Journal of Strategic Information Systems xxx (2013) xxx–xxx

Contents lists available at ScienceDirect

Journal of Strategic Information Systems

journal homepage: www.elsevier.com/locate/jsis

Viewpoint

Towards an information systems perspective and research agenda on crowdsourcing for innovation

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ARTICLE INFO

Article history:
Received 10 January 2013
Received in revised form 3 July 2013
Accepted 29 July 2013
Available online xxxx

Keywords:
Crowdsourcing
Collective intelligence
Innovation
Collaboration
Innovation tournaments
Platforms

ABSTRACT

Recent years have seen an increasing emphasis on open innovation by firms to keep pace with the growing intricacy of products and services and the ever changing needs of the markets. Much has been written about open innovation and its manifestation in the form of crowdsourcing. Unfortunately, most management research has taken the information system (IS) as a given. In this essay we contend that IS is not just an enabler but rather can be a shaper that optimizes open innovation in general and crowdsourcing in particular. This essay is intended to frame crowdsourcing for innovation in a manner that makes more apparent the issues that require research from an IS perspective. In doing so, we delineate the contributions that the IS field can make to the field of crowdsourcing.

1. Introduction

In order to continually innovate, firms are opening their boundaries to engage external expertise (Boudreau, 2010; Boudreau et al., 2011; Chesbrough, 2003; Enkel et al., 2009; Surowiecki, 2004). Instead of simply collaborating with a select few known external parties, firms are increasingly innovating using "crowdsourcing". Crowdsourcing is the act of taking a challenge faced by a firm and, instead of asking internal research and development departments to solve the challenge, the firm broadcasts an open call to individuals with relevant expertise outside the firm to become involved in solving the challenge (Howe, 2006). Sometimes participants in crowdsourcing are limited to specifically selected communities (e.g., Genius Crowds, and Innocentive); other times, the general public is invited.

Information systems play a huge role in making crowdsourcing possible by providing the network and software for sharing ideas (Andriole, 2010; Awazu et al., 2009; Bingham and Spradlin, 2012; Doan et al., 2011; Dodgson et al., 2006; Lindic et al., 2011, Trott and Hartmann, 2009; Williams, 2012). However, information systems (IS) scholarship has only minimally engaged with crowdsourcing or the broader phenomenon of open innovation (Diener and Piller, 2009; Ebner et al., 2009). Systematic research by IS scholars on the design of the software, user interface, and practices to facilitate the crowdsourcing process is scarce (Leimeister et al., 2009 and Feller et al., 2012 are exceptions). This essay is intended to help overcome this dearth. In the tradition of Strategic Information Systems (Gable, 2010), this paper establishes the strategic use of IS in the context of open innovation. Our focus is not on the short term use of IS platforms to satisfy the current needs of the crowdsourcing trend. Rather, we are interested in establishing a theory of the design of IS platforms that can be strategically leveraged over the long term to maximize the potential of open innovation, i.e., to create a generative capacity for the firms through the strategic design and use

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http://dx.doi.org/10.1016/j.jsis.2013.07.004

of IS (Avital and Te'eni, 2009). In keeping with the ideas put forth in the 20th anniversary special issue of this journal, we focus on behavioral issues related to IT in high velocity environments (Galliers et al., 2012). Our focus is on establishing the dynamics of the use of social software for extra-organizational knowledge management (von Krogh, 2012).

We first define crowdsourcing for innovation, Next, we highlight the variations in "participation architectures" (West and O'mahony, 2008), recognizing that IS design has been a "neglected" critical component of research on participation architectures. From this examination, we are able to identify the gap that IS research can fill: improving the participation architectures for crowdsourcing. We then propose a set of affordances for the design of crowdsourcing platforms that could fill this gap, and the future research questions that these affordances offer the field.

2. Crowdsourcing for innovation

Dating as far back as 1714 when the British government cast an open call for solutions determining precise longitude coordinates for navigation purposes, crowdsourcing for innovation has been used to obtain ideas, technologies, and even entire businesses from outside the organization (Afuah and Tucci, 2012). While crowdsourcing for innovation in itself is not a new concept, the move towards open innovation (Chesbrough, 2003; Rheingold, 2003) and innovation as a strategic competitive advantage for the firm (Terwiesch and Xu, 2008) has accelerated its focus by academics (e.g., Chesbrough et al., 2008; Dahlander and Gann, 2010; West and Bogers, 2013).

Crowdsourcing is defined as: "a type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call [i.e., announcement], the voluntary undertaking of a task." (Estellés-Arolas and Gonzalez-Ladron-de-Guerva, 2012, p. 9) Crowdsourcing for innovation is one type of task to which crowdsourcing is applied (Erickson et al., 2012). *We define innovation in a crowdsourcing context as the public generation of innovative solutions to a complex problem posed by the company sponsoring the challenge call*. Innovative solutions are those that are novel and implementable for the sponsoring organization (Amabile, 1988). Innovative solutions may include new sources of revenue such as new product lines or new services, or changes to existing processes and practices (Dahlander and Gann, 2010). For example, Heineken's 2012 crowdsourcing challenge yielded a new design for a beer bottle to create a new image for the customer experience of consuming beer. Similarly, General Electric's Sustainability Challenge led to the acquisition of a company with a new business model for sustainability.

The theoretical basis for crowdsourcing being generative of innovation is the value of expertise diversity. External crowds are more diverse in expertise and experiences than internal research and development units, and, with expertise diversity, comes the possibility of a greater quantity and variety of ideas, ideally resulting in more innovative ideas (Bingham and Spradlin, 2012; Dahan and Mendelson, 2001; Terwiesch and Ulrich, 2009). Taking advantage of a theorem referred to as "diversity trumps ability", a number of studies have demonstrated that a large diverse crowd of independent strangers performs better on certain types of challenges than a small number of experts (Brabham, 2013). This theorem has been demonstrated across a wide range of fields including computing, science, sports forecasting, stock forecasting, and world events (e.g., Buecheler et al., 2010). Diverse expertise may be derived from differences in knowledge domains, contexts, product usage, discipline or specialty work areas (Erickson et al., 2012; Schenk and Guittard, 2011). Variability in the source of diversity extends beyond the von Hippel (1986) notion of ideas coming from lead users to include ideas coming from all members of a company's value constellation – suppliers, competitors, customers, service delivery channels, and content providers (Lee et al., 2010; Normann and Ramirez, 1993; Vanhaverbeke and Cloodt, 2006). The greater the size of the crowd, the greater the possibility of idea diversity put forth by the crowd (Boudreau, 2012). With greater variety in the ideas and comments, the greater the probability that ideas will be more highly valued as novel and implementable by challenge sponsors (Poetz and Schreier, 2012), and that novel approaches not previously considered by the "internal" experts will be generated (Boudreau, 2012; Boudreau et al., 2011; Jeppesen and Lakhani, 2010).

3. Participation architectures for innovation crowdsourcing

Participation architectures refer to sociotechnical systems design elements that encourage and integrate contributions made by participants to an open online forum focused on developing innovative solutions, such as open source software or Wikipedia (O'Reilly, 2005; Wagner and Majchrzak, 2007; West and O'mahony, 2008). Several distinct design dimensions of participation architectures have been identified, two of which we focus on: (1) production (the way the community conducts its production process) and (2) co-creation boundary management (the process by which, through incentives and intellectual property rights management, only certain individuals will be encouraged to participate (West and O'mahony, 2008). Below we describe the variations in participation architectures along these two dimensions that have been studied to date in the literature.

