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Leveraging Crowdsourcing for Organizational Value Co-Creation

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Abstract:

Crowdsourcing is an emerging trend of using the crowd to solve organizational tasks that can offer companies various benefits. However, companies often have difficulty realizing value from crowdsourcing partly because of a lack of knowledge about what kind of crowdsourcing approach will fit their tasks. Also, companies need to understand how to codify task requirements and what incentives to provide to the crowd for different types of tasks. Given the absence of prior research to answer these questions, this article aims to address this knowledge gap. Deriving from the literature, we identified three crowdsourcing approaches and two characteristics to categorize tasks that can determine the appropriate approach. We then performed an analysis of eighty successful tasks from eight popular crowdsourcing websites to understand the appropriate approaches and task specification requirements for the tasks. We also interviewed sixteen participants (two from each website) to identify the motivations for solving different kinds of tasks. Based on the analysis, we propose a framework to match task types with appropriate crowdsourcing approaches, requirement specificity, and motivations of the crowd. Accordingly, we provide guidelines to companies on how to select the appropriate crowdsourcing mechanism for each type of task.

Keywords: crowdsourcing; task complexity; outcome variety; requirements specificity; motivations

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I. INTRODUCTION

As the paradigm of open innovation acquires momentum, the importance of leveraging external knowledge for organizational tasks is gaining management's attention [Howe, 2008; Zwass, 2010]. Companies are starting to tap the wisdom of the crowds for activities such as carrying out tedious work, collecting product ideas, and promoting brand awareness [Schulze, Seedorf, Geiger and Kaufman, 2011; Surowiecki, 2004]. Such a phenomenon is called "crowdsourcing," which refers to the act of recruiting a large group of undefined individuals (solvers) to perform organizational tasks through Internet-based platforms [Howe, 2006; Tapscott and Williams, 2006].

Advances in information technologies (IT) that enable companies to reach and engage global crowds have fueled this trend [Zwass, 2010]. This has led to crowds playing an active role in co-creating value with companies [Bullinger, Neyer, Rass and Moeslein, 2010; Heeks, 2010]. As the crowds are becoming increasingly connected and informed [Prahalad and Ramaswamy, 2004; Sawhney, Verona and Prandelli, 2005], often with access to the same tools professionals have, companies can leverage their knowledge to solve organizational problems at a lower cost [Howe, 2008]. As a result, companies are increasingly interested in making use of the crowd and obtaining the benefits of a crowdsourcing strategy [Zwass, 2010]. These potential benefits include externalizing the risk of failure, reducing the cost of task execution, accessing heterogeneous valuable knowledge, and remaining specialized in their core areas [Doan, Ramakrishnan and Halevy, 2011; Kittur, 2010; Leimeister, Huber, Bretschneider and Krcmar, 2009].

Evidence of this trend can be seen in crowdsourcing platforms such as Amazon Mechanical Turk and InnoCentive [Schulze et al., 2011; Tapscott and Williams, 2006]. For example, Amazon Mechanical Turk hosts more than 100,000 tasks every day.[1] Since its foundation, InnoCentive has posted more than 1,500 tasks from external companies, with the awards adding up to $39 million [Innocentive.com, 2013]. Another example is the Netflix prize, which attracted experts from around the world to develop better algorithms for movie recommendations [Lohr, 2009]. Two other platforms, CrowdFlower and CloudCrowd, have respectively received $5 million and $5.1 million in venture funding [Techcrunch.com, 2010a, 2010b]. Even established market leaders such as Google and Procter & Gamble have got into the act. In 2008, Google funded a $10 million crowdsourcing project (Project 10^100) that called for ideas from the crowd to change the world [Yang, Chen and Banker, 2010]. Since P&G launched its "Connect and Develop" program in 2000, it had been relying on external knowledge sources for more than 50 percent of its innovation tasks [Huston and Sakkab, 2006].

However, companies also encounter challenges in obtaining benefits from crowdsourcing activities. Numerous crowdsourced tasks do not get responses or are unable to satisfy companies' requirements [Boudreau and Lakhani, 2009; Roman, 2009]. For instance, by January 2013, 26 percent of the problems posted on InnoCentive in different domains were not solved [Innocentive.com, 2013]. In certain crowdsourcing approaches, popular opinion may shape solutions such as in open source software projects. However, this would not satisfy companies that seek unconventional or idiosyncratic views [Kazman and Chen, 2009]. Even the correctness of solutions obtained from crowdsourcing cannot be guaranteed [Greengard, 2011]. For TaskCn, a major crowdsourcing platform in China, most participants are not professionals in their domains. Hence, companies may be dissatisfied if they are looking for highly professional solutions from TaskCn. Thus, companies need to be aware of which crowdsourcing platforms and approaches would be appropriate based on the nature of their task.

