborative efforts have the advantage of minimizing groupthink by accessing multiple views.

5 The intersection between crowdsourcing and OSS

Crowdsourcing is a technique that companies can use to support the development and implementation of better methods or better products, generally taking advantage of the Web to link participants. It is a form of collective action. Voluntary participation in OSS development differs from that of participation in crowdsourcing; yet, they have a common framework. Interestingly, Howe (2006) offers an alternative definition for crowdsourcing, "the application of Open Source principles to fields outside of software." It is toward this intersection that we now direct our attention.

6 OSS

Raymond (2001) identified the major philosophical differences between traditional software development and open cooperative software. There are fundamentally different processes involved in the two approaches (Garzarelli et al. 2008).

6.1 The Cathedral process

Traditional software development is comparable to building a cathedral in which an architect or team of architects work in isolation. The Traditional software development process begins with the creation of a software product by an individual or team applying systems analysis to systematically design, code, test, and implement a product.

- A firm undertakes development of a software product.
- The firm hires a team of developers.
- The development project is centrally managed.
- Code is developed and written in binary so that it cannot be modified outside the firm.

- Clients buy and use the software product.
- If problems arise, clients inform the firm, which works on fixing the software.

Once the computer program is developed, the code is locked so that it cannot be seen or modified by others and then sold to clients. If clients encounter problems, they inform the proprietary company, which works on fixing the problem and providing a patch or improved version of the code. Intellectual property rights are protected in that nobody outside of the proprietary organization is allowed to change the basic code.

6.2 Voluntary OSS

In contrast to traditional software development, voluntary OSS relies upon a cooperative, loosely formed group of computer developers who share interest in developing some specific product. This software development technique is characterized by an unorganized and open nature in which multiple individuals work together to accomplish tasks on a voluntary basis. As a result, the process becomes as follows:

- The community of volunteers develops the code.
- Code is distributed to users.
- Binary code is created by users.
- Users use the software.
- If problems arise (or improvements thought of), users work on fixing them.
- Users distribute improved software through their community.

In this development process, knowledge is for sharing, with the focus on the development of better software and little if any attention given to profitability. Crowdsourcing applies these same concepts outside the domain of software development to areas including (but not limited to) product design.

7 Crowdsourcing participation

There are many types of user contribution systems that have appeared. Some involve active entry of content, such as Facebook, YouTube, or those who make entries in Wikipedia. Others involve active listing of content, such as eBay or Craigslist. More passive systems involve users looking for information such as readers of Wikipedia, Amazon product recommendations, or Google search. You also can use resources over the web, such as Skype telephone calls.

Wikipedia was one of the earliest examples of crowdsourcing. This online encyclopedia has been a spectacular success, posting over 2 million articles (in English; additional articles in other languages) through the collaborative contributions of over 150,000 participants who receive no compensation (Prasarnphanich and Wagner 2009). It is the world's largest encyclopedia, as well as the most widely used. The code of conduct for wikis includes

1. Openness to change, allowing all to modify content;
2. Collaborative writing of shared pages;
3. Minimization of individualism (author names not displayed).
4. Significant reduction in writing and maintenance effort required;
5. Division of labor for content creation, integration, and quality improvement;
6. Cumulative, incremental development.

Altruism has been cited as a major element in open source participation, but is not the only factor. Many participants have been found to be highly individualistic, placing high value on reputation. Participation is motivated by peer recognition, self-marketing, and potential impact on future career opportunities (Fitzgerald and Feller 2001; Hars and Ou 2002).

8 OSS participation

Participation in information software technology development has been expected to be different from what might be true for other forms of economic activity. Raymond (2001) claims you cannot motivate the best people in information technology with money. Florida (2003) surveyed high-tech participation with respect to reasons they developed software, finding results shown in Table 3:

Florida noted that about one-third of the survey participants valued flexibility over other factors, including the ability to work from home. Another third were more compensation driven, representing the conventional economic assumption. One in five were primarily driven by technology, seeking to work with leading-edge peers and technology. About 15 percent were primarily professionally driven.