3.1. Production

The process of production in crowdsourcing involves participants making contributions to a crowdsourcing web-based platform that specifies the crowdsourcing "call" and instructions on how to post contributions. Crowdsourcing-for-innovation challenges may range from calls for incremental innovation such as improvements in existing product lines (Mattel and

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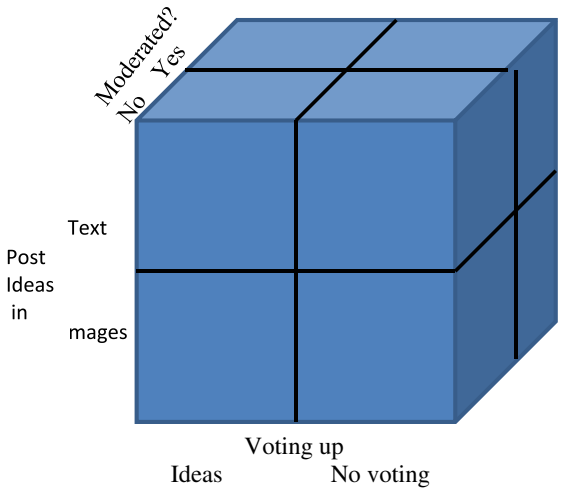

Fig. 1. Variations in the production process of crowdsourcing for innovation participation architectures.

Lego are examples) to calls for radical innovation such as developing entirely new service models to solve societal problems (using OpenIdeo as an example).

Crowdsourcing web-based architectures generally require participants to post their ideas in the form of text (as with IBM Innovation Jam's discussion forums) or in the form of product design specifications (such as for Lego Mindstorms). The posting of the idea starts a discussion thread. Follow-on participants may then choose to either contribute by adding comments to a posted idea (i.e., one focused on someone else's idea), or post their own idea to start a new discussion thread. Across different crowdsourcing experiences, there may be little discussion on an idea (such as with Heineken's Beer Challenge) or many comments and replies (as with Threadless, Malone et al., 2010). Because the architectures generally require posting an idea to start a discussion (rather than posting facts or some other generative response), the discussion tends to focus primarily on refining a posted idea, and rarely recombining existing posts into new ideas. Consequently, ideas are rarely substantially changed through combination and re-combination (Wright, 2013).

The architecture rarely provides any guidance to participants for the generativity of their comments. This lack of structure leads to a range of comments from emotive ("great idea!!!") to highly prescriptive ("if you changed this design in this specific way, I might be interested in buying it") to content-free ("please explain"). In some crowdsourcing experiences, there may be moderators provided by intermediaries (e.g., Genius Crowds) who ask generative questions, but the use of moderators by the sponsoring organization leads to an impression in the crowd that they are being watched, dampening diverse ideas (Fuller et al., forthcoming).

Another variation in the architecture for innovative production during crowdsourcing is in the way that the crowd votes. For many architectures, the crowd is asked to vote on each posted idea. In some crowdsourcing experiences, there may be thousands of ideas – Leimeister et al. (2009) reported 46,000 ideas posted in the 2006 IBM Innovation Jam. Without voting to indicate the most preferred ideas by the crowd, it would take a sponsoring organization countless hours to consider each idea. Moreover, by voting on the ideas, the crowd is improving the cycle-time through which experimental ideas are quickly evaluated (Diener and Piller, 2009; Huang et al., 2011). However, while all crowd members are permitted to vote, not all crowd members vote on all ideas. Additionally, the criteria for voting are often left vague leading to implicit variations in criteria used for voting, from likelihood of purchase (if a product), to "coolness" of idea to feasibility. Consequently, the ideas that are voted as most popular may not be the most innovative ideas. Moreover, because votes are focused on ideas, the attention is not drawn to idea recombination or comments that are particularly generative. Fig. 1 displays a simple $2 \times 2 \times 2$ matrix of the variations in how the architecture fosters production of innovation solutions.

3.2. Co-creation boundary management

In open source creative communities, co-creation boundary management refers to the basis by which individuals with certain identities are given preference over others when encouraging participation (Jarvenpaa and Lang, 2011). Co-creation boundary management is often manifested in incentive structures and intellectual property protections. Crowdsourcing may or may not provide extrinsic prizes to the winner. When extrinsic prizes are offered, the crowdsourcing effort is referred to as an "innovation tournament" (Terwiesch and Ulrich, 2009) or "innovation contest" (Diener and Piller, 2009) or "idea tournament" (Morgan and Wang, 2010). Additional to extrinsic rewards for crowdsourcing participants are intrinsic personal satisfaction in seeing ideas carried forward by the organization (Boudreau and Lakhani 2009), as well as recognition by the crowd or the sponsoring organization for one's contributions (Adler and Chen, 2011; Huizingh, 2010; Jeppesen and

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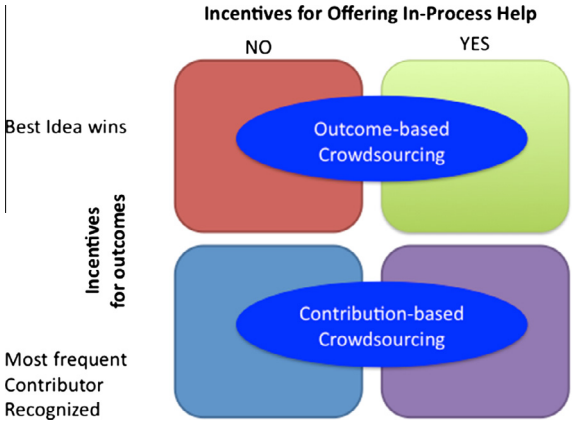

Fig. 2. Variations in incentives.

Frederiksen, 2006; Leimeister et al., 2009; Zwass, 2010). Not all motivators are the same for all crowd members. Jeppesen and Frederiksen (2006), for example, found that participants in crowdsourcing who were hobbyists with respect to the domain of the challenge question were more motivated by the recognition from the sponsoring organization than people who earned their money in the domain. Fuller et al. (forthcoming) found a crowding out effect of extrinsic motivation on participation with moderate intrinsic motivation.

In addition to extrinsic incentives for outcomes, some crowdsourcing challenges provide incentives for the process by which the crowd participates in the crowdsourcing challenge, such as how often comments are made on others' ideas. Based on the particular variety of production process being fostered (given the variations described in Section 3.1 above), the sponsoring organization may be particularly concerned about fostering enough crowd activity on the crowdsourcing platform. In this case, incentives may be provided based on number of posts made. These incentives can be for the top contributor in terms of amount of contributions made or the number of ideas posted. Rarely are process or outcome incentives provided for the content of contributions made, such as whether the contributions were those that fostered more generative ideas from the crowd.

Fig. 2 displays a simple 2×2 matrix of four different variations in crowdsourcing-for-innovation based on different forms of incentives. The outcome incentives can be based on a winning idea or an individual who contributes the most number of ideas. In addition, process incentives can be offered in terms of recognition/awards to individuals who help develop/comment on others' ideas.

Finally, participants are often informed that, when the sponsor is a for-profit entity and the crowd is the general public, the sponsoring company owns *all* intellectual rights. Essentially, members of the crowd are giving up their intellectual property rights in exchange for the opportunity to win the prizes. In contrast, with "captive" or "closed" communities in which individuals have been specially selected to be a member of the community because of their interests and expertise, winners often retain some intellectual property.

3.3. Summary of variations

In sum, there is substantial variation in the participation architectures of crowdsourcing-for-innovation. Table 1 presents examples of three different participation architectures in terms of how they foster innovation, with each described below. Apparent form these three examples is that the architectures provide relatively little support for idea evolution and generative and collaborative co-creation.

