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Evaluation on crowdsourcing research: Current status and future direction

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Abstract Crowdsourcing is one of the emerging Web 2.0 based phenomenon and has attracted great attention from both practitioners and scholars over the years. It can facilitate the connectivity and collaboration of people, organizations, and societies. We believe that Information Systems scholars are in a unique position to make significant contributions to this emerging research area and consider it as a new research frontier. However, so far, few studies have elaborated what have been achieved and what should be done. This paper seeks to present a critical examination of the substrate of crowdsourcing research by surveying the landscape of existing studies, including theoretical foundations, research methods, and research foci, and identifies several important research directions for IS scholars from three perspectives—the participant, organization, and system—and which warrant further study. This research contributes to the IS literature and provides insights for researchers, designers, policy-makers, and managers to better understand various issues in crowdsourcing systems and projects.

Keywords Crowdsourcing · Web 2.0 · Socio-technical systems · Collective intelligence · Mass collaboration · Problem-solving · Research progress

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1 Introduction

With the sweeping progress of Web 2.0 technologies and capabilities, many socio-technical systems have attracted attention from both practitioners and scholars. Crowdsourcing is one of the emerging phenomena that has seen its wide applications in practice and is yet to receive intense attention from the scholars. The term crowdsourcing was first coined by Howe, in a *Wired Magazine* article in June 2006. It is defined as the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined network of people in the form of an open call (Howe 2006). In essence, crowdsourcing is based on a simple, but powerful, concept: virtually everyone has a potential to plug in valuable information (Greengard 2011). Crowdsourcing seeks to mobilize competence and expertise, which are distributed among the crowd, and has different forms. While some crowdsourcing platforms have a much more competitive nature, such as "Idea Competition" and "Design Contest", crowdsourcing is not limited to the style of contest. For example, Wikipedia as a classic form of crowdsourcing, according to Howe (Howe 2006), has a strong collaborative nature. A typical process of crowdsourcing works in the following way. An organization identifies tasks and releases them online to a crowd of outsiders who are interested in performing these tasks on the organization's behalf, for a stipulated fee or any other incentives. A vast number of individuals then offer to undertake the tasks individually or in a collaborative way. Upon completion, the individuals involved submit their work to the crowdsourcing platform, and the organization then assesses the quality of the work (Howe 2006; Riedl et al. 2010; Whitla 2009). It is worth mentioning that some crowdsourcing projects provide a clear format for compensating valuable contributors; while in other cases, such as Wikipedia or Dell's Ideastorm, contributors are not compensated.

The impetus for crowdsourcing arises from the Web 2.0 movement, in which individuals are no longer passive browsers but active contributors. It is no surprise that crowdsourcing explodes in use in parallel with the development of the Internet, web tools, and Web 2.0 (Rouse 2010). Although it is still in an early stage, crowdsourcing has gained considerable attention in the business world, and many companies realized its potential business value and launched campaigns (Leimeister et al. 2009; Rouse 2010; Whitla 2009). Meanwhile, crowdsourcing is not exclusive for business purposes though. Many non-profit organizations have adopted crowdsourcing as an effective model for problem-solving (Brabham 2008a, 2010; Brito 2008). In addition to having gained great attention and interest from the industry, crowdsourcing has also gained attention from the academic community. Scholars from different disciplines have examined various issues in this emerging research area and produced publications that focus on different topics and with different units of analysis. The identity of the Information Systems (IS) discipline, as well as the state of IS research, has been tightly bound with the notion of the IT artifact because IS research has been traditionally situated around people, organizations, and technology (Benbasat and Zmud 2003; Hevner et al. 2004; Orlikowski and Iacono 2001). IT artifacts have been consistently evolving; thus changing and forming new social phenomena that continue to attract IS scholars' attention. IS research has reached out beyond the traditional organizational boundaries to a much broader context (Agarwal and Lucas 2005; Zhang et al. 2011). Web 2.0 is a connective and collaborative technological environment that enables individuals to get involved in internet-mediated social participation, communication, and collaboration. Thus, we believe that crowdsourcing is an emerging IT artifact and a new frontier for IS research. For anyone interested in pursuing further effort in this area, an assessment of the current status and future direction of crowdsourcing research can facilitate a comprehensive understanding of what has been achieved in this research area, what are overlaps with other research topics and efforts, and what potential opportunities for future research are. For example, although the concept of crowdsourcing is related somehow to open source software (OSS) and outsourcing (Rouse 2010), there are significant differences that need to be further explored, and the research findings from those related areas cannot be directly transplanted to crowdsourcing. Jain (2010) poses five open challenges in crowdsourcing, including effective incentive mechanisms, managing submissions, loss of control, quality of the ideas, and creating trust. We believe these challenges are interesting, and there might be additional issues to be explored in future research from IS perspective.

In this paper, we survey the landscape of existing studies on crowdsourcing to provide an overview of the current status. We then identify important research directions that remain unaddressed and warrant further study by IS scholars. The remainder of this paper proceeds as follows: In section 2, we introduce the selection and identification of the research publications. In section 3, we conduct a critical examination of the visible and invisible substrate of crowdsourcing research, including the authorship and the audience of current crowdsourcing research, theoretical foundations, research methods, and research foci. Section 4 proposes seven future directions from three perspectives, i.e. participant's perspective, organization's perspective, and system's perspective. Section 5 concludes.

2 Selection and identification of the research publications

Given the broad interest in crowdsourcing from scholars in multiple disciplines, we intended to include all crowdsourcing publications without being restricted by academic disciplines or outlets. We searched eight different databases, including EBSCO Business Source Premier, EBSCO Academic Source Premier, ISI Web of Knowledge, ABI, ACM Digital Library, Elsevier, SAGE, and Springer databases. The search terms for Subject/Title/Keywords included 'crowdsource', 'crowdsourcing', 'crowdsourced', 'crowdsourcer' and 'crowdsources'. Only publications in English language were considered. The search yielded a total of 128 publications. After removing books, doctoral dissertations, editorial introductions, book reviews, critique comments, letters, and announcements and screening the rest of the publications, especially those that contain "crowdsourc$" terms in the *Subject* or *Keywords*, but essentially have a non-crowdsourcing focus, a total of 38 papers were left in the pool. In an effort to find more relevant articles, we conducted a backward and forward citation analysis (Webster and Watson 2002) on a randomly selected sample of papers in the pool. For the backward tracking, we looked at the references in the sample set and checked if we missed any relevant papers. For the forward tracking, we used Google Scholar to identify articles that cited the sample set but were not in our paper pool. Through this process, we were able to identify a few more publications. The final pool has a total of 55 articles.

During our paper selection and identification process, we found that the number of academic articles is relatively small compared with short reports, news, letters, and announcements on crowdsourcing. This is an indication that the crowdsourcing area is still emerging and evolving, with less established progress. Among the 55 academic publications, 22 appeared in journals, 33 in conference or workshop proceedings, and all were published since 2006 (one paper

in 2006, zero in 2007, 11 in 2008, 13 in 2009, and 30 in 2010 and 2011). Although few papers were published in 2006 and 2007, we found several projects initiated toward the end of 2006 and during 2007, such as the Pepsi's marketing campaign, Zooppa's brand sponsored advertising contests, and Crowdflower's simple task competition, etc. From 2008 and onward, there was a steady increase of published academic articles, and the number in 2010 and 2011 might be larger than 30, due to the time lag in indexing databases.