Table 3 Information technology motivation

Motivation	Percent	Description
Challenge and responsibility	67	Contributing with impact, knowing your work makes a difference
Flexibility	31	Flexible schedule and work environment, with the ability to shape your work
Stability and security	29	Not lifetime employment, but avoidance of chaos & uncertainty
Compensation	25	Money you can count on (base pay, core benefits)
Peer recognition	21	Chance to obtain recognition and esteem of those you respect
Location and community	19	Participate in local planning
Stimulating colleagues and managers	14	Being around other creative people
Organizational culture	14	An environment where you feel valued and supported
Professional development	13	Ability to expand one's future opportunities
Exciting job content		Chance to work on interesting intellectual problems breaking new ground

Adapted from Florida (2003)

Fourteen (14) percent were primarily motivated by the pursuit of overall company success (organizationally oriented). About 11 percent were entrepreneurial, preferring to work in startup organizations.

The salient point of Florida's study is that those who work in information technology seem to be driven by altruistic factors rather than conventional economic self-interest. This personal attribute may explain to a great degree the popularity of crowdsourcing.

OSS development is seen shifting from individual proprietary development to more open communities, especially small-to-medium size organizations (Ågerfalk and Fitzgerald 2008). Bonaccorsi et al. (2006) surveyed Italian software firms, examining strategies for firms to offer proprietary and OSS under different licensing schemes. They found that adopting open source systems did not lock in organizations, as various hybrid options were often used. Firms providing OSS benefit from maximizing customer involvement through customization, and open source participation is a source of learning on the part of customers. Open source development of course reduces personnel expenses, but can also reduce project cycle time and access better practices. Even those organizations that continue proprietary development can benefit in open source development projects by gaining access to talents that they can recruit. Studies have looked at participation in open source projects through the SourceForge.net site, which records OSS projects (www.sourceforge.net). Participation is the key to OSS project success. Fang and Neufeld stated that 80 percent of OSS projects disappear due to insufficient participation (Fang and Neufeld 2009). Conversely, participation in industrial settings is based more on reward mechanisms (Lai and Chu, 2002).

Cromie and Ewing (2009) considered three broad categories of motivation: an altruistic resistance to proprietary software firms (such as Microsoft, or in the past IBM), personal motivations (such as fun), and need (utilitarian benefits perceived). The resistance motivation was represented by one respondent's comment: "Companies like IBM, Microsoft, Intel, HP are after differentiated advantages so they can lock the customer into a straight jacket." Evidence of the strength of work-related motivations has been found as well (Bitzer and Geishecker 2010). Table 4 compares these motivations.

This categorization is similar to that offered in another study, displayed in Table 5. Shah (2006) looked at over 100,000 open source projects on SourceForge.com in late 2005, finding that long-term participants expressed enjoyment in programing and interaction with fellow software developers. These open source participants are considered hobbyists.

Short-term participants were more driven by the immediate need for useful software. Team size was found to be a significant predictor, with mid-sized project teams performing the best. Increasing the percentage of problems assigned or boosting developer participation in other open source projects improved performance.

Xu et al. (2009) applied structural modeling to assess factors related to performance, hypothesizing that involvement affected performance (with control variables education and experience) and that involvement was motivated by the six factors, divided into those focused on individual motivation and those involving community influence:

Table 4 Motivation for OSS participation

Broad	2nd Level	3rd Level	Example comment
Altruistic	Philosophical match	Fairness, reciprocity, sharing	Free software is aligned with my own values and goals
	Altruism	Serving society	I like the idea that I am building something that is "free forever"
Personal	Creative enjoyment	Fun, interesting, challenging, cool	Free software is an outlet for my creative urges
	Sense of community	Openness, honesty, sharing, cross-cultural, cross-discipline	I saw the project as a way for a diverse group of people to participate
Need	Utility	Productivity, functionality, support, cost	It made my job easier
	Control and freedom	Can fix bugs, customization, trustworthiness	If I find a bug, I can do something about it
	Self-improvement	Availability of source, learn from others, depth of complexity, self-respect	I have to say that the ability to get in and dirty attracted me immensely, as I have always been both curious and a hacker.
	Quest for excellence	Good designs, open standards, quality of code	The real people doing OSS work are trying to create the best technology in the world

Adapted from Bitzer and Geishecker (2010)

Table 5 Developer participation framework

Reason to create	Reason to contribute	Level of participation	Number	Knowledge of content
Need	Reciprocity	Low	High	Limited to initial app
	Future product improvements	Varies by need	Moderate	Primarily initial app, can expand
	Desire to integrate your code into source code	Moderate to high	Low	Varies
	Career	Low, peripheral	Very low	Varies
	None	Very low		Limited to initial problem
Fun, enjoyment	Feedback	High	Low	Begins with initial, expands

Adapted from Shah (2006)

8.1 Individual motivations

1. Software needs: participants have a working need for the software being developed.
2. Reputation: reputation and skills obtained are expected to positively impact future opportunities.