Second, participants are often unevenly distributed, with some tasks attracting many solvers and others getting few responses [Yang, Admic and Ackerman, 2008]. The crowd participating in different types of tasks may be motivated by varying incentives [Schenk and Guittard, 2011; Sun, Fang and Lim, 2012]. In fact, monetary reward alone may not sufficiently motivate participation in crowdsourcing [Zheng, Li and Hou, 2011]. The inability to provide what the crowd wants results in a failure to attract solutions. For example, a cosmetics company, Natural Lady, failed to attract solvers in TaskCn. It then adjusted its incentive scheme to re-invite solvers and was able to obtain the desired solutions.[2] Thus, companies should be aware of the particular motivations of the crowd to participate in solving different types of tasks.

[1] https://www.mturk.com/mturk/welcome (current Feb. 20, 2013)
[2] http://www.taskcn.com/w-78323.html (current Feb. 20, 2013)

Third, how tasks are codified determines whether companies are able to receive satisfactory results from crowdsourcing [Hallerstede and Bullinger, 2010; Yang, Chen and Pavlou, 2009]. Tasks codified with general requirements will receive solutions of different originality and creativity than will those with specific requirements [Ward, Patterson and Sifonis, 2004]. The inability to specify the task requirements appropriately for each type of task limits the performance of crowdsourcing [Howe, 2008; Kaufman, Schulze and Veit, 2011]. For example, NASA failed to obtain satisfactory names for the International Space Station from a public contest. This could result from the task requirement not being specifically codified.[3] Thus, for crowdsourcing success, companies should also be aware of the fit between task type and requirements specificity.

Due to the challenges that were previously discussed, companies have been struggling to understand how to reap the desired benefits from crowdsourcing [Morgan and Wang, 2010]. They need to know what kind of crowdsourcing approach suits a particular type of task [Hallerstede and Bullinger, 2010], how they should codify task requirements [Leimeister et al., 2009], and what incentives they should provide to attract the crowd [Kaufman et al., 2011]. However, there is an absence of studies examining the appropriate crowdsourcing approaches, task requirement specificity, and the motivations of participants for different types of tasks (see Table A–1 in Appendix A for a brief review). Motivated thus, our article aims to address this knowledge gap by answering the questions: *for a particular type of task, which crowdsourcing approach is appropriate, how specific should the task requirements be*, and *what are the motivations for the crowd to work on the task*?

To address the questions, we first reviewed related previous literature on crowdsourcing to identify three crowdsourcing approaches and two task characteristics that can determine the appropriate crowdsourcing approach. We then performed an analysis of eighty successful tasks from eight popular crowdsourcing websites and interviewed sixteen participants (two for each website) from these websites to understand the appropriate approach, requirements specificity, and motivations for different tasks. Based on the analysis, we propose a framework to match task types with appropriate crowdsourcing approaches, requirements specificity, and motivations of the crowd. Accordingly, for each type of task, we provide guidelines to companies on how to select the appropriate crowdsourcing approach, how to codify the task requirements, and what incentives to offer to attract the crowd. Last, we discuss the theoretical and practical implications of the study.

II. CONCEPTUAL BACKGROUND

Benefits of Crowdsourcing

Crowdsourcing can offer various benefits to companies. We elaborate on the following benefits identified from the literature (i.e., accessing heterogeneous valuable knowledge, reducing the cost and time for task execution, externalizing the risk of failure, and remaining specialized in their core areas) [Doan et al., 2011; Howe, 2008; Kittur, 2010; Leimeister et al., 2009].