3 Critical assessment of current studies on crowdsourcing

3.1 Authorship and audience

Information about authors and their institutional affiliations were extracted and analyzed. Among the total of 117 authors, 81 (69 %) are from academia and 36 (31 %) from industry. Among the 55 publications, 35 (64 %) are solely by academics, 10 (18 %) solely people are from industry, and 10 (18 %) co-authored by academics and industry. This indicates that academics play a dominant role in crowdsourcing research, while some industry people are also active in contributing. It is interesting to note that some world renowned research centers from industry, such as IBM Watson Research Center, Microsoft Research, HP Lab, AT&T Lab, etc., have produced publications in recent years. The 117 authors are from a total of 78 institutions, and a closer look at the institutions of the authors shows a wide range of disciplines such as Computer Science, Information Systems, Management Science, Library & Information Science, Business & Economics, and Communications, etc.

In terms of the audience, the 55 articles were published in 19 different journals and 26 different conferences, which represent audience in a diverse set of disciplines that include Management and Business (e.g., *Management Science, Contemporary Management Research, Academic of Management Conf., Conf. on Intl. Management Strategies*), Information Systems and Information Management (e.g., *J. Management Information Systems, International Conference on Information Systems*), Communications (e.g., *Intl. J. Research into New Media Technologies*), Library and Information Science (e.g., *J. of Information Science, ACM Annual Joint Conf. on Digital Libraries*), Computing, Engineering and Human-Computer Interaction (e.g., *Communications of the ACM, Annual SIGCHI Conf. on Human Factors in Computing Systems*), and multidisciplinary fields (e.g. *Science, Technology & Innovation Studies, Information, Communication & Society, ACM Intl. Conf. on World Wide Web*). Although the pool is small, the articles in various disciplinary outlets indicate a broad audience base.

3.2 Theoretical foundations

According to the philosophy of science, the use of theory in research is a hallmark of a discipline's academic maturity (Hauser 1988). Moreover, there are a number of grounds for believing that disciplines require theories that originate from within to attain recognition as an independent field of scientific inquiry (Pettigrew and McKechnie 2001). In terms of any specific research field or area, theories can act as the abstract entities that aim to describe, explain, and enhance understanding of the world and, in some cases, to provide predictions of what will happen in the future and to give a basis for intervention and action, either in natural science or in social science.

In this study, we found that only nine (16 %) out of the 55 articles provided some theoretical bases, which includes a total of 11 theories or models. To examine these theories in detail, we used two lenses: theory types and theory roles. The theory types are adopted from the structuring approach for IT/IS outsourcing by Cheon et al. (1995) and Lee and Kim (1999), which combine the alternate reference theories into three categories: *strategic*, *economic*, and *social/organizational*. *Strategic theories* focus on how firms develop and implement strategies to achieve a chosen performance goal. *Economic theories* center on the coordination and governance of economic agents, regarding their transactions with one another. *Social/Organization theories* concentrate on the relationships that exist between individuals, groups, and organizations. In addition, '*other theories*' would include Motivation theories, Cognitive theories, and Social psychological theories, etc. Theories can also be examined for the roles they play in a study. Gregor (2006) suggests five roles: 1) *analyzing*; 2) *explaining*; 3) *predicting*; 4) *explaining* and *predicting*; 5) *design*. Table 1 shows the theoretical foundations from the nine papers. The theories show diversity in types, yet the majority of the theories are for explanation.

3.3 Research methods

We adopted Alavi and Carlson's classification (Alavi and Carlson 1992) for its comprehensiveness and wide acceptance (Boudreau et al. 2001), and with some modifications as Zhang and Li (2005). At the high level are empirical and non-empirical methods. For empirical methods, we added "individual-based interview" and "focus group", and we divided the original case study into "positivist case study" and "interpretive case study". Among the 55 papers, 44 or 80 % used one method, 10 used two, and one used three methods. Among the 67 total methods used, empirical methods (43 or 64 %) exceeded non-empirical ones (24 or 36 %). Empirical studies have been conducted almost entirely on events/processes. In particular, case study (12 studies, including interpretive and

Table 1 Theoretical foundations

Theory	Type of theory	Role of theory	Referred article
Value Chain Theory	Strategic	Analysis	Lane (2010)
Auction Theory	Economic	Explanation & Prediction	DiPalantino and Vojnovic (2009); Archak and Sundararajan (2009)
Motivation Crowding Theory	Economic	Explanation	Bayus (2010)
Organizational Learning Theory	Social/Organization	Explanation	Bayus (2010)
Cognitive Evaluation Theory	Others	Explanation	Bayus (2010)
SCOUT Model	Others	Explanation & Prediction	Stewart et al. (2010)
Game Theory	Economic	Prediction	Horton and Chilton (2010)
Transaction Cost Theory	Economic	Explanation & Prediction	Horton and Chilton (2010)
Strategic Management Theory	Strategic	Explanation	Mazzola and Distefano (2010)
Innovation Theory	Social/Organization	Explanation	Trompette (2008)
MIAB Model	Others	Design	Leimeister et al. (2009)

positivist), lab experiment (10), field experiment (6), survey (5), and secondary data (5) are the top methods used. It is interesting that although the non-empirical methods were not frequently used as a whole, applied concepts method (10) was often adopted to present some concepts or frameworks in crowdsourcing and then describe the applications of them. This may be partially due to the fact that crowdsourcing is a new research area and many scholars focus on its concepts and applications in various contexts, especially in the early stages. The same can be true to partially explain why the interpretive case studies outnumber the positivist case studies.

3.4 Research foci

Early evidence on authorship and audience revealed that research on crowdsourcing can be multi- and cross-disciplinary. To indicate research foci, we made wordle clouds (see Fig. 1) with all the authors' keywords from the 55 articles (minus the word *crowdsourcing* since it appeared in every article), with minor adjustments for keeping the keywords consistent, unified, and unambiguous.

High frequencies words include *Innovation*, *Evaluation*, *Problem-Solving*, *Model*, *Design*, *Social*, *Platform*, *Measurement*, and *AMT (Amazon Mechanical Turk)*, etc. A closer look at the articles reveals that the studies cover

Fig. 1 Research foci by keywords clustering

different levels of granularity. For example, some studies regard crowdsourcing as a paradigm that exists at the higher level and provides principles or rules to the real world problems (Albors et al. 2008; Brabham 2008a, 2010; Kazman and Chen 2009; Vukovic et al. 2010). Some studies retreat crowdsourcing as a process that involves several key actors and operations (Stewart et al. 2009; Whitla 2009); while others address crowdsourcing as a platform with specific functions and features which can implement the paradigm and support the corresponding processes (Kittur et al. 2008; Schenk and Guittard 2009; Vukovic 2009). Such diverse treatment shows the level of specificity upon which crowdsourcing is studied.

We further explored the research foci of the 55 papers by applying the open coding approach (Strauss 1987) to examine categories of research foci inductively. Three primary research foci and their relationships were identified, which will be discussed in detail below: the conceptualization focus, the system focus, and the application focus. It is worth noting that although a study with a primary focus may touch upon other foci, we only considered the primary focus of a paper for the analysis purpose. For example, to conceptualize crowdsourcing, Brabham (2008a) uses some cases and applications to describe crowdsourcing as a legitimate and complex problem-solving model. Although the study included some cases of applications, its main objective is on conceptualization of crowdsourcing; and it is thus treated so in our analysis. As a result, 11 out of 55 papers are with the conceptualization focus, 19 with the system focus, and 25 with the application focus.