The first example, the IBM Innovation Jam (Fig. 3) has an architecture in which several ideas are displayed. Each idea is typically quite lengthy and detailed. For each idea, there is substantial commenting. There is also substantial moderation provided by specially selected members of the sponsoring organization. The primary reward is the opportunity to be recognized for influencing the future of the company, and an intellectual property design in which the crowd holds no intellectual property rights. While IBM Jams are known for their large numbers of participants, there is little re-combination of ideas (Majchrzak et al., 2009).

In Fig. 4, the Lego Mindstorms, in which participants generate new product designs for Lego, is displayed. The participation architecture in Fig. 4 is substantially different than IBM's in Fig. 3. The production process is one of using Lego's platform as a virtual product design space. While the crowd is encouraged to comment on others' designs, few do. In part, this is the nature of the incentives, in which monetary rewards are given to the contributor with the "best" design as selected by Lego, based in part on the crowd's votes. The intellectual property design gives all the intellectual property to Lego.

Fig. 5 shows GE's EcoImagination Challenge which was a challenge "to provide ideas to create a cleaner more efficient and economically viable grid, and accelerate the adoption of smart grid technologies" (from the Challenge website). The

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Table 1
Examples of existing crowdsourcing-for-innovation architectures.

	IBM innovation Jams	Lego mindstorms	Heineken idea brewery, GE EcoImagination
Idea evolution	Minimal since little structure of comments to know how to evolve an idea	Minimal since designer spent considerable time in preparing design	Minimal: first post is well-developed detailed idea; followup comments may lead to idea refinement
Individual output-based incentives	Individual recognition based on those with most contributions	Monetary rewards given to the contributor with the "best" design as selected by sponsoring firm & individual recognition based on crowd's votes for designs	Monetary rewards given to idea originator with "best" idea as selected by sponsoring firm & individual recognition based on crowd's votes for ideas
Incentives to encourage process behaviors that facilitate innovation	Recognition based on realtime tallies of # of contributions made, but nothing about how individuals should behave to encourage innovation	None	Recognition based on realtime tallies of # of contributions made, but nothing about how individuals should behave to encourage innovation
Activities performed by whom	Any member of invited crowd can post unstructured comments about topic; discussion moderation (such as encouragement or starting new threads) done by sponsoring firm representative	Complete designs done mostly by lead users, comment & vote done by crowd or other lead users	Mostly complete idea posting & championing by person wanting to win prize; comment & vote by anyone else

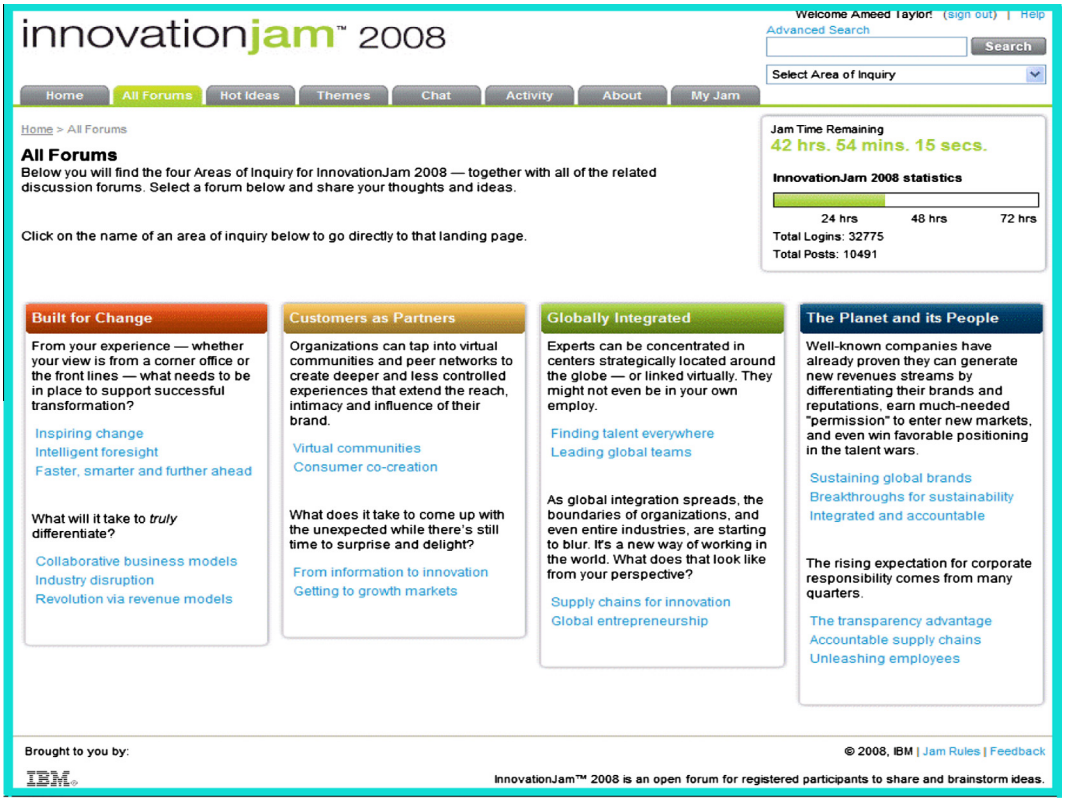

Fig. 3. Example of IBM innovation Jam.

production process was similar to IBM's in Fig. 3 in which individual crowd members posted detailed and lengthy proposals for technology and business strategy. There was minimal commenting on each idea. Ideas were voted on by the crowd, and a team of venture capital firms and GE selected a few winners to receive investment funding from GE and the pursuit of a commercial relationship with GE. The intellectual property was maintained by the crowd members; in fact the crowd was encouraged not to share confidential information. Consequently, there was little co-creation.

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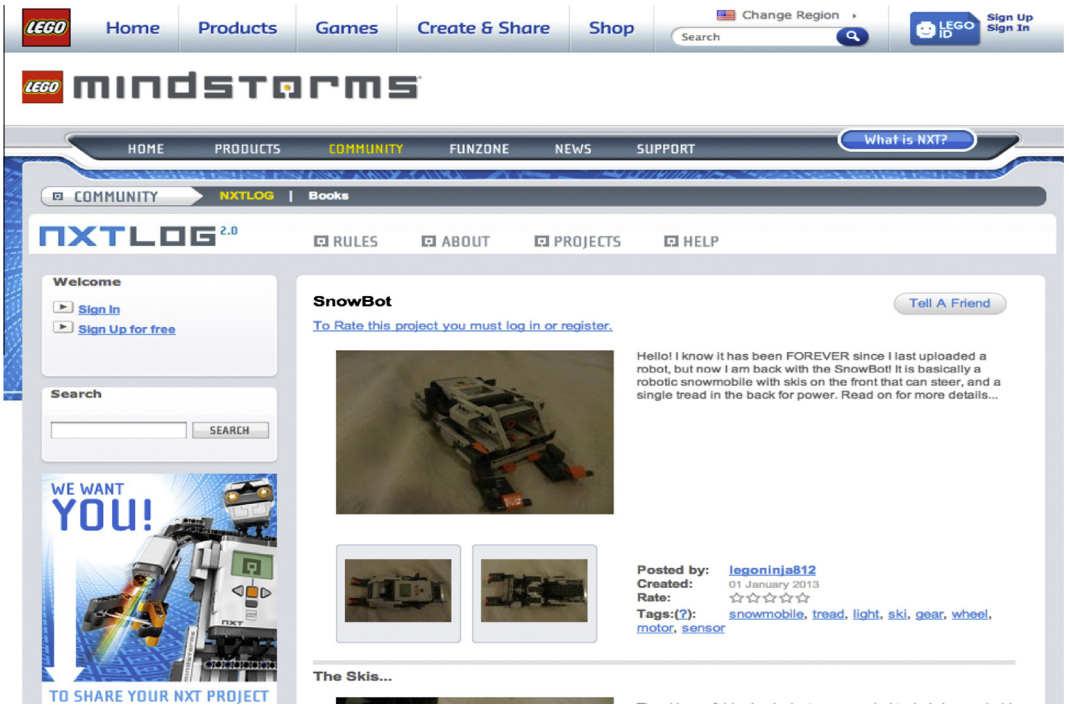

Fig. 4. Example of Lego mindstorms.