First, crowdsourcing allows companies to leverage capabilities and skills that are unavailable within [Keupp and Gassmann, 2009]. Through crowdsourcing, companies can invite a large volume of solvers to work on organizational tasks [Howe, 2008]. Their heterogeneous skills and knowledge contribute to the diversity and innovativeness of solutions obtained from crowdsourcing [Poetz and Schreier, 2012]. Further, the crowds have heterogeneous knowledge about their own problems with existing products and services [Brabham, 2008, 2010]. Through crowdsourcing, companies can collect information about customer preferences and experiences with existing offerings, obtain their suggestions for further improvement [von Hippel, 2005; Zwass, 2010], and aggregate these in a useful way [Morgan and Wang, 2010]. With their skills and unique needs, the crowds may even be able to design ahead-of-trend products or services of commercial value in the market [Franke, von Hippel and Schreier, 2006; Huston and Sakkab, 2006].

Second, through crowdsourcing, companies can obtain solutions for their problems at a relatively lower cost than by solving them internally [Horton and Chilton, 2010; Kaufman et al., 2011]. For example, on average, it only costs $1.38/hour to engage the crowd in laborious work in Amazon Mechanical Turk [Horton and Chilton, 2010]. Solvers may even work for free if the tasks are fun and enjoyable [Brabham, 2010]; in Galaxy Zoo (Galaxyzoo.com), for example, the crowd finds labeling the galaxy images engaging enough to do it for free. Thus, crowdsourcing internal tasks could be a viable way for companies to reduce costs of obtaining solutions and increase profits [Zwass, 2010]. Further, companies can save time in completing tasks by inviting a large number of solvers to participate [Morgan and Wang, 2010]. For instance, crowdsourcing enables companies to solve image labeling or audio transcription tasks in a shorter time than performing them internally [Schenk and Guittard, 2011]. In Galaxy Zoo, it would take researchers years to label the photographs, but the process could be completed in one month with 20,000 to 30,000

[3] http://www.crowdsourcing.org/editorial/crowdsourcings-seven-deadly-sins/1900 (current Feb. 20, 2013)

people engaged in classifying the galaxies [McGourty, 2007]. For new product or service development tasks, crowdsourcing can help companies to quickly brainstorm new possibilities that may fall outside their normal operations and routines. This would allow them to shorten innovation life cycles and enhance competitive advantage through increasing the speed to market of new products or services [Chesbrough, 2003].

Third, through crowdsourcing, companies can externalize the risk of failure and remain specialized in their core areas [Howe, 2006; Roman, 2009]. These risks include the uncertainties of solution experimenting and the costs of failure. Take logo design, for example. Traditionally, companies would require employees in their sales or marketing departments to generate ideas and prototypes of logos for their new products or services. Internal employees would then experiment and come up with various logo designs. Even if managers are dissatisfied with the logos, they still need to pay the employees and cover the costs of failure. In contrast, through crowdsourcing, companies can invite the crowd to participate in logo design and choose from the logos proposed by solvers. They can refuse to pay if they are not satisfied with the solutions [Howe, 2008]. This will allow them to externalize the risk of failure as compared to deploying employees to the task. At the same time, it will enable the company (especially small companies) to remain specialized in its core areas instead of hiring employees for logo design.

However, as discussed in the previous section, companies encounter significant challenges and lack understanding of how to realize the benefits from crowdsourcing activities [Doan et al., 2011]. Specifically, companies would want to know how to identify the appropriate crowdsourcing approach, requirements specificity, and incentives for solvers for different types of crowdsourced tasks. In the next section, we will introduce the various crowdsourcing approaches identified from the literature.

Crowdsourcing Approaches

Based on our review of relevant literature that describes different crowdsourcing approaches (i.e., Bullinger et al. [2010]; Hallerstede and Bullinger [2010]; Morgan and Wang [2010]; Schenk and Guittard [2011]; and Zwass [2010]), we identify three main crowdsourcing approaches (i.e., *open call for participation, open call for solutions*, and *open call for candidate* approach). Table 1 summarizes the characteristics of each crowdsourcing approach and provides examples of websites employing these approaches.