3.4.1 The conceptualization focus

Studies with this focus aim to explore what crowdsourcing is, how it is different from other similar or related concepts, and how crowdsourcing works. Despite a significant

increase of effort on crowdsourcing research and practice, its conceptualization is still under construction and its contours are not clear yet. Many researchers attempt to propose their own definitions for crowdsourcing, based on a diverse set of practices and a number of different theoretical bases and models, and some researchers even state several versions of definitions (e.g., Brabham has two versions and Howe has more than three versions) (Brabham 2008a, b; Howe 2006, 2008). If we take a closer look at these definitions, each one is focused on some perspective or feature of the application of crowdsourcing in a particular area, and it is difficult to reach a consensus. To get a comprehensive definition which integrates the rest, Estellés-Arolas and González Ladrón-de-Guevara (2012) synthesize and analyze those existing definitions in the literature and create an integrated crowdsourcing definition. According to their definition, eight characteristics have been employed to verify if an application or case can be classified as crowdsourcing. We agree with Estellés and González's definition, and in this study, we will examine the difference between crowdsourcing and other related term. What's more, we would like to address that even if some cases can be regarded as crowdsourcing from the general conceptualization, they still reflect some differences in essence and can be classified into various camps.

Customer/user integration into innovation activities is regarded as a mode of value creation, and an *Open Innovation* paradigm was proposed to address the value creation and capture (Chesbrough 2003, 2006a, b). In this view, firms should open their innovation processes by seeking outside knowledge and capturing value with knowledge that does not directly fit the firm's business model (Trompette 2008). Some researchers indicate that open innovation can be effectively done by crowdsourcing (Leimeister et al. 2009). It is worth noting that although the two concepts share the same assumption that knowledge is distributed and the crowd wisdom and the collective intelligence can be a source of competitive advantage, they have some differences. The most obvious difference is that open innovation focuses exclusively on innovation processes of firms, while crowdsourcing has a much broader coverage and target user. Another difference is that when applying the open innovation strategy to a very large degree, firms tend to interact not only with other firms, but also with other stakeholders, mainly customers (Chesbrough 2003; Leimeister et al. 2009), while crowdsourcing refers to links between an organization and the undefined crowd, which is diverse in forms and has a hallmark of internet-mediated or supported mass participation, communication, and collaboration.

The term *Outsourcing* refers to the use of external agents to perform one or more organizational activities, reflecting a company contracting other companies to provide services that might otherwise be performed by in-house employees. Some people view crowdsourcing as a Web 2.0 form of outsourcing, which highlights the value of the Internet platform and interactive technologies (Diana 2010). However, outsourcing and crowdsourcing may still have some differences. One major difference lies in the inclusion of the word 'contract'. In outsourcing, the client firm seeks a supplier and defines needs, and then the pre-selected supplier provides the client firm with goods or services, according to a contract. While in crowdsourcing, the client firm issues an open call and individuals within the crowd provide inputs to the client firm on a voluntary basis. It would be more difficult, if not impossible, to secure a contract because that would entail engaging in an agreement with multiple parties who are often anonymous. In addition, outsourcing largely depends on business relationships (financial incentives), while crowdsourcing may have a much more diverse participation motivation, which may lead to multiple incentives.

In general, *Open Source* can be seen as an overall philosophy for product development and has been widely applied to software development in the last decades. Major companies, such as IBM, Oracle, and HP, have invested generously in the communities that develop Open Source Software (OSS) (Gallivan 2001; Ke and Zhang 2010). The concept of open source involves allowing access to the essential elements of a product (such as source codes for software) to anyone for the purpose of collaborative improvement to the existing products, with the continued transparency and free distribution of the product through the various stages of open development. Howe (2008) defines crowdsourcing as an application of the open source principles to other industries. However, this idea may deserve some further discussions. First, crowdsourcing is not open in the sense that open source could be. In crowdsourcing contest, an organization that invests the capital for the solutions or feedbacks has the ownership or Intellectual Properties Right (IPR), which seems to be more private than that in the open source campaign. Second, in open source, the pursuit of the problem and the satisfaction in finding a better solution to the problem is payment enough (Hars and Ou 2002; Hertel et al. 2003; Lakhani and Wolf 2005), while in many crowdsourcing projects (e.g. 99Designs, Threadless, and IStockPhoto etc.), the contributors need to be compensated by some monetary ways. This will lead to some differences in motivations (e.g., intrinsic and extrinsic) (Bagozzi and Dholakia 2006; Hars and Ou 2002; Ke and Zhang, 2009, 2010; Lakhani and Wolf 2005; Roberts et al. 2006) and incentive mechanism. Third, in crowdsourcing, the items contributed by members of the crowd can be created independently (e.g. cases in idea competition or design contest) or collaboratively (e.g. cases in Wikipedia or citizen science); while in open source, the crowds usually work together to create something, and important dependencies exist between their contributions (Malone et al. 2010).

Based on the current understanding and major differences among crowdsourcing and several related concepts, we presented a conceptualization framework of crowdsourcing (see Fig. 2) by identifying fundamental dimensions and their relationships based on Malone et al.'s work (2010).

The framework addresses a set of key questions in crowdsourcing: 1) Who is performing the task? 2) Why are they doing it? 3) How is the task performed? and 4) What about the ownership and what is being accomplished? These questions address, respectively, the provider or doer of the task (either the undefined crowds or specific groups), the motivation of the participants and the incentives (either intrinsic or extrinsic), the sense of collection (activities can be divided into small pieces that can be done independently of each other), competition (only one or a few good solutions are needed) or collaboration (each individual performs a small fraction of the activity: in this case, participants are complementary) held in people's minds when participating and completing the task, and the solutions to the task be regarded as goods and have the attribute of ownership (either public goods or private goods) (Kazman and Chen 2009). For example, the difference between crowdsourcing and outsourcing may be reflected in "Who" and "What" questions, and the overlap between the two may be demonstrated by the crowdsourcing contest, which shows the characteristics of competition, financial incentives, and private goods. Furthermore, the framework can be used to differentiate various cases of crowdsourcing based on the four fundamental dimensions. We use several examples of actual crowdsourcing venues to illustrate the framework (See Table 2). Some other literatures also support our conceptualization framework theoretically. For instance, Rouse (2010) decomposes the notion of crowdsourcing to create a preliminary taxonomy of crowdsourcing, which focuses on the different capability levels of crowdsourcing suppliers, different motivations, and different allocation of benefits. The three dimensions can be very well mapped to our framework, i.e. "What"-supplier capabilities/nature of the task; "Who & How"-distribution of benefits; and "Why"-forms of motivation. Hence, we believe that the framework can partially reflect the fundamental characteristics of crowdsourcing and attempt to work out an aggregated conceptualization of crowdsourcing.

3.4.2 The system focus

These types of studies aim to explore crowdsourcing as a set of interacting or interdependent components and the structure they form. A crowdsourcing system can also be examined as a bounded transformation process, that is, a process or collection of processes that transforms inputs into outputs. Crowdsourcing systems are man-made systems that comprise multiple views such as planning, requirement, design, implementation, deployment, operational, and behavior, etc. Doan et al. (2011) attempt to provide a global picture of crowdsourcing systems on the Web. They define and classify such systems, then describe a broad sample of various systems. The sample ranges from relatively simple well-established systems (e.g. reviewing books) to complex emerging systems that build structured knowledge bases to systems that "piggyback" onto other popular systems. Kazman and Chen (2009) propose a metropolis model for the development of crowdsourcing systems. The metropolis model offered a unified logic for reasoning about and managing system development for the two major forms of crowdsourcing systems: OSS and community-based service systems. Unlike the traditional system life-cycle models, the metropolis model deliberately focused on the role and nature