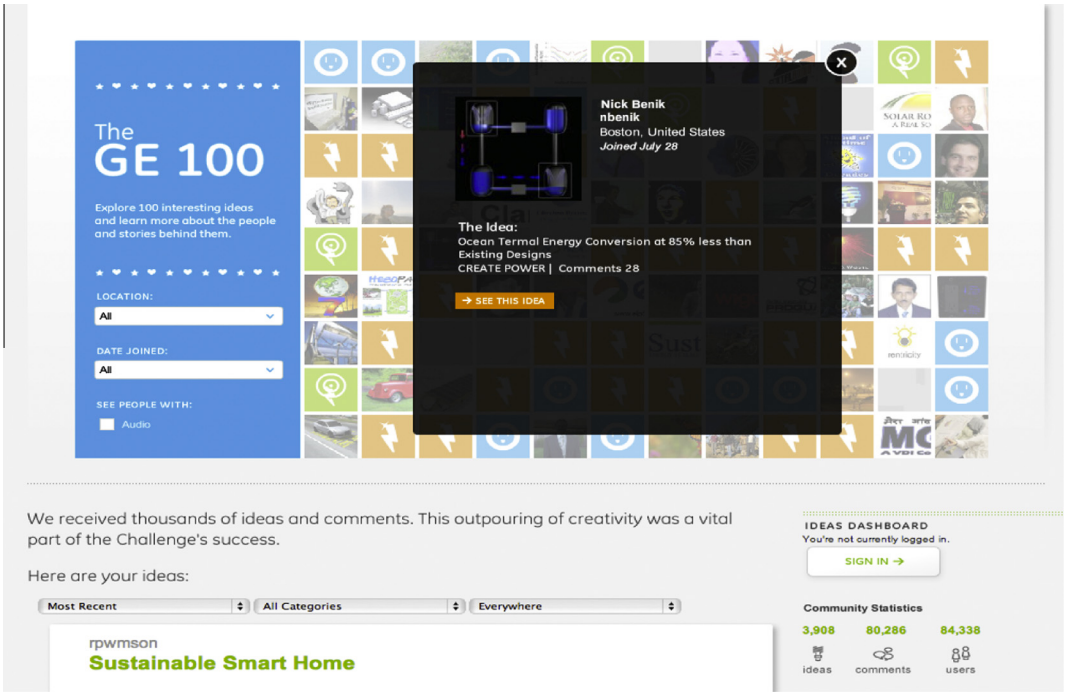

Fig. 5. GE EcoImagination.

4. Problems with existing participation architectures

Despite the variations in existing participation architectures for crowdsourcing-for-innovation, some generalities emerge across the variations. A first generality is that there appears to be minimal collaboration among participants, minimal

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feedback-based idea evolution, and posting primarily focused on designs or ideas rather than initial ideas that evolve over time (Madsen et al., 2012). This state of affairs led to a recent description of crowdsourcing as:

> "*Typically, individuals or groups in a crowd acting autonomously to develop a solution rather than elaborating on the ideas of others*"
>
> [(Madsen et al. 2012, p. 9).]

A second generality across the variations in participation architectures is that the incentives are primarily directed at the individuals or teams that post ideas. While there are some crowdsourcing intermediaries such as Quirky that encourage participants to comment on each other's discussion threads, the architectures rarely provide detailed guidance or incentives on specific ways to build on each other's ideas for co-creation, or evolve and integrate multiple ideas into a more integrated solution (Füller et al., 2007).

Given the minimal co-creation, the impact of crowdsourcing on the quality and quantity of innovative ideas generated by the crowd has been a source of research attention (e.g., Blohm et al., 2011; Boudreau, 2012; Leimeister et al., 2009; Ye et al., 2012). These studies have generally found that crowdsourcing, regardless of the specific participation architectures used, has led to a large quantity of ideas generated (Boudreau, 2012). The quantity of ideas generated have, in some cases, overwhelmed crowdsourcing sponsors as the sponsors attempt to evaluate not just top-ranked ideas, but all the ideas offered (Blohm et al., 2011).

Despite the large quantity of ideas, however, another finding in the literature is that, in the race to post lots of ideas, idea quality often suffers. For example, the crowd fails to offer well-considered solutions that incorporate multiple perspectives, risks, and needs (Schenk and Guittard, 2011), and the crowd fails to offer solutions that are novel and implementable (Blohm et al., 2011; Poetz and Schreier, 2012). In one study, crowdsourcing was found to lead to less innovation than solutions generated by small groups of specialized experts (Blohm et al., 2011; Poetz and Schreier, 2012). The crowdsourcing participants failed to consider many facets of the problem, creating only incremental improvements over what was being done currently, and failed to create solutions that the sponsoring firm could implement. These failings have been traced to less collaboration among the contributors; in one study, it was found that, as the competitive pressures increased, the willingness of members to provide free help diminished (Franke and Shah, 2003).

These concerns over the quality of solutions derived from crowdsourcing for innovation have left many reconsidering whether crowdsourcing should be used at all for a firm's external sourcing of innovation (e.g., Morgan and Wang, 2010; Wright, 2013). Some scholars have suggested that crowdsourcing may only be useful when the task given to the crowd is of a modular, self-contained, closed solution type (Afuah and Tucci, 2012; Lakhani and Tushman 2012; Terwiesch and Xu, 2008). Other researchers have suggested that the benefits of the crowd need to be disaggregated into phases, with the crowd limited to only suggesting ideas, rather than collaboratively co-creating innovative solutions. Hutter et al. (2011), for example, suggested a staged approach such that participants from the crowd compete with each other initially to have their ideas judged in the top 1% or 10%. These highly judged ideas are then reopened to the crowd with specific questions asked by the sponsoring organization about each idea to encourage more development. Leimeister et al. (2009), like Hutter et al. (2011), recommended that a first stage of crowdsourcing should allow the crowd to autonomously offer ideas; a second stage should have the crowd further refine firm-selected ideas, and in the third stage, the crowd should be asked to do a final vote on the ideas. These recommendations for staged approaches, however relegate the crowd to the same tasks as before: autonomously generating ideas, offering comments on others' ideas, and then voting on ideas.

5. The need for generative co-creation discussions during crowdsourcing for innovation

The problem with an approach to innovation that uses the crowd for the sole purpose of ideation, commenting, and voting is the lack of collaborative discourse that leads to generative co-creation, a foundational requirement for innovation from diverse sources (Carlile, 2002; Tsoukas, 2009). Generative co-creation is defined as a series of interactions in which different assumptions and perspectives are discussed in order to surface and resolve critical tradeoffs that were unresolvable previously (Carlile, 2002; Leonard-Barton, 1995; Majchrzak et al., 2012; Tsoukas, 2009). It involves collaborative discourse in which participants offer alternatives and jointly modify examples, metaphors, data, knowledge translations, boundary objects, idea seeds, constraints, problem definitions, problem observations, and idea analyses in an effort to co-create solutions that would not have been suggested if only a single perspective had been represented (Majchrzak et al., 2012).