Table 1: Characteristics of Crowdsourcing Approaches

	Open call for participation	Open call for solutions	Open call for candidates
Peer interaction	Some collaboration between peers	Few or no interaction(s) between peers	A large amount of interaction and collaboration among chosen candidates
Task requirement	No specific requirement	The diversity of solutions and speed of task solving are important	The cumulative advances in knowledge are important
Task characteristic	General task and no firm deadline for task completion	Well defined tasks that can be finished in a relatively short time (e.g., within a month)	Tasks that take a long period of time to complete (e.g., over six months)
Outcome characteristic	Quality of outcomes cannot be easily evaluated	Quality of outcomes can be evaluated at a low cost	Quality of outcomes cannot be easily evaluated
	Results are dominated by popular ideas	Results are characterized by heterogeneous solutions	Results are affected by multiple interactions and collaboration
Example website	Ideastorm, Galaxy Zoo, iStockphoto	Wilogo, TaskCn, Amazon Mechanical Turk	InnoCentive, NineSigma

Open Call for Participation Approach

The *open call for participation approach* is exemplified by websites such as Dell Ideastorm,[4] which was set up for end users to share their ideas and collaborate with Dell to create new or modify existing products and services [Di Gangi and Wasko, 2009]. Through this approach, companies can obtain ideas from users about what product or service features should be improved. This follows the process where participants view the ideas available on the website, post their own ideas, vote for posted ideas, and see popular ideas put into action. In this approach, IT plays an important role in enabling companies to establish connections with geographically distributed customers and to collect ideas about features that they desire. It also allows customers to comment on and vote for the ideas so that

[4] http://www.ideastorm.com (current Feb. 20, 2013)

companies can implement the most popular ideas in developing new products or services [Di Gangi, Wasko and Hooker, 2010].

However, this approach works mainly as a general mechanism for collecting ideas from customers [Bullinger et al., 2010]. Typically, there are no specific tasks issued by the organization and no deadlines for task completion. Moreover, the crowdsourcing process may not be controlled or coordinated [Bullinger et al., 2010]. Also, results obtained through this approach are typically dominated by popular ideas rather than heterogeneous views [Di Gangi and Wasko, 2009]. Further, outcomes cannot be anticipated by companies and may not be easily evaluated [Hallerstede and Bullinger, 2010]. Companies need to expend time and effort to assess and select ideas from the submissions if they want to go beyond filtering by popularity [Bullinger et al., 2010; Yang et al., 2008]. Consequently, a high cost of idea selection has deterred some companies from adopting this approach. Dell itself has encountered problems in leveraging ideas from Ideastorm mainly because of the costs of idea selection and the difficulty in evaluating the feasibility and business value of these ideas [Soukhoroukova, Spann and Skiera, 2012]. Still, companies continue to anticipate value from obtaining customer inputs through this approach.

Open Call for Solutions Approach

The *open call for solutions approach* can be seen in websites such as Wilogo.[5] The process followed in this approach involves companies proposing tasks, inviting the crowd to solve them, selecting the winning submissions, and paying the corresponding winners [Morgan and Wang, 2010]. Through an open call, companies can invite crowds from around the globe to submit solutions for their problems proposed through Internet-based crowdsourcing platforms [Howe, 2008; Schulze et al., 2011]. This approach is usually conducted in the form of an online contest [Archak and Sundararajan 2009]. In such contests, companies (seekers) start by developing a statement of the problem or task to be solved. They then publish the problem description in a contest platform hosted by the seekers themselves [e.g., Di Gangi and Wasko, 2009; Ebner, Leimeister and Krcmar, 2009] or by a third-party service provider, such as TaskCn.com or Wilogo [Yang et al., 2009]. For example, the crowd was invited to design a logo for a game called Black Dragons on Wilogo.[6] After the contest deadline, the seeker selected the winning logo from 165 logos submitted, with a cost of £427.

Through an open call for solution, a potentially large pool of solvers may be accessed to solve seekers' problems [Howe, 2006]. This approach thus allows for a diversity of solvers and hence fosters the creativity of submissions [Boudreau and Lakhani, 2009]. In this approach, the main role of IT is to support companies in disseminating task briefs to the crowd and to select potential solutions from submissions. Also, the IT platform can ensure that the submission process is independent for each participant and protect an individual's submission from being seen by others. However, this approach may be more suitable for tasks that can be completed by solvers in a relatively short time (e.g., within one month) and where the outcome quality can be evaluated at a relatively low cost [Morgan and Wang, 2010].