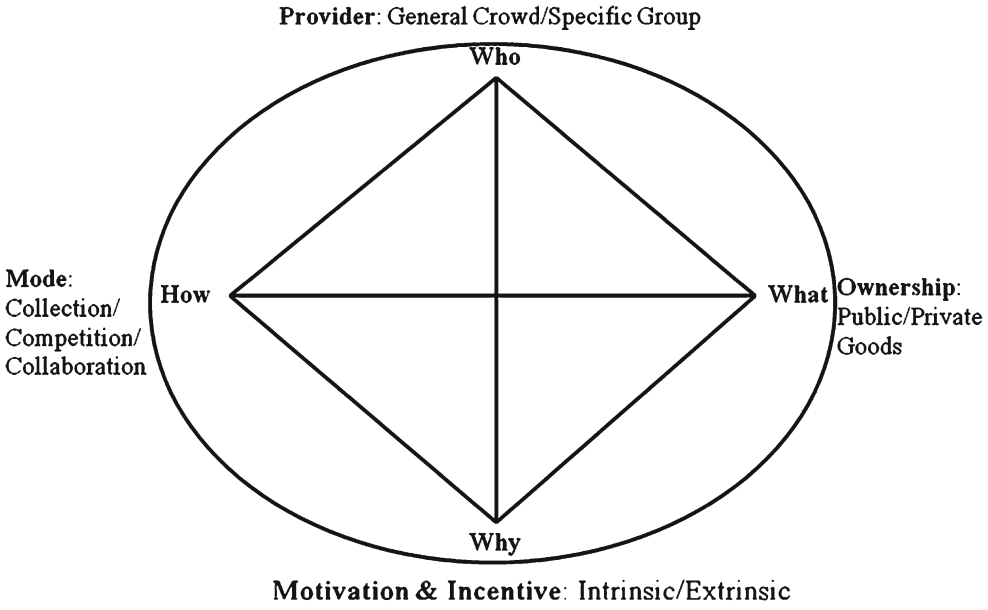

Fig. 2 Fundamental dimensions in crowdsourcing (Adapted from Malone et al. 2010)

Table 2 Conceptualization of crowdsourcing in real cases

Crowdsourcing cases	Who	What	Why	How
Wikipedia	undefined crowd	public goods (terms or articles)	intrinsic incentives	collaboration
Threadless	specific group (designers)	private goods (T-shirts)	extrinsic incentives (financial)	competition
Galaxy Zoo	undefined crowd	public goods (Galaxy ratings)	intrinsic incentives	collection
UTest	specific group (professionals)	private goods (software testing)	multiple incentives	collection
Yahoo! Answers	undefined crowd	public goods (Q & A)	multiple incentives	competition

of creation by crowds. Specifically, crowdsourcing can be defined as a collective intelligence system, which means nodes consisting of individuals or firms interconnected by information transfer links which may involve online or offline communication (von Hippel 2005). In that sense, crowdsourcing systems may reflect the common lifecycle of those real projects. The specific crowdsourcing systems usually involve three categories of components: (1) the organizations directly benefitting from the crowd input, otherwise, called the assigners, who initiate the process of crowdsourcing and has a task as the main appendant; (2) the individuals or members of communities forming the crowd who are providers. They respond to the task and attempt to submit their solutions as feedbacks; (3) an intermediation platform building a link between the assigners and providers, which serves as a crowdsourcing enabler and has some parameters as the rules for the whole lifecycle of crowdsourcing, such as the skill-set, certification level, due date, expected outcomes, and payments for the winners (not a necessity).

In terms of the connections among the three components, there are six primary actions that we synthesized from the literature. Between the assigner and the platform, we distill three actions, i.e. submit, validate, and reward (not necessarily for collaboration based crowdsourcing such as Wikipedia), in which submitting a task and its related requests exists at the early stage of crowdsourcing lifecycle (Whitla 2009), while the validating (evaluate the feedback and select the satisfied ones) and rewarding (especially for some crowdsourcing contests) are the last two steps in the whole process (Roman 2009; Stewart et al. 2009; Yang et al. 2008). Between the providers and the platform, another three actions, i.e. push & pull, participate, and bid represent the interactions, in which push & pull signify the functionalities (e.g., personalized recommendation and customization) provided by the platform to attract, incent, and sustain the crowd (Kittur et al. 2008; Stewart et al. 2009; Vukovic 2009). Participation happens when people have the intention to join some of the projects and take some actions to respond to the tasks. Bidding is a submission state by the participants who have produced outcomes and join in the competition (not necessarily for all types of crowdsourcing systems). Some studies indicate that sometimes there might be mass participation in a crowdsourcing project; however, only a small number of them work out a solution and submit for competition (Brabham 2008b; Kazman and Chen 2009; Stewart et al. 2010). Thus, we differentiate these two actions. In addition, the assigner and the providers may have some direct connections besides the intermediation of platform, which can be achieved by email, telephone, or face-to-face communications (Vukovic 2009). For example, the providers may inquire about some details of the task to support their works, or may negotiate with the assigner over the requirements and rewards. They can also request a reply for their concerns. Figure 3 illustrates the components and their primary actions in crowdsourcing systems. Among the papers with the system focus from our pool, each paper has selected at least one of the components or actions in Fig. 3 as the unit of analysis.

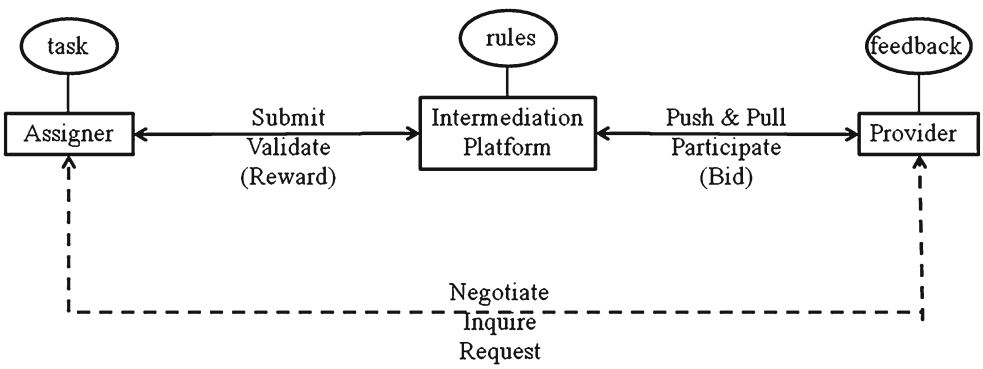

Fig. 3 Components, processes and actions in crowdsourcing

Another way of examining crowdsourcing research with the system focus is to identify a study's paradigm orientation. Hevner et al. (2004) identify two paradigms in the IS research: behavioral science and design science. The behavioral-science paradigm seeks to develop and verify theories that explain or predict human or organizational behavior, while the design-science paradigm attempts to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts. Among the 19 articles with the system focus, 16 articles can be classified as either behavioral-science or design-science paradigm. For the behavioral-oriented research, Bayus (2010) empirically explores the relationship between individual creativity, productivity, and past success in crowdsourcing over time from 2 years of panel data from Dell's IdeaStorm system. The findings address some of the difficulties in maintaining an adequate supply of creative ideas from existing crowdsourcing applications and emphasize the need for a greater understanding of the reward and feedback mechanisms in these systems. DiPalantino and Vojnovic (2009) model crowdsourcing as a two-stage game, in which strategic users select among contests, offering different rewards and upon joining a contest. Those who selected it compete amongst themselves for the reward. The aim of the study is to demonstrate the precise relationship between incentives and participation in crowdsourcing systems. For the design-oriented research, Stewart et al. (2009) explore the distinction in two kinds of crowdsourcing (enterprise versus the public domain) based on the motivation lens, and set up design principles for implementing crowdsourcing within the enterprise. Leimeister et al. (2009) describe how activation-enabling functionalities can be systematically designed and implemented in one kind of crowdsourcing system—IT-based ideas competition. The authors propose a two-step model and proceed to evaluate the outcomes of these design measures. The findings show that the components of the model support incentives and motives of the users; and thus support the process of activation and consequently participation throughout the ideas competition.