While the extant literature on generative co-creation has demonstrated that it can occur among relative strangers organized into teams (Majchrzak et al., 2012), there is some evidence to also suggest that large crowds of strangers can engage in generative co-creation as well (Blohm et al., 2011; Hutter et al., 2011; Madsen et al., 2012; Piller and Walcher, 2006; Ransbotham and Kane, 2011; Ransbotham et al., 2012; Ye et al., 2012). These studies have shown that ideas that were co-created during crowdsourcing were of higher quality than those autonomously submitted by individuals.

Co-creation during crowdsourcing requires more than simply commenting on others' ideas (Tsoukas, 2009). It requires discussing the sponsor's challenge from a variety of different viewpoints, surfacing and confronting different assumptions underlying each other's models about causes and effects related to the problem or proposed solutions, concisely sharing ideas that are sufficiently under-developed so that others are willing to build upon them to create more complete solutions, and creating

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metaphors for solutions that can be iteratively modified over time (Majchrzak et al., 2012). Particularly important conclusions from this research on generative co-creation is that participants need to be able to self-select which types of co-creation activities they perform because, when they are permitted to volunteer for an activity they are particularly motivated to perform, they are more likely to use their cognitive energy to co-create (Majchrzak et al., 2012). Similarly, Doan et al.'s (2011) review of crowdsourcing platforms indicated that humans need to be able to play several different roles when using the platform, including not simply content provision, but also perspective provision when combining multiple contributions.

Therefore, there are several requirements for implementing co-creation into crowdsourcing participation architectures. The crowd needs to be able to engage in a variety of participation activities – from discussing the sponsor's challenge to surfacing different assumptions. Crowd members need to be able to share under-developed ideas rather than the more complete ideas they have been asked to share. Finally, the crowd needs to be allowed and encouraged to volunteer for different participation activities, rather than asking everyone to post ideas and vote.

These requirements for crowdsourced co-creation are not easily implementable in a participation architecture because of three tensions they raise. Below, we discuss each of the tensions that a participation architecture for crowdsourced co-creation needs to address.

5.1. Tension 1: simultaneously encouraging competition and collaboration

The tension between competition and collaboration has been identified by a number of crowdsourcing researchers (Adler and Chen, 2011; Boudreau, 2012; Franke and Shah, 2003). The competitive nature of crowdsourcing helps to motivate people to put effort into their contributions (Boudreau et al., 2011) while competition also brings decreased willingness to share the prizes through collaborating, and decreased willingness to share information with others (Adler and Chen, 2011; Leimeister et al., 2009).

5.2. Tension 2: idea evolution takes time but crowd members spend little time

Research on the participation of crowd members in crowdsourcing indicate that the crowds appear to react to crowdsourcing in similar proportion to those who participate in online communities, open source development, and Wikipedia-based knowledge production; that is, as many as 70% of registered users never submit an idea or comment (Ebner et al., 2009). Yet, developing a concept at the fuzzy front-end of innovation takes participant effort and time. It takes time for the participant to understand the problem being addressed (including relevant details from a variety of different perspectives), the reasons why a problem has not been solved in the past, previous solutions that were tried and failed, the suggestions of others, and how those suggestions might be combined with other suggestions to present a comprehensive solution to the problem (Carlile, 2002). The tension is that, while this understanding takes time, crowds in crowdsourcing do not generally return very often to the challenge. As with Wikipedia (Ransbotham and Kane, 2011), the majority of the crowds spend little time on the website, reading others' posts. Thus, the tension is one of how to facilitate idea evolution, yet with participants who spend minimal time.

5.3. Tension 3: creative abrasion requires familiarity with collaborators; yet crowd consists of strangers

Innovation generally requires creative abrasion (Leonard-Barton, 1995), a process whereby people with conflicting viewpoints engage each other to surface different assumptions and to recognize that a solution that combines the conflicting viewpoints would best resolve the problem. Creative abrasion has generally been found to occur among team members who know each other's functional boundaries, functional assumptions, and confrontational work styles (Carlile, 2002). Yet, the crowd responding to a challenge is composed of online strangers who are not aware of each other's expertise or experiential background, in which assumptions about causes and effects concerning the problem are often tacit, and in which the norms for engagement are often non-confrontational and not based on having the type of discourse that would allow surfacing assumptions. Thus, there is this tension: creative abrasion is needed, but unlikely to happen among a crowd of strangers.

6. Research questions fostering crowdsourcing co-creation

A participation architecture for crowdsourcing that fosters co-creation will need to consider the three tensions mentioned above. IS researchers are particularly adept at understanding how architectures relieve, or inversely worsen, the conflicts inherent in the innovative use of information systems. By following variants of the Technology Affordance and Constraints Theory (Majchrzak and Markus, 2013), based on Gibson's (1977) notion of affordances, IS researchers have identified design elements of a variety of architectures that constrain and afford purposeful human actions where tensions abound. In the context of tensions in crowdsourcing for innovation, design affordances and constraints may be identified that help to increase the possibility of co-creation among crowds of strangers. For each tension, we offer possible affordances, not as specific proposals but rather as questions for future research that we summarize in Table 2.

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6.1. Managing the tension of simultaneously encouraging competition and collaboration

One way to manage this tension may be with an architectural affordance that separates idea evolution and idea generation. Currently, the architectures emphasize idea generation over idea evolution. But that need not be the case. Idea evolution could be emphasized with architectural designs that make re-combination easy (Jarvenpaa and Lang, 2011); yet, there is little research on design options for recombination. Thus research is needed on affordances specifically for idea evolution.

To simultaneously encourage competition and collaboration, the architecture needs to be designed to incentivize both competition and collaboration. Franke and Shah (2003) demonstrated that, in crowds, innovators like to help others – even those they do not know – and they do it for the fun and enjoyment, not just for reciprocity. "Coopetition", such that individuals within a firm or across firms can exhibit cooperative social ties nested within a broader competitive framework, has been demonstrated to improve a firm's financial performance (Luo et al., 2006; Tsai, 2002). Moreover, crowdsourcing researchers have suggested that individuals are incentivized not just by the final competitive outcomes, but also by cooperative process behaviors (Adler and Chen, 2011; Ebner et al., 2009; Franke and Shah, 2003; Huizingh, 2010; Lakhani and Tushman 2012; Leimeister et al., 2009; Terwiesch and Xu, 2008). Therefore, reward points could be offered to participants based both on how well they compete on ideas, and cooperate on contributing to others' ideas (Hutter et al., 2011), in a manner similar to CCMixter's ownership contribution tree (Jarvenpaa and Lang, 2011). How these points are allocated and aggregated, though, has not been researched.