Open Call for Candidate Approach

The *open call for candidate approach* can be seen in websites such as InnoCentive[7] and NineSigma.[8] There are two stages for this approach: (1) open call for candidates and (2) intensive collaboration with chosen candidates [Bullinger et al., 2010; Morgan and Wang, 2010]. In the first stage, several candidates may be chosen by screening the proposals that they have submitted for the crowdsourced tasks. Subsequently, in the second stage, the chosen candidates collaborate with each other and/or with the company to cumulatively build on each other's knowledge and transfer the knowledge to the company [Boudreau and Lakhani, 2009]. For example, in InnoCentive, seekers can first call for solvers, select the solvers through screening their proposals, and then directly sign contracts with the chosen solvers. This approach better suits tasks which need intensive interaction and a long-time collaboration between participants and companies or those tasks in which the intellectual property of solutions is difficult to transfer [Pisano and Verganti, 2008]. Examples of tasks for this approach include technical problems in new product design, technologies for manufacturing chemicals, and technological hurdles in software design.

For this type of approach, it is important that chosen candidates share their knowledge, and learn from and build upon the knowledge of others [Pisano and Verganti, 2008]. Typically, chosen candidates may be distributed across geographical locations. Here, IT plays an important role by allowing companies to select candidates, connect with the chosen candidates, facilitate knowledge sharing between candidates, and store the knowledge advances for efficient retrieval and cumulation later on. However, the outcome quality is affected by multiple interactions and

[5] http://en.wilogo.com/ (current Feb. 20, 2013)
[6] http://en.wilogo.com/contest/36056-logo-design-for-Black-Dragons.html (current Feb. 20, 2013)
[7] http://www.innocentive.com (current Feb. 20, 2013)
[8] http://www.ninesigma.com (current Feb. 20, 2013)

collaboration among candidates and hence not easily controlled or evaluated [Bullinger et al., 2010]. For globally dispersed candidates from diverse backgrounds, companies need to spend time coordinating them and facilitating their collaboration [Chen, Ren and Riedl, 2010].

Task Categorization

As the characteristics of the crowdsourcing approaches differ (see Table 1), companies need to carefully consider which approach fits their objectives and design the elements, such as the task requirements specificity and the incentive system, accordingly [Bullinger and Moeslein, 2010; Leimeister et al., 2009]. Past literature suggests that the crowdsourcing approach and design elements may depend on the type of task to be performed [e.g., Bullinger et al., 2010; Schenk and Guittard, 2011]. Based on previous studies [Hallerstede and Bullinger, 2010; Morgeson and Humphrey, 2006; Schenk and Guittard, 2011], we identified two characteristics to classify tasks for this purpose (i.e., task complexity and outcome variety).

As an important characteristic that can determine the crowdsourcing approach, "task complexity" refers to the extent to which the task is difficult to perform [Morgeson and Humphrey, 2006]. This includes the time and specialized knowledge or skills required for the task [Campbell, 1988]. For simple tasks, companies do not need solvers with specialized knowledge to complete them. Rather, they may employ the crowd to help reduce costs or obtain more diverse solutions for such tasks. For complex tasks, a company may decide to turn to the crowd for problem solving when it lacks the specialized skills or satisfactory in-house solutions [Schenk and Guittard, 2011]. Highly complex tasks require a significant investment of time and effort by solvers. Attracting individuals with specialized knowledge is key for companies to obtain desired solutions for such tasks.

Another salient characteristic that may influence the crowdsourcing approach, "outcome variety," refers to the extent to which the task outcome should be diverse [Ahuja and Carley, 1999]. Low outcome-variety tasks such as data input are characterized by few exceptions in terms of alternative courses of action and outcomes. High outcome-variety tasks such as innovation and logo design are less predictable and require creativity to solve them [Ahuja and Carley, 1999]. Here, multiple outcomes are desired from solvers with different perspectives. Examples for each type of task are shown in Table 2. We now discuss the nature of the tasks in each quadrant of the table.

Table 2: Classification of Crowdsourcing Tasks

Task Complexity	Low	Image labeling, data input, posting advertisement articles in online communities	Logo or visual identity design, print ads, or poster design
	High	Translation, programming, video clips design	New product development, R&D innovation problems, and software design
		Low	High
		Outcome Variety	

Simple Task with Low Outcome Variety

Simple tasks with low outcome variety typically do not require specific competencies for their performance or need varied outcomes, but may be crowdsourced because they are time-consuming and monotonous. Such tasks include labeling images, inputting data, and posting advertisement articles in online communities. Crowdsourcing websites that feature such tasks include Galaxy Zoo,[9] which has been set up for classifying the images of galaxies. Another example is Amazon Mechanical Turk[10] where the crowd solves tasks like labeling images, transcribing audio, and reporting website bugs. This type of task can be time-consuming and wasteful for companies to assign employees to solve internally [Schulze et al., 2011]. Crowdsourcing helps reduce the cost and increase the speed of task execution for these tasks.