3. Enjoyment: intrinsic psychologic rewards drive many of the things that we humans do.

8.2 Community factors

4. Leadership effectiveness: managerial encouragement can drive participation.
5. Interpersonal relationship: a sense of belonging to a community through social ties.
6. Ideology: people with similar attitudes, beliefs, and values tend to work together.

The results indicated that involvement had significant effect on performance, explaining 70 % of total variance ($p \leq 0.01$). Both community and individual factors seem important in motivating participation in OSS projects.

Au et al. (2009) studied learning effects in OSS projects, using the number and percentage of resolved bugs and the time of bug resolution as measures of learning effectiveness. They also used SourceForge.net, obtaining 118 usable samples. SourceForge.net can track four primary types of events: bugs, support requests, patches, and feature requests. All four types were used in the study. A total of 91,745 of these tasks were included, 73,253 of which were resolved. The data were processed including 14,293 project-week observations over the 118 projects. Team size was found significant, with mid-sized project teams performing best. Increasing the percentage of bugs assigned to specific developers and boosting participation in other OSS projects also improved performance.

OSS is related, in that it utilizes the Web to access participants, but the focus is on software development. While not all such developed software has to be free, it can be and often is distributed without charge. Thus, OSS development is related, but the motivation may be the art of developing good code, without the profit link of crowdsourcing. Often, participants have been found to seek maximization of their reputation in the software community or to seek benefits such as consulting or employment opportunities after demonstrating their abilities in OSS development (Prasarnphanich and Wagner 2009). Ågerfalk and Fitzgerald (2008) found that open sourcing worked better under conditions of openness, trust, tact, professionalism, transparency, and complementariness.

Cook (2008) categorized a number of systems that had been developed through user contribution (crowdsourcing). He gave a list of six reasons for crowdsourcing participation, which parallels that of Fang and Neufeld's list of motivation for open source participation cited earlier. Table 6 compares these motivations.

Table 6 lists OSS motivations in order of strength as reported by Fang and Neufeld. It is interesting to note that getting paid appears on the list; it is not, however, a universal feature of OSS projects. Most of the motivations for OSS match those found in crowdsourcing. Learning shows up in the OSS list and not on the crowdsourcing list, but learning is a type of social reward. In crowdsourcing, some applications pay participants (especially those involving competitions), others do not. This analysis reveals that reciprocity is not a major motivation in crowdsourcing; however, it is a major factor in motivating participation in OSS.

Table 6 Comparative motivations for participation

OSS (Fang and Neufeld)	Crowdsourcing (Cook)
Value of software developed	Practical solutions
Status and recognition	Social reward
Learning	
Personal enjoyment	Self-expression
Reciprocity	
Getting paid	
Sense of ownership and control (practical solutions obtained)	Contribution
Career advancement (reputation enhanced)	Reputation
Free software ideology	
Social identity (fostering a feeling of contribution)	Altruism

9 Conclusions

The Internet has enabled far more value to society than was envisaged when the United States' military designed a system to be secure from Russian disruption. Scientists found the Internet highly useful to exchange files in the 1980s, and computer engineers established the OSS movement. In the 1990s, business use of the Internet exploded. Crowdsourcing and Web technology demonstrate a fundamental paradigm shift in the way business is conducted. This raises a number of issues. Crowdsourcing taps global inputs to work, but increases complexity. There are benefits in reducing groupthink, but dispersed participation also eliminates close group collaboration. Crowdsourcing advantages are expected when high creativity is needed for quick work, but the cost is variability in quality.

Motivations for participation in OSS projects such as Linux are often altruistic. However, there also is a strong motivation to work with others to gain critical skills that can be marketed in proprietary settings. Crowdsourcing is often driven by a similar altruism, but involves a much broader spectrum of participants. Software development is a skilled field. Crowdsourcing may require few professional skills. It is, for many, often an attractive way to utilize free time (like reading books or doing crossword puzzles).