The architecture would also need to be designed to provide the multi-valenced rewards desired by the crowd (Adler and Chen, 2011). For example, Leimeister et al. (2009) demonstrated that various crowd members wanted such diverse rewards as different types of learning, prizes, career opportunities, self-marketing, appreciation from peers, and appreciation by the sponsoring organization. Ebner et al. (2009) found that the promise of training, creative challenge, and opportunity to come in close contact with sponsoring organizations were higher motivators than money for some participants. Even if a competitive process yields several ideas at faster pace, the satisfaction level of the crowd may be higher with a more collaborative process. The developmental nature of a more collaborative crowdsourcing process may lead to a higher level of learning for individual participants, and a greater willingness to repeatedly participate in future crowdsourcing efforts, rather than suffer crowdsourcing fatigue due to a more competitive crowdsourcing process. Therefore, research is needed on how the participation architecture can be designed to allow participants to personalize rewards, such as networking, learning or recognition, in addition to competitive prizes.

6.2. Managing the tension of idea evolution takes time, but crowd members spend little time

One affordance that may be helpful to manage this tension is an affordance that encourages and makes transparent (i.e., readily accessible and viewable) to the crowd the knowledge evolution (in addition to idea generation) that has occurred in the crowd. Knowledge evolution refers to knowledge that is generated by the community not only for the purposes of refining a posted idea, but for the purposes of keeping the crowd informed of the gaps in knowledge that need to be filled, the knowledge decisions already made, and paths taken but dropped (Erden et al., 2008; Malhotra and Majchrzak, 2012). This knowledge evolution can be organized in a way that the crowd can quickly skim to identify recent changes, and then be able to step into a discussion to offer the next contribution (Majchrzak et al., 2013a,b). Similar to the wiki way (Leuf and Cunningham, 2001), an architecture affording knowledge evolution allows anyone to see what knowledge has been collectively generated thus far. Such transparency encourages people to contribute based on the existing state of that knowledge, not in ignorance of it. Blohm et al. (2011) used wiki technology to foster such an affordance, resulting in more innovative ideas.

Table 2
Future research questions on crowdsourcing for innovation.

Tension	Research needed on tensions
Simultaneously encouraging competition and collaboration?	• Is this tension better managed when the process of co-creation is separated from the process of idea generation? • What are the appropriate allocation and aggregation of incentives for competition and cooperation when co-creation is needed? • How do we personalize the rewards to crowd members' motives when we do not know the crowd very well?
Idea evolution takes time but crowd members spend little time	• Can ongoing co-creation proceed as members rotate in and out of the crowdsourcing event? • What is a design of an architecture that fosters different participants evolving the same idea?
Creative abrasion requires familiarity with collaborators yet crowds consist of strangers	• Does a distinction between front and back stage facilitate co-creation in a crowd? • Does a multi-staged approach to crowdsourcing narrow innovative options too soon or hurt innovation by having the crowd directed to specific ideas rather than evolving their own?

Please cite this article in press as: Majchrzak, A., Malhotra, A. Towards an information systems perspective and research agenda on crowdsourcing for innovation. J. Strateg. Inform. Syst. (2013), http://dx.doi.org/10.1016/j.jsis.2013.07.004

Table 3
Activities undertaken by USAID to obtain crowd for crowdsourcing event.

- Conducted a planning workshop among a large diverse participant base early in the process, identified partner organizations based on the workshop
- Invited individuals in partner organizations to take key roles, conducted conference calls with partner organizations and targeted USAID missions, created a master guest list of over 1000 organizations
- Asked the partner organizations to develop creative and personalized approaches to inviting their constituents (such as videos, and blogs)
- Created a variety of social media channels including Facebook badges indicating who registered before the start of the event
- Recruited dozens of volunteer facilitators to play key roles during the event
- Provided training to the facilitators through a workshop, and
- Identified and invited "Featured Guests" and "Hosts" who were leaders in their field to lend credibility to the seriousness of the topics

With an affordance for knowledge evolution, the focus is also kept on evolving comprehensive solutions, rather than generating more ideas or point solutions. Use of knowledge evolution affordances has been demonstrated to increase knowledge exchange (Malhotra and Majchrzak, 2012). As with Wikipedia, such an affordance may allow individuals who have little time to engage in a process to eventually evolve to a more integrative and comprehensive solution. Research is needed on whether different members of the crowd are actually able to maintain an ongoing co-creation process.

An alternative approach to accommodating to the minimal time that crowdsourcing participants spend online is by manipulating the composition of the crowd. For example, increased diversity of expertise may help to ensure that the long tail of ideas is obtained, thus contributing to a more innovative solution without expending substantial effort from the crowd (Almirall and Casadesus-Masanell, 2010; Terwiesch and Ulrich, 2009). Or, it may be that, by increasing the size of the crowd, the probability is increased of an innovative solution that is sufficiently evolved with crowd members expending little additional effort. Or it may be that, by increasing the involvement of not simply diverse expertise, but the right expertise, the idea evolution is more efficient; an example of this might be when the crowd includes not only individuals external to an organization but also employees who can help to make an innovative idea implementable. Increasing involvement is not a simple feat. Since crowd members who most frequently contribute to crowdsourcing platforms tend to be those who are passionate about the topic (Jeppesen and Frederiksen, 2006; Huizingh, 2010), it becomes a necessary but difficult task to find the passionate few. USAID needed to engage in multiple activities, as listed in Table 3, in order to obtain a crowd of 6700 participants from 150 countries contributing to 10 topics during a 3-day online event to generate ideas addressing the global challenges of human development, entrepreneurship, science and technology, and innovation (Ferguson, 2010). Therefore, research is needed that compares different approaches to reducing crowd members' time commitment, as well as compares the amount of time required of the crowdsourcing sponsor to obtain the crowd members' time.

6.3. Managing the tension of creative abrasion requires familiarity with collaborators yet crowds consist of strangers

An affordance that may be able to manage this tension may be one suggested by Faraj et al. (2011) as the back and front stage approach of Goffman (1959) applied to online knowledge co-creation in communities. In the front stage of the architecture, such as where ideas are posted or knowledge evolution is displayed, the crowd politely aggregates its knowledge with minimal confrontation. In a Wikipedia context, for example, the article being co-created is in the front stage. In the back stage of the architecture, such as where a tab for a discussion forum specifically focused on disagreements is made available, participants may be encouraged to engage each other in task-based generative disagreements and deliberations. In a Wikipedia context, the Talk Page is the back stage. An affordance of having front and back stages may help to manage the creative abrasion tension by having the need for creativity identifiable on the front page, having a back stage where individuals can engage in the creative abrasive process, and then having the creative results displayed in the front page section for the crowd to absorb and continue evolving. Research is needed to examine the front and back stage design of crowdsourcing architectures.

Additionally, the notion of a front and back stage may be generative when there is a common artifact for which a front and back stage are devised, such as a common encyclopedia entry as in Wikipedia or a common relatively constrained design space such as a beer bottle (for the Heineken challenge). For many challenges, though, many different solution alternatives are pursued simultaneously, which may create confusion about which front and back stage is being displayed. In such complex contexts, the multi-staged approach, in which the crowd first generates ideas and then is asked to focus on only a few ideas for further development (Hutter et al., 2011), may provide the means to maintain a focused set of front and back stages. But at what cost to innovativeness of solutions?

7. Conclusions

Firms look outside their boundaries for innovation is a well-accepted strategy. Firms are increasingly experimenting with new ways to make this external engagement for innovation more effective and efficient. Crowdsourcing for innovation provides one such approach. As an approach that requires careful attention to the design of a sociotechnical participation architecture, the inadequacies of current architectures are particularly problematic. Designs that emphasize idea generation,

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prizes for competing ideas, and unguided voting are not likely to provide firms with a new strategic lever for external sourcing of innovation. Nor do such designs leverage the opportunities provided by a diverse crowd.