3.4.3 The application focus

These studies aim to explore the applications of crowdsourcing in different situations and for different purposes. As mentioned earlier, crowdsourcing can be viewed as a paradigm (Albors et al. 2008; Brabham 2008a, 2010; Kazman and Chen 2009; Vukovic et al. 2010), a process (Stewart et al. 2009; Whitla 2009), or a platform (Kittur et al. 2008; Schenk and Guittard 2009; Vukovic 2009), so people may use it as a tool or method to solve real world problems. Nearly half of the 55 articles have an application focus. Although crowdsourcing started in the business world, its applications are predicted to go beyond the business world to benefit social and environment sustainability, emergencies handling, cultural heritage conservation, and urban planning, etc. (Brabham 2008a, 2010, 2011). This is demonstrated by the articles with the application focus, where a good number of studies have applied crowdsourcing to scientific and engineering fields. Brabham (2011) proposes a typology of crowdsourcing applications based on four different functions to illustrate the problem solving process, including knowledge discovery and management, broadcast search, peer-vetted creative production, and distributed human intelligence tasking. However, this typology only focuses on one dimension, i.e. kinds of problems and how it works. To illustrate in more details on the nature of crowdsourcing applications, we attempted to use two dimensions to classify them, i.e. context and function.

First, we divided the context into two categories: business context and non-business context. The former includes companies, for-profit organizations or marketplaces (Chanal and Caron-Fasan 2008; Poetz and Schreier 2009; Vukovic 2009; Whitla 2009), while the latter includes non-profit organizations or institutions, such as public libraries, R & D centers, government (Shah et al. 2009), etc., where mass participation (Holley 2009), scientific collaboration (Heer and Bostock 2010; Hsueh et al. 2009; Kittur et al. 2008), or citizen science (Hudson-Smith et al. 2009) take place. As Zhang and Li (2005) note that "nothing happens in a vacuum," the context of an application plays an important role in reflecting the impacts and significances of crowdsourcing.

Second, the dimension of function represents the part of the product and/or service lifecycle that is being crowdsourced (Vukovic 2009). Some researchers attempt to characterize the functions of crowdsourcing applications by the nature and granularity of the task (Rouse 2010; Schenk and Guittard 2009). Low task granularity usually deals with some routine tasks, such as data collection, rating, and translation of simple texts. Middle task granularity usually refers to some creative tasks, such as logo design, photography, user-generated advertisement, etc. High task granularity usually copes with some sophisticated problems and complicated tasks, such as product development and intellectual consultant. In general, it is obvious that different task granularities need various extents of individual's involvement (time and effort), intellectual capital, and opportunity cost, etc. Moreover, some researchers investigate the functions of crowdsourcing applications for business use by the purpose and aim. For instance, Kleeman et al. (2008) group the business-oriented applications of crowdsourcing by several functions: product development and configuration, product design, competitive bids, permanent open calls, community reporting, product rating, and customer-to-customer support. Whitla (2009) surveyed the literature and found that there are three marketing-related areas in which firms actively use crowdsourcing, namely product development, advertising & promotion, and marketing

research. For those applications in the non-business context, some other functions may need further attention. In our literature pool, many researchers from the computer science discipline are enthusiastic to use the crowdsourcing to test, evaluate, and/or support their work on natural language processing (Munro et al. 2010), machine learning (Ambati et al. 2010; Chris 2009), software engineering (Stolee and Elbaum 2010), network event monitoring (Choffnes et al. 2010), and sentiment classification (Brew et al. 2010), etc. Some researchers from other disciplines also applied the crowdsourcing to support, mediate, and facilitate their work on user studies (Alonso et al. 2008; Eckert et al. 2010; Franklin et al. 2011; Kittur et al. 2008; Marcus et al. 2011), cataloging (Holley 2009), and transportation plan (Brabham 2009), etc. Based on the cases and projects we collected (126 in total), an open coding was conducted to classify the crowdsourcing by its function. After several iterations, we finalized three main categories, namely design & development (52 or 41 %), test & evaluation (30 or 24 %), and idea & consultant (25 or 20 %). Some other functions, such as data reporting, editing, and translating, etc., only account for 15 % out of 126 cases. Thus, we classified the crowdsourcing functions into four categories: *Design & Development*, *Test & Evaluation*, *Idea & Consultant,* and *Other*.

The above examination leads us to conclude that crowdsourcing applications can be better understood by examining both contexts and functions. Table 3 shows the typology of crowdsourcing applications, and lists some of the examples. For instance, 99Designers, Threadless, and IStockPhoto focus on the design of logos, business cards, banners, T-shirts, and digital photos etc. Thus, they belong to the Business & Design/Development cell. UTest provides real-world QA services for software testing based on communities of more than 15,000 professional testers around the globe. Mob4Hire is the world's largest mobile usability testing community and helps mobile application developers access a variety of testing problems. Thus, these two applications would fit in the Non-Business & Test/Evaluation cell.

4 Future directions

As a research area, crowdsourcing is far from being established. So far, only 55 academic articles have been retrieved in our study, among which about half focus on the applications and fewer are on the kernels or essences. The lack of theoretical orientation is an indication of the immaturity of the research area. Although researchers from diverse disciplines have contributed to the current research on crowdsourcing, different strands of crowdsourcing research and practice do not seem to have converged yet. So it is challenging to capture its essence or to predict its future movement. In the IS discipline, one would expect to see scholars have more interests and efforts on crowdsourcing given their previous enthusiasm on outsourcing and OSS development. Furthermore, IS researchers may take a system focus to examine crowdsourcing research. As illustrated in Fig. 3, three components, namely assigner, provider, and platform, should be highlighted by IS scholars. To contribute and facilitate future progress, we propose several future research directions on crowdsourcing. These are summarized in Fig. 4, where the directions are grouped by three different perspectives, i.e., participant's perspective, organization's perspective, and crowdsourcing system's perspective. Accordingly, participant's perspective responds to the provider component, including member of crowd's motivation and behavior. Organization's perspective responds to the assigner component, including some relevant activities, such as adoption, implementation, governance, and evaluation of crowdsourcing cases and projects. System's perspective responds to the platform component, including the incentive mechanism design of interface, system, and platform, and some other related technology issues.

4.1 From a participant's perspective

Crowdsourcing can provide individuals in the crowd opportunities for working with large or small organizations to increase exposure and working experiences, and has allowed people to tap, explore, and turn their hobbies into something more beneficial. Participation in crowdsourcing projects can provide individuals with more chances to get noticed, sharpen their creative skills, and strengthen a sense of community. It is critical that the crowd is treated as a partner in the crowdsourcing initiative, and the needs, aspirations, and motivations of the crowd must remain an important consideration. Hence, from a crowd's perspective, future researchers might want to pay more attention to the directions outlined below.