Control mechanisms can insure effective performance of autonomous agents participating in virtual organizations, even in the absence of trust (Gallivan 2001). Insuring control is important for effective performance in OSS projects. Social control mechanisms include behavioral norms and member voting. Self-control includes professional reputation. Control mechanisms that have been used include regulation of participation, rules, institutions, and sanctions.

References

Ågerfalk P, Fitzgerald B (2008) Outsourcing to an unknown workforce: exploring opensourcing as a global sourcing strategy. MIS Q 32(2):385–409

Au Y, Carpenter D, Chen X, Clark J (2009) Virtual organizational learning in OSS development projects. Info Manag 46(1):9–15
Bitzer J, Geishecker I (2010) Who contributes voluntarily to OSS? An investigation among German IT employees. Res Policy 39(1):165–172
Bonaccorsi A, Giannangeli S, Rossi C (2006) Entry strategies under competing standards: hybrid business models in the OSS industry. Manag Sci 52(7):1085–1098
Cook S (2008) The contribution revolution: letting volunteers build your business. Harv Bus Rev 86(10):60–69
Cromie J, Ewing M (2009) The rejection of brand hegemony. J Bus Res 62(2):218–330
Fang Y, Neufeld D (2009) Understanding sustained participation in OSS projects. J Manag Info Syst 25(4):9–50
Fitzgerald B, Feller J (2001) OSS: investigating the software engineering, psychosocial and economic issues. Info Syst J 11(4):273–286
Florida R (2003) The rise of the creative class: and how it's transforming work, leisure, community and everyday life. Basic Books, New York
Gallivan M (2001) Striking a balance between trust and control in a virtual organization: a content analysis of OSS case studies. Info Syst J 11(4):277–304
Garzarelli G, Limam Y, Thomassen B (2008) OSS and economic growth: a classical division of labor perspective. Info Technol Dev 14(2):116–135
Hars A, Ou S (2002) Working for free? Motivations for participating in open-source projects. Int J Electron Commerce 6(3):25–39
Howe J (2006) Crowdsourcing: A definition, crowdsourcing: tracking the rise of the amateur. http://crowdsourcing.typepad.com/cs/2006/06/crowdsourcing_a.html. Accessed 17 Sept 2012
Howe J (2008) Crowdsourcing: why the power of the crowd is driving the future of business. Random House, New York
Kleemann F, VoB G, Rieder K (2008) Un(der)paid innovators: the commercial utilization of consumer work through crowdsourcing. Sci Technol Innov Stud 4(12):5–26
Lai H, Chu T (2002) Knowledge management: a review of industrial cases. J Comput Info Syst 42(5): 26–39
Lakhani K, Jeppesen L (2007) Getting unusual suspects to solve R&D puzzles. Harv Bus Rev 85(5):30–32
Lynch A, Borchok D (2009) Is crowd-sourcing the best way to create a kick-ass brand identity? B&T Mag 59(2691):15
Maxmen A (2010) Driving innovation: ready, set, go! Cell 140(2):171–173
Norton M, Mochon D, Ariely D (2012) The IKEA effect: when labor leads to love. J Consum Psychol 22(3):453–460
Prasarnphanich P, Wagner C (2009) The role of wiki technology and altruism in collaborative knowledge creation. J Comput Info Syst 49(4):33–41
Raymond E (2001) The cathedral and the bazaar: musings on linux and open-source by an accidental revolutionary. O'Reilly, Sebastopol
Shah S (2006) Motivation, governance, and the viability of hybrid forms in OSS development. Manag Sci 52(7):1000–1014
Shen B (2008) Toward cross-sectorial team science. Am J Prev Med 35(2):S240–S242
Singer P (2009) Wired for war: the robotics revolution and conflict in the 21st century. Penguin, New York
Tapscott D, Williams A (2006) Wikinomics: how mass collaboration changes everything. Penguin, New York
Xu B, Jones D, Shao B (2009) Volunteers' involvement in online community based software development. Info Manag 46(3):151–158
Zittrain J (2008) The future of the internet: and how to stop it. Yale University Press, New Haven