Strategic IS scholars are particularly well-suited to re-orienting crowdsourcing participation architectures from idea generation to idea evolution, from competitive prizes to personalized multi-valenced incentives, and from the crowd as vote providers to the crowd as a gestalt of every-changing elements that progress toward an innovation and comprehensive solution to previously intractable problems. The community of scholars that succeeds at this reorientation may be doing nothing less than defining a new basis for strategic competition in the years to come.

Acknowledgement

The authors would like to thank NSF (Award Id: 1219832) for the generous grant to support this research as well as helpful comments from the JSIS review team.

References

Adler, P., Chen, C., 2011. Combining creativity and control: understanding individual motivation in large-scale collaborative creativity. Accounting, Organizations and Society 36, 63–85.
Afuah, A., Tucci, C.L., 2012. Crowdsourcing as a solution to distant search. Academy of Management Review 37 (3), 355–375.
Almirall, E., Casadesus-Masanell, R., 2010. Open versus closed innovation: a model of discovery and divergence. Academy of Management Review 35 (1), 27–47.
Amabile, T.M., 1988. From individual creativity to organizational innovation. In: Gronhaug, K., Kaufmann, G. (Eds.), Innovation: A Cross-disciplinary Perspective. Norwegian University Press, Oslo, Norway, pp. 139–166.
Andriole, S.J., 2010. Business impact of Web 2.0 technologies. Communications of the ACM 53 (12), 67–79.
Avital, M., Te'eni, D., 2009. From generative fit to generative capacity: exploring an emerging dimension of information systems design and task performance. Information Systems Journal 19 (4), 345–367.
Awazu, Y., Baloh, P., Desouza, K., Wecht, C.H., Kim, J., Sanjeev, J., 2009. Information – communication technologies open up innovation. Industrial Research Institute, 51–54.
Bingham, A., Spradlin, D., 2012. Open Innovation Marketplace: Creating Value in the Challenge Driven Enterprise. FT Press, Upper saddle River, NJ.
Blohm, I., Bretschneider, U., Leimeister, J., Krcmar, H., 2011. Does collaboration among participants lead to better ideas in IT-based idea competitions? An empirical investigation. International Journal of Networking and Virtual Organizations 9 (2), 106–122.
Boudreau, K., 2010. Open platform strategies and innovation: granting access vs. devolving control. Management Science 56 (10), 1849–1872.
Boudreau, K.J., 2012. Let a thousand flowers bloom? an early look at large numbers of software app developers and patterns of innovation. Organization Science 23 (5), 1409–1427.
Boudreau, K., Lakhani, K.R., 2009. How to manage outside innovation. MIT Sloan Management Review 59 (4), 69–76.
Boudreau, K., Lacatera, N., Lakhani, K., 2011. Incentives and problem uncertainty in innovation contests: an empirical analysis. Management Science 57 (5), 843–863.
Brabham, D.C., 2013. Crowdsourcing. MIT Press, Canbridge, MA.
Buecheler, T., Sieg, J.H., Füchslin, R.M., Pfeifer, R., 2010. Crowdsourcing, open innovation and collective intelligence in the scientific method: a research agenda and operational framework. In: Artificial life XII. Proceedings of the Twelfth International Conference on the Synthesis and Simulation of Living Systems, Odense, Denmark, pp. 19–23.
Carlile, P.R., 2002. A pragmatic view of knowledge and boundaries: boundary objects in new product development. Organization Science 13 (4), 442–455.
Chesbrough, H., 2003. Open Innovation: The New Imperative for Creating and Profiting From Technology. Harvard Business School Press, Boston, MA.
Chesbrough, H., Vanhaverbeke, W., West, J. (Eds.), 2008. Open Innovation: Researching a New Paradigm: Researching a New Paradigm. OUP, Oxford.
Dahan, F., Mendelson, H., 2001. An extreme value model of concept testing. Management Science 47 (1), 102–116.
Dahlander, L., Gann, D.M., 2010. How open is innovation? Research Policy 39, 699–709.
Diener, K., Piller F., 2009. The Market for Open Innovation, Increasing the Efficiency and Effectiveness of the Innovation Process. In: The RWTH Open Innovation Accelerator Survey, pp. 1–94.
Doan, A., Ramakrishnan, R., Halevy, A.Y., 2011. Crowdsourcing systems on the world-wide web. Communications of the ACM 54 (4), 87–96.
Dodgson, M., Gann, D., Salter, A., 2006. The role of technology in the shift towards open innovation: the case of Procter & Gamble. R&D Management 36 (3), 333–346.
Ebner, W., Leimesiter, J., Krcmar, H., 2009. Community engineering for innovations: the ideas competition as a method to nurture a virtual community for innovations. R&D Management 39 (4), 342–356.
Enkel, E., Gassmann, O., Chesbrough, H., 2009. Open R&D and open innovation: exploring the phenomenon. R&D Management 39 (4), 311–316.
Erden, Z., von Krogh, G., Nonaka, I., 2008. The quality of group tacit knowledge. Journal of Strategic Information Systems 17 (1), 4l–18.
Erickson, L.B., Petrick, I., Trauth, E.M., 2012. Hanging with the right crowd: matching crowdsourcing need to crowd characteristics. In: Proceedings of the Eighteenth Americas Conference on Information Systems, August 9–12, Seattle, Washington.
Estellés-Arolas, E., Gonzalez-Ladron-de-Guerva, F., 2012. Towards an integrated crowdsourcing definition. Journal of Information Science 38 (2), 189–200.
Faraj, S., Jarvenpaa, S.L., Majchrzak, A., 2011. Knowledge collaboration in online communities. Organization Science 22 (5), 1224–1239.
Feller, J., Finnegan, P., Hayes, J., O'Reilly, P., 2012. 'Orchestrating' sustainable crowdsourcing: a characterization of solver brokerages. Journal of Strategic Information Systems 21, 216–232.
Ferguson, D.D., 2010. Global pulse 2010: insight and ideas from around the world. Report of the united states agency for international development, Washington, D.C.
Franke, N., Shah, S., 2003. How communities support innovative activities: an exploration of assistance and sharing among end-users. Research Policy 32, 157–178.
Füller, J., Jawecki, G., Mühlbacher, H., 2007. Innovation creation by online basketball communities. Journal of Business Research 60 (1), 60–71.
Fuller, J., Hutter, K., Hautz, J., Matzler, K. forthcoming. Internal innovation communities: the influence of motives and barriers on employees' participation intensity. Journal of Product Innovation Management.
Gable, G., 2010. Strategic information systems research: an archival analysis. Journal of Strategic Information Systems 19 (1), 3–16.
Galliers, R.D., Jarvenpaa, S.L., Chan, Y.E., Lyytinen, K., 2012. Strategic information systems: reflections and prospectives. Journal of Strategic Information Systems 21 (2), 85–90.
Gibson, J.L., 1977. A theory of affordances. In: Shaw, R., Bransford, J. (Eds.), Perceiving, Acting, and Knowing: Toward an Ecological Psychology. Erlbaum, Hillsdale, NJ, pp. 67–82.
Goffman, E., 1959. The Presentation of Self in Everyday Life. Doubleday, NY.
Howe, J., 2006. The rise of crowdsourcing. Wired Magazine 14(6). <http://www.wired.com/wired/archive/14.06/crowds_pr.html>.