Table 3 Typology of crowdsourcing application

Context \ Function	Design & development	Idea & consultant	Test & evaluation	Other
Business	99Designs	BBNM	Crowdspirit	Poptent
	Threadless	Marketocracy	Netflix Prize	MusikPitch
	IStockPhoto	Squadhelp		
Non-business	Mass Mapping	TunedIT	UTest	Kaggle
	PeoplePerHour	Acsys Interactive	Mob4Hire	EditZen

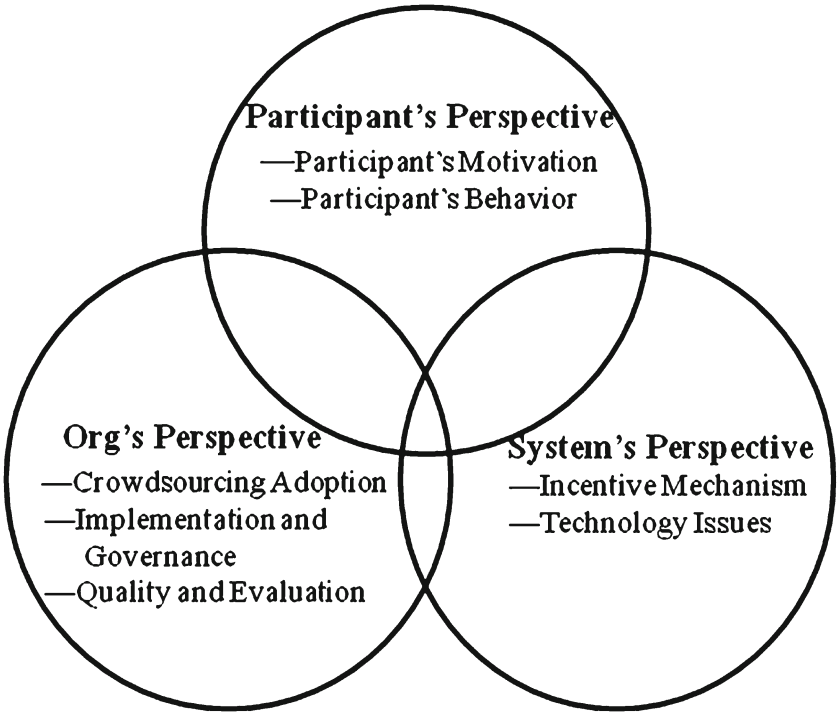

Fig. 4 The road ahead: Research opportunities in crowdsourcing for IS scholars

4.1.1 Motivation to participate

Since the essence of crowdsourcing is the crowd's wisdom (Surowiecki 2004) and collective intelligence (Gregg 2010; Leimeister 2010; Lévy 1995), the successful initialization and sustainable development of crowdsourcing communities largely depend on mass participation. Thus, it is of great importance to explore what motivates the crowd to participate in problem-solving activities. Motivators in OSS and outsourcing are helpful, but not precisely transferrable to crowdsourcing cases due to the differences among them, as discussed earlier. Some empirical studies attempt to explain the many reasons crowd participate in crowdsourcing applications (e.g., Brabham 2008b, 2010; Lakhani et al. 2007). Yet, some findings are conflicting, especially in regard to the importance of making money as a motivator across varying crowdsourcing cases (Brabham 2010). We infer that such conflicting results may be partially due to various crowdsourcing application contexts. For example, the motivation to participate in a citizen science project or a business-oriented crowdsourcing contest may differ widely (Brabham 2008b; Nov et al. 2011; Raddick et al. 2010). Hence, it is meaningful to conduct more studies on the crowd's motivations to participate in various contexts. Such studies will provide insights on influencing factors to participate, which may then shed light on crowdsourcing systems design and policy making. At the higher level, meta-analysis can be conducted to provide a broad view of diverse research by comparing different subcategories of studies rather than pure aggregation. For example, the impact of intrinsic or extrinsic motivation on user's participation in crowdsourcing can be separately examined, and the moderating effects of some constructs can be investigated in various application contexts of the crowdsourcing cases.

Furthermore, among the 55 articles we examined, only two used motivation theories in their studies (Bayus 2010; Leimeister et al. 2009). We argue that more studies should take theoretical positions in understanding crowd's motivation. Reeve (2005) listed 24 motivation theories developed in different disciplines, in different contexts, and from different philosophical points of views. Some of these theories may provide direct guide in studying crowd's motivation or inspirations for developing new theories in crowdsourcing. We suggest that researchers scrutinize those theories and appropriately use them in the motivation studies of crowdsourcing.

4.1.2 Participant's behavior

Participant's behavior in crowdsourcing is an important research topic. Two interesting issues arise. The first has to do with the crowd's effort and quantity of contribution. A better understanding of effort and contribution can help find the target crowd and design incentive strategies, accordingly. To date, only few studies explore related issues on effort and contribution quantity. Stewart et al. (2010) propose a SCOUT model for the enterprise domain to reflect crowdsourcing participation inequality. The model classifies crowds into three groups: super contributors, contributors, and outliers. In the future, researchers may find literature

support from other areas (e.g., OSS and online community) and use some quantitative methods, such as data mining and secondary data analysis, to better understand the behaviors in crowdsourcing.

The second research issue has to do with the processes of crowdsourcing. Due to the observation that a small fraction of participants account for the vast majority of outcomes, and most participants become inactive after only a few submissions, it is interesting to investigate what happens when crowds select tasks, compete or collaborate with others, and submit feedbacks. Yang et al. (2008) find that participants in crowdsourcing contests tend to select tasks where they are competing against fewer opponents to increase their chances of winning, and they are prone to select less popular and higher rewards tasks. However, Yang et al. (2008) also indicate that those efforts do not significantly increase their chances of winning, and in some categories of tasks, their chances even decrease. Thus, this raises a further question: What kind of strategic behavior may enhance the winning chances? There have been a number of studies of auction bidding behavior and strategies in experimental economics, and we believe that these studies may have referential value for crowd's successful behaviors in crowdsourcing contests. In future work, it is worth studying winners' strategic behaviors and viewing these behaviors as benchmarks for other participants. Considering that crowdsourcing systems have diverse contexts and functions, and the granularity of the tasks may vary from case to case, it is necessary to study participants' behaviors in certain scenarios and context. For example, in a market-oriented crowdsourcing portal, such as TopCoder, a sense of competition is found to play a leading role, and participants compete to design and develop software, which is later sold for profit by the sponsoring firm (Archak 2010). While in a citizen science-oriented crowdsourcing project, such as Google map, a sense of collaboration plays a dominant role, and the crowd collaborates to tag and update maps. Therefore, more quantitative studies (such as lab/field experiments) may reveal participants' behaviors in various cases.

4.2 From an organization's perspective

Crowdsourcing can provide organizations richer content and better solutions in a creative and cost-effective way from a diverse crowd than what may be possible within an organizational unit or function. This model of opening up the boundaries of an organization to tap knowledge of external entities increasingly becomes a source of competitive advantage for organizations in various fields (Chesbrough 2003; Jain 2010). From an organization's perspective, future researchers might want to pay more attention to the directions outlined below.

4.2.1 Crowdsourcing adoption

Despite the advancement of Web 2.0 technologies and emerging crowdsourcing systems and applications, few studies have focused on the adoption issue of crowdsourcing. Schenk and Guittard (2009) identify four main reasons for a firm to adopt crowdsourcing, i.e. quality of output, risk reducing, problem solving, and organizational core competences, and then they elaborate on the strength of adopting crowdsourcing as a business strategy. Maiolini and Naggi (2010) focus on the relation between SMEs and crowdsourcing. They indicate that crowdsourcing allows SMEs to build up new competences that normally cannot be implemented or developed due to scarcity of expertise and available investments. Also, crowdsourcing gives new opportunities to SMEs to start a dialog with large enterprises and new markets. Meanwhile, they also point out that some challenges to crowdsourcing adoption by SMEs should be highlighted. Although direct research on crowdsourcing adoption is relatively scarce, some articles on the adoption of open innovation practices may discuss the relevant issues since open innovation can be done by crowdsourcing mode (Leimeister et al. 2009). For example, Sims and Crossland (2010) explore what drives traditional firms to engage with open innovation communities and what are the expected consequences of such engagement, which to some extent examine a crucial facet of crowdsourcing adoption. Some researchers examine the open innovation adoption in specific industries, such as telecommunication industry (Bigliardi et al. 2012) and bio-pharmaceutical industry (Chiaroni et al. 2009), which explore some determinants of open innovation from different dimensions. We believe that, in general, crowdsourcing adoption may meet those similar problems, but due to the difference between open innovation and crowdsourcing we addressed above, the real cases in crowdsourcing adoption may have a new look. Thus, an important question to consider before any crowdsourcing adoption decision is: Why crowdsource a particular task? Addressing this question needs to pay attention to the objectives of crowdsourcing projects, types of tasks (simple, moderate, or sophisticated), and platform selection (self-developed or a third-party one). The fit among these three components is an interesting research topic and can shed light on the adoption of crowdsourcing. Hence, future work may concentrate on the enablers and barriers to the acceptance and effective use of crowdsourcing. Some potential factors that influence crowdsourcing adoption, such as organization's strategies, human resources, timeliness, financial situations, functionalities, and environment, etc., are worth further examination.