Simple Task with High Outcome Variety

Simple tasks with high outcome variety usually require creativity but can be completed by a solver with not much difficulty. Such tasks include logo or visual identity design, print ads or poster design, and product packaging style design. For these tasks, solvers need not possess highly specialized skills; however, they would be required to know the basics of using software to handle graphics and images, such as Photoshop. Companies' main objective of crowdsourcing this type of task is to obtain solution novelty. The diversity of the crowd is important for fostering solution creativity and heterogeneity of outcomes.

[9] http://www.galaxyzoo.org/ (current Feb. 20, 2013)
[10] https://www.mturk.com/mturk/welcome (current Feb. 20, 2013)

Crowdsourcing websites for this type of task include Wilogo and TaskCn. For example, Wilogo is a logo design community with a pool of 15,000 designers. It allows companies to choose from at least eighty design alternatives to reach a customized solution.

Complex Task with Low Outcome Variety

Complex tasks with low outcome variety typically require time and specific skills to perform. Such tasks include website design, translation, programming, and photograph and video clips design. For this type of task, the size of the crowd reached determines the effectiveness of solutions obtainable from crowdsourcing. A large group of skilled participants provides companies with the resources needed to complete their tasks efficiently.

Typical examples of crowdsourcing platforms for this type of task include TaskCn and iStockphoto.[11] iStockphoto is a global crowdsourcing community for user-generated stock photos, illustrations, video, audio and Flash [Brabham, 2008]. It enables companies to obtain professional pictures, vectors, and clips at a low cost. Companies can directly search for or propose requirements for what they want from iStockphoto. Solvers in this community expend time and effort to perform the tasks and must possess the skills to produce the picture or clips required by seekers.

Complex Task with High Outcome Variety

Complex tasks with high outcome variety generally require time and a high level of specialized skills and context-specific knowledge to complete. Also, creativity and solution diversity are key requirements for such tasks. Examples of these tasks include new product development, R&D innovation problems, and software design. Here, interactions between the seeker and solvers are needed to include company-specific requirements into the solutions and for the seeker to learn how to implement and maintain the solutions. Therefore, participants need to have multiple interactions with the seeker company. Usually, these tasks are too complex to obtain full solutions through the crowdsourcing process but it is possible for companies to obtain a proposal for solutions.

Crowdsourcing for this type of task is offered by websites such as InnoCentive and NineSigma.[12] For example, InnoCentive is a Web-based community that matches scientists to R&D challenges presented by companies worldwide. Companies such as P&G have proposed problems on the website that could not be solved internally. Tasks on InnoCentive attract a solver base of more than 180,000 professionals from around the globe.

III. RESEARCH METHODOLOGY

To identify which crowdsourcing approach is appropriate for different types of tasks, how specific the codification of task requirements should be, and what incentives companies should provide to the crowd, we conducted an analysis of eighty successful tasks from the eight crowdsourcing websites listed in Table 1, and interviewed two participants from each website. We chose the eight websites because these are among the popular and successful crowdsourcing platforms appearing on several lists (i.e., Innovation Zen, [13] open innovators, [14] and crowdsourcing.org). [15] Further, the selected platforms have received researchers' attention before (for better comparison) and had been around for a while (>5 years), such that their practices are established. For each of the eight crowdsourcing websites, we randomly selected ten tasks from a list of successful tasks and two participants from the solver pool with at least one year tenure. For example, in Wilogo, we randomly selected ten successful tasks from a webpage,[16] which lists all the tasks hosted including in-process, awaiting customer decision, short listing, and complete tasks. Two solvers were randomly selected from a list of all designers with at least one year tenure generated from Wilogo. We sent invitations for interviews to these solvers through Wilogo's private messaging tool on the designers' personal webpages.