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Huang, Y., Singh, P., Srinivasan, K., 2011 Crowdsourcing "Blockbuster" ideas: a dynamic structural model of ideation. In: International Conference on Information Systems 2011 Proceedings (ICIS2011), pp. 4–7.
Huizingh, E., 2010. Open innovation: state of the art and future prospective. Technovation, 1–8.
Hutter, K., Hautz, J., Fuller, J., Mueller, J., Matzler, K., 2011. Communitition: the tension between competition and collaboration in community-based design contests. Creativity and Innovation Management 20 (1), 3–21.
Jarvenpaa, S.L., Lang, K.R., 2011. Boundary management in online communities: case studies of the Nine Inch Nails and ccMixter music remix sites. Long Range Planning 44, 440–457.
Jeppesen, L.B., Frederiksen, L., 2006. Why do users contribute to firm-hosted user communities? The case of computer-controlled music instruments. Organization Science 17 (1), 45–63.
Jeppesen, L.B., Lakhani, K., 2010. Marginality and problem-solving effectiveness in broadcast search. Organization Science 21 (5), 1016–1033.
Lakhani, K.R., Tushman, M., 2012. Open Innovation and organizational boundaries: the impact of task decomposition and knowledge distribution on the locus of innovation. Harvard Business School Working Paper 12-057.
Lee, S., Park, G., Yoon, B., Park, J., 2010. Open innovation in SMEs – an intermediated network model. Research Policy 39 (2), 290–300.
Leimeister, J., Huber, M., Bretschneider, U., Krcmar, H., 2009. Leveraging crowdsourcing: activation-supporting components for IT-based ideas competition. Journal of Management Information Systems 26 (1), 197–224.
Leonard-Barton, D., 1995. Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation. Harvard Business Press.
Leuf, B., Cunningham, W., 2001. The Wiki Way: Quick Collaboration on the Web. Addison Wesley, Boston.
Lindic, J., Baloh, P., Ribiere, V.M., Desouza, K.C., 2011. Deploying IT for organizational innovation. Internal Journal of Information Management 31 (2), 183–188.
Luo, X., Slotegraaf, R., Pan, X., 2006. Cross-functional "Coopetition": the simultaneous role of cooperation and competition within firms. Journal of Marketing 70, 67–80.
Madsen, T., Woolley, J., Sarangee, K., 2012. Using Internet-based collaboration technologies for Innovation: crowdsourcing vs. expertsourcing. In: Academy of Management Annual Meeting, August, Boston.
Majchrzak, A., Markus, M.L., 2013. Technology affordances and constraints in management information systems. In: Kessler, E. (Ed.), Encyclopedia of Management Theory. Sage Publications, Thousand Oaks.
Majchrzak, A., Cherbakov, L., Ives, B., 2009. Harnessing the power of the crowds with corporate social networking tools: how IBM does it. MIS Quarterly Executive 8 (2), 103–108.
Majchrzak, A., More, P.H., Faraj, S., 2012. Transcending knowledge differences in cross-functional teams. Organization Science 23 (4), 951–970.
Majchrzak, A., Wagner, C., Yates, D.N., 2013a. The impact of shaping on knowledge reuse for organizational improvement with wikis. MIS Quarterly 37 (2), 455–469.
Majchrzak, A., Wagner, C., Yates, D.N., 2013b. Online supplement on wikis and knowledge management: the impact of shaping on knowledge reuse for organizational improvement with wikis, MIS Quarterly, online supplement.
Malhotra, A., Majchrzak, A., 2012. How virtual teams use their virtual workspace to coordinate knowledge. ACM Transactions on Management Information Systems 3 (1), 6:1–6:14.
Malone, T.W., Laubacher, R., Dellarocas, C., 2010. The collective intelligence genome. MIT Sloan Management Review 51 (3), 21–31.
Morgan, J., Wang, R., 2010. Tournaments for ideas. California Management Review 52 (2), 77–97.
Normann, R., Ramirez, R., 1993. From value chain to value constellation: designing interactive strategy. Harvard Business Review 71 (4), 65–77.
O'Reilly, T., 2005. The open source paradigm shift. In: Feller, J., Fitzgerald, B., Hissam, S.A., Lakhani, K.R. (Eds.), Perspectives on Free and Open Source Software. MIT Press, Canbridge, MA, pp. 461–482.
Piller, F., Walcher, D., 2006. Toolkits for idea competitions: a novel method to integrate users in new product development. R&D Management 36 (3), 307–318.
Poetz, M.K., Schreier, M., 2012. The value of crowdsourcing: can users really compete with professionals in generating new product ideas? Journal of Product Innovation Management 29 (2), 245–256.
Ransbotham, S., Kane, G.C., 2011. Membership turnover and collaboration success in online communities: explaining rises and falls from grace in Wikipedia. MIS Quarterly 35 (3), 613–627.
Ransbotham, S., Kane, G.C., Lurie, N.H., 2012. Network characteristics and the value of collaborative user-generated content. Marketing Science 31 (3), 387–405.
Rheingold, H., 2003. Smart Mobs. Basic Books, Cambridge.
Schenk, E., Guittard, C., 2011. Towards a characterization of crowdsourcing practices. Journal of Innovation Economics 7 (1), 93–107.
Surowiecki, J., 2004. The Wisdom of the Crowds: Why the Many are Smarter Than the Few and How Collective Wisdom Shapes Business, Economics, Societies and Nations. Doubleday, NY.
Terwiesch, C., Ulrich, K.T., 2009. Innovation Tournaments: Creating and Selecting Exceptional Opportunities. Harvard Business School Publishing Press, Boston, MA.
Terwiesch, C., Xu, Y., 2008. Innovation contests, open innovation, and multiagent problem solving. Management Science 54 (9), 1529–1543.
Trott, P., Hartmann, D., 2009. Why 'Open Innovation' is old wine in new bottles. International Journal of Innovation Management 13 (4), 715–736.
Tsai, W., 2002. Social structure of "Coopetition" within a multiunit organization: coordination, competition and intraorganizational knowledge sharing. Organization Science 13, 179–190.
Tsoukas, H., 2009. A dialogical approach to the creation of new knowledge in organizations. Organization Science 20 (6), 941–957.
Vanhaverbeke, W., Cloodt, M., 2006. Open innovation in value networks. In: Chesbrough, H., Vanhaverbeke, W., West, J. (Eds.), Open Innovation: Researching a New Paradigm. Oxford University Press, Ocford.
Von Hippel, E., 1986. Lead users: a source of novel product concepts. Management Science 32 (7), 791–805.
Von Krogh, G., 2012. How does social software change knowledge management? Towards a strategic research agenda. Journal of Strategic Information Systems 21 (2), 151–164.
Wagner, C., Majchrzak, A., 2007. Enabling customer-centricity using wikis and the wiki Way. Journal of Management Information Systems 23 (3), 17–43.
West, J., Bogers, M., 2013. Leveraging external sources of innovation: a review of research on open innovation. Journal of Product Innovation Management (forthcoming).
West, J., O'mahony, S., 2008. The role of participation architecture in growing sponsored open source communities. Industry and Innovation 15 (2), 145–168.
Williams, D., 2012. Navigate the co-creation vendor landscape. In: Forrester Report, June 22.
Wright, R.S., 2013. Thinking of running an open innovation context? Think again. In: MIT Technology Review, Wednesday, June 05.
Ye, H., Kankanhalli, A., Huber, M., Bretschneider, U., Blohm, I., Gaswami, S., Leimeister, J., Krcmar, H., 2012. Collaboration and the quality of user generated ideas in online innovation communities. In: Annual Academy of Management Meetings, August, Boston.
Zwass, V., 2010. Co-creation: toward a taxonomy and an integrated research perspective. International Journal of Electronic Commerce 15 (1), 11–48.

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