Another research question has to do with the level of crowdsourcing adoption. It is worth noting that crowdsourcing applications are still considered experimentations and

innovations. It is difficult to predict which of the application types will become dominant in the future. After classifying over 100 crowdsourcing cases listed in Wikipedia with the framework in Table 3, we found that nearly 50 % cases fell into the "business-design & development" camp. Therefore, it is interesting to examine the characteristics of organizations that have adopted crowdsourcing. Meanwhile, it is also interesting to compare the rate of crowdsourcing adoption among organizations in various domains and contexts. This may provide practical values and guidelines for organizations that have a slower adoption and still wonder the value of crowdsourcing as a business strategy.

4.2.2 Implementation and governance

Although nearly half of the articles in our collection pool focus on the applications, few studies deliberate on implementation and governance issues from the organization's perspective. In addition, "easy to flourish, and easy to decay" is a hallmark of crowdsourcing, which is similar to some other Web 2.0 modes and applications. Thus, a critical issue is to improve the implementation and governance of crowdsourcing projects, which may lead to a meaningful use of crowdsourcing after its adoption.

Sharma (2010) provides a framework on the important considerations while implementing a crowdsourcing initiative. After studying several current crowdsourcing initiatives and associated models in outsourcing and technology adoption, Sharma proposes a critical success factor model for crowdsourcing. In the model, motive alignment of the crowd is the central factor, whereas the peripheral factors include the vision and strategy of the crowdsourcing initiative, linkages & trust, infrastructure, human capital, and external environment. The model is interesting yet needs to be tested and maybe improved and refined. For example, some of the identified factors (e.g., vision & strategy, trust, and human capital, etc.) can be represented by some detailed constructs, which may help build specific theoretical models. Furthermore, we expect more case studies, both positive and negative ones, to verify whether those factors can really play a critical role in implementing successful crowdsourcing projects.

Another interesting but less explored question is how to measure/quantify whether a crowdsourcing initiative achieves its goals? On one hand, organizations initiate the crowdsourcing projects and have some expectations on the performance. On the other hand, the success or failure of an initiative also relies on the crowd. If the crowdsourcing initiative is successful, the collective voice of the crowd will definitely make it known via the rating, commenting, and recommendation systems (Meier 2010).

Crowdsourcing has significant transformational power in collective action and content creation. By allowing the crowd to participate in problem-solving process, organizations may lose a significant degree of control over the behavior of the crowd and outcome of the project, as the crowd is likely to make unpredictable moves or is steered by undue influences (Bonabeau 2009), and sometimes the crowd may even change the project and the organization's primary goals. Thus, organizations will need to identify appropriate governance mechanisms to steer the crowd toward completing the designated task without losing focus. Drawing from the governance mechanisms in the OSS literatures, Jain (2010) develops an analysis framework to examine the governance mechanism implemented in three different crowdsourcing initiatives. The study provides insights into how governance mechanisms might impact the outcome of crowdsourcing initiatives. Here, we suggest two directions for further research. First, explore and justify governance mechanisms built in the OSS and other areas such as outsourcing and open innovations. Second, empirically validate the mechanisms by case studies such as best practices in various domains and contexts.

4.2.3 Quality and evaluation issues

Although crowdsourcing works on the principle that 'two heads are better than one', sometimes a crowd can return a vast amount of noise that may be of little relevance (Keen 2007). In that case, crowdsourcing does not really help sort through or synthesize information. Instead, it may lead to information and/or cognitive overload, which can cause problems on evaluating submitted feedbacks and identifying qualified ones. Although some studies show that the crowd can provide valuable results and can actually compete with professionals in some cases (Hsueh et al. 2009; Poetz and Schreier 2009; Wiggins & Crowston 2011), many people still doubt the quality of feedbacks, especially related to science or business innovation issues that may need a higher standard. Riedl et al. (2010) indicate that due to company's limited absorptive capacity, there is a strong need for an evaluation mechanism to identify the best ideas. They use a multi-method approach to show that despite the popular use of simple rating mechanism in open innovation communities, such thumbs up/down rating or 5-star rating do not produce valid outcomes and are significantly outperformed by the multi-attribute scale. Generally, there are three evaluation approaches that can be used to measure the quality of crowdsourcing results.

First, some organizations check the volunteer data by experts in some cases (Delaney 2008; Galloway et al. 2006) and may work out an evaluation framework based on their own conditions and some experience from other fields, such as the quality control framework in Wikipedia. However, this approach could be critiqued for the heavy workload and biased judgments. Second, organizations can employ popular voting/rating mechanisms by the public or use some machine learning or text mining techniques to

automatically evaluate the quality of data. For example, Ipeirotis et al. (2010) indicate that existing techniques cannot separate the true error rate from the biases that some workers exhibit, which may lead to the incorrect assessments of data quality. In that case, they present algorithms that aim to solve the separation problem by incorporating cost-sensitive classification errors and seamlessly integrate unsupervised and supervised techniques for inferring the quality of the workers. However, we suggest that more work should be done to prove whether this method is valid and effective due to the 'information cascading' which arises when individual's opinion about the merit of a given product or service are influenced by those of others (Johnson 2007). Third, some third-party organizations (e.g., the Dolores Labs) can help to evaluate the quality of crowdsourcing feedbacks. It posts Amazon Mechanic Turk HITs on behalf of its clients, and then filters the answers through custom-built software systems to check for quality and generate meaningful results. However, some organizations do not have enough time for Dolores's extensive quality-control measures, which may include creating test questions, checking responses against one another, tracking individual answer histories, and creating a confidence measure. So far, there is little research on how to effectively combine those social and computational approaches to evaluate the feedback of crowdsourcing. Therefore, we suggest a selective use or combination of those evaluation methods based on organizations' objectives, characteristics of tasks, and scale of feedbacks.

4.3 From a system's perspective

Crowdsourcing systems are man-made socio-technical systems to support interaction and connectivity between people and technology in workplaces, and to reflect interaction between society's complex infrastructures and human behaviors. Some researchers define and explore the characteristics of crowdsourcing models and yield implications for the design of crowdsourcing systems directly (Doan et al. 2011; Huberman et al. 2009; Kazman and Chen 2009; Stewart et al. 2009, 2010). Other researchers integrate the idea of crowdsourcing into the design of collective intelligence systems, such as IT-based ideas competition systems (Leimeister et al. 2009). However, if we take a closer look at the interrelatedness of people, information, technologies, and organization/society in crowdsourcing systems, we may find that there is a large space for future research. Here we list several future directions just to illustrate the potentials.

4.3.1 Incentive mechanism design for crowdsourcing systems

Incentive issues have become important in many IS areas, and some studies have focused on the incentive aspects of crowdsourcing, especially from the economics which looks at incentive issues from a game theoretic perspective (Archak and Sundararajan 2009; DiPalantino and Vojnovic 2009; Horton and Chilton 2010; Wilcox 2000). It is of great importance to explore the incentive mechanism for crowdsourcing systems, which can help the organization catch the mass users and gain the valuable solutions from them. Hence, organizations will need to ensure that their incentive mechanisms are designed pertinently and appropriately.

We believe that incentive issues have to do with the understanding of motivation to participate, and designers should incorporate different motivation elements into the design of a good incentive mechanism. Zhang (2008) proposes a motivational affordances theory (MAT) for the positive design of information and communication technology (ICT), in which the intrinsic motivational sources and needs can be derived from psychological, cognitive, emotional, and social aspects; thus, MAT can function as a theoretical foundation for researchers and practitioners to explore the crowd's diverse intrinsic motivations and find ways to link to incentive strategies. Additionally, some researchers regard the extrinsic incentives, especially the financial incentives, as an important element in the design of crowdsourcing contest systems (Kleeman et al. 2008; Mason and Watts 2010).

Furthermore, it is worth noting that incentive issues not only rely on the motivation of participants, but also have great relevance with the nature of the problem crowdsourced (Boudreau et al. 2011), and the organizations' purposes and objectives. Boudreau et al. (2011) put forward the research question how many competitors should be admitted in designing innovation contests, and provide evidence of two coexisting and opposing forces in incentive design of crowdsourcing systems, i.e. enthusiasm of participants and the likelihood of extreme-value solution. The results indicate that uncertainty and the nature of the problem should be explicitly considered in the design of innovation tournament. Ba et al. (2001) introduce a dimension in information systems design, i.e. incentive alignment, which addressed the high-level design issues that recognize the interests and incentives of the target users, especially when the users' own objectives differ from that of the organizations. In crowdsourcing systems, incentive alignment of the crowd is a critical factor influencing the crowd's behavior and interaction with the system. It is vital that the motives of the crowd are aligned to the long-term objectives of a crowdsourcing initiative (Sharma 2010). Thus, we propose the following research questions: (1) In a specific crowdsourcing system, is the user's behavior mainly driven by economic incentives or by social incentives, or a mix of them? What is the relationship between the incentives and the expected behavior? (2) In general, is there any mechanism that induces the appropriate crowd's behaviors, while

distilling an outcome that contributes to the organizational goal, thus achieving incentive alignment? To answer these questions, many theories from other disciplines, such as Psychology, Economics, and Communication may need be used to build some theoretical frameworks and models, and the appropriate theoretical mix will to some extent, enrich our understanding about the incentive mechanism of crowdsourcing and help to support more empirical and/or experimental studies.

4.3.2 Technology issues in crowdsourcing systems design

Organizations can either develop their own crowdsourcing systems or use third-party crowdsourcing systems or platforms. Web 2.0 technologies can help improve collaboration and communication within organizations and across multiple domains and contexts. Gartner Group (http://www.gartner.com) reports that Web 2.0 technologies rapidly make their way into corporate technology infrastructures and architectures. For crowdsourcing systems, many Web 2.0 technologies, such as wikis, social tagging, mashups, blogs, RSS filters, podcasts, and SNS, etc., can be employed to design the interfaces and backup platforms of the systems. However, Web 2.0 technologies are taken for granted and not well addressed in the current crowdsourcing studies. It has been observed that similar interfaces and functionalities exist in many crowdsourcing systems. Yet, Vukovic (2009) finds that most existing crowdsourcing systems fall short on facilitating the dynamic formation of globally distributed teams, and lack a flexible and proactive team discovery and building mechanism. Furthermore, none of these crowdsourcing systems provide a comprehensive set of tools and computational services that can be used by the crowd to participate in problem-solving. Therefore, we suggest two directions for future research. One is about technology selection in the design of crowdsourcing systems, which should emphasize the task-technology fit and technology alignment with functions, features, objectives, and the crowd. The other direction is related to the technology-mediated or technology-driven process innovation. This relies on the assumption that the emergent and/or convergent technologies can lead to some unpredictable and surprising results. The researchers can foresee the potential of some technologies or the combination of technologies, and then design the crowdsourcing systems based on those technologies to see if there are some innovations occurred in the process of crowdsourcing.

5 Conclusions

Crowdsourcing is a new Web 2.0 based phenomenon and becomes a recognized sourcing mechanism for problem-solving in organizations and societies by outsourcing problems to an undefined entity or the 'crowd' (Jain 2010). Much like the phenomenon it is studying, crowdsourcing research is a dynamic and vibrant research area, and has been steadily growing over the years. We attempt to use the information-model (I-model) proposed by Zhang and Benjamin (2007) as a conceptual framework to prescribe main research objectives of crowdsourcing. I-model conceptualizes the information related fields and studies by identifying and characterizing their four core components and the dynamic and equilibrium relationships among them: Information, Technology, People, and Organization/Society. In terms of the Information component, crowdsourcing as a competitive/collaborative workflow or group decision support system, provides user-generated content, human intelligence, and/or other kinds of information artifacts as a solution or feedback to mediate, support, or facilitate the problem-solving process. As illustrated in Fig. 3, the information component works through the whole process of crowdsourcing and embeds in other components. In terms of the Technology component, crowdsourcing as a community-based approach has extended to various types of collaboration tools in the age of the Internet. In today's Web 2.0 world, peer-to-peer and collaboration-based platforms play increasingly important roles in an array of fields (Tapscott and Williams 2007). For example, AMT is the most well-known platform as it provides a marketplace for the micro-tasks. A large number of organizations use AMT to source thousands of micro-tasks that require human intelligence. In this study, we were surprised to find that nearly half of the articles on the application level have adopted AMT as an empirical platform. In terms of the People component, crowdsourcing systems, as socio-technical systems, largely depend on people's motivation and behavior. In crowdsourcing systems, people may include assigners, users/providers, managers, and designers. Their various actions and behaviors will be more or less influenced by their cognitive and affective factors. In terms of the Organization/Society component, crowdsourcing finds its way in one or more of these forms: working groups, institutions, communities, industries, governments, and global societies. Among them, business and engineering are two primary contexts where crowdsourcing takes place, and an increasing number of organizations are also applying crowdsourcing to reengineer an array of processes. For example, military units have explored ways to collect intelligence data through crowdsourcing; government agencies have used it to collect data on everything from road repairs to urban planning; relief agencies have relied on it to better understand how to focus aid and resources (Greengard 2011).

The focus of this paper was to identify the current research status, synthesizes various views and streams of research, and prescribes directions for future investigation

from IS perspectives. Our research has both theoretical and practical contributions. Theoretically, it paints an intellectual landscape of crowdsourcing research, provides conceptualizations on various aspects, and points out gaps and holes that deserve future attention. Practically, our study provides insights for designers, policy-makers, and managers to better understand various issues involved that may affect them to design, initiate, implement, manage, and evaluate crowdsourcing systems and projects. We believe that it is a good opportunity for IS scholars to pay more attention to this research area and contribute to what is likely to be not only a significant scholarly endeavor, but also one with important implications to benefit people, organizations, and societies.

It should be noted that although we identify several essential research directions for future investigation, the list is by no means complete. Some social, cultural, and ethical issues (Brabham 2008a, b, 2011; Whitla 2009) are also very important to investigate in future studies. Our objective in this paper was merely to provide a starting point for a research conversation and to encourage IS scholars to become active participants in the global discourse on crowdsourcing research.

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