Successful tasks are those deemed satisfactory and paid for by seekers (i.e., in Amazon Mechanical Turk, iStockphoto, Wilogo, TaskCn, InnoCentive, and NineSigma) or those whose solutions have been adopted by seekers (i.e., in Ideastorm and Galaxy Zoo). For the selected tasks, we analyzed the crowdsourcing approaches employed and task requirement specificity. Task requirement specificity refers to the extent to which the task requirement is codified concretely [Bullinger and Moeslein, 2010]. Following the approach suggested in Wasko and Faraj [2005], one of the authors and a domain expert (an experienced staff member of each website) [17]

[11] http://www.istockphoto.com/index.php (current Feb. 20, 2013)
[12] http://www.ninesigma.com/ (current Feb. 20, 2013)
[13] http://innovationzen.com/blog/2006/08/01/top-10-crowdsourcing-companies/ (current Feb. 20, 2013)
[14] http://www.openinnovators.net/list-open-innovation-crowdsourcing-examples (current Feb. 20, 2013)
[15] http://www.crowdsourcing.org/directory (current Feb. 20, 2013)
[16] http://en.wilogo.com/wilogo/contest/listing.html (current Aug. 10, 2011)
[17] The staff members are employees of the crowdsourcing website who assist seekers and solvers during crowdsourcing. They provide advice to seekers on matters such as how to define their tasks and how much reward is appropriate for the task. They also help solvers (e.g., to make sure they get a fair reward). Both the solvers interviewed and the staff members were provided a token incentive of $20 in return for their participation.

independently coded the eighty tasks. The tasks were coded for the task type and requirements specificity by both coders (see Table B–1 in Appendix B). The coding schema used by the two raters is elaborated in Table 3. For the task type, we rated two aspects (i.e., task complexity and outcome variety). The chosen tasks were rated as "complex" or "simple" for the task complexity dimension, and "high variety" or "low variety" for the outcome variety dimension. For requirements specificity, we coded whether the problem requirements were "specific" or "general."

Table 3: Coding Schema

Task Complexity	Simple	The task neither requires solvers to have specialized skills nor needs a long time to complete (i.e., more than one month).
	Complex	The task requires solvers to have specialized skills and needs a long time to complete (i.e., more than one month).
Outcome Variety	High	The task requires diverse solutions from solvers.
	Low	The task does not require diverse solutions from solvers.
Requirement Specificity	Specific	The task background information, evaluation criterion, and seekers' contact for further information inquiry are provided.
	General	Not all the task-related information is provided.

For each website, we evaluated inter-rater reliability by calculating the agreement score and Cohen's Kappa score for the two coders [Cohen, 1960]. In general, a Kappa score of 0.65 or higher and an agreement score of 0.7 or higher are preferred [Jarvenpaa, 1998]. The inter-rater reliability results for the eight websites are shown in Table 4, which suggest a satisfactory level of reliability among the coders.

To understand the drivers and incentives for solver participation, we interviewed the two solvers selected from each website to unveil their motivations for providing solutions. We conducted the interviews through instant messaging tools such as MSN and Google talk. Questions asked included: "Why do you participate in solving tasks in this website?" and "What keeps you doing this in the website?" Follow-up questions were asked based on the interviewee's answers. One of the authors coded the interview records and listed out all the motivations mentioned. On average, we spent about 30 minutes. Table B–2 in Appendix B shows more detailed information about the interviews. For each website, we extracted the motivations that were agreed upon by both interviewees for greater validity. We also classified the motivations into two categories (i.e., extrinsic and intrinsic motivations).

Table 4: Inter-rater Reliability

	Agreement				Cohen's Kappa
	Task complexity	Outcome variety	Requirement specificity	Average	
Ideastorm	0.900	0.900	0.900	0.900	0.857
Galaxy Zoo	1.000	0.900	0.900	0.933	0.974
iStockPhoto	0.900	1.000	0.800	0.900	0.857
Wilogo	0.900	1.000	1.000	0.967	0.951
TaskCn	0.800	0.900	0.900	0.867	0.812
InnoCentive	1.000	0.900	0.900	0.933	0.974
NineSigma	1.000	0.900	0.900	0.933	0.974
Amazon Mechanical Turk	1.000	1.000	1.000	1.000	1.000

IV. RESULTS

Crowdsourcing Approach and Task Type

We propose that the approach a company chooses for crowdsourcing should depend on the type of task to be crowdsourced. Through analyzing a sample of successful tasks from the eight crowdsourcing websites shown in Table 1, we derive a match between the task type and crowdsourcing approach as shown in Table 5.

For *simple tasks with low outcome variety*, companies are looking for efficiency of task completion. A large crowd size is most appropriate for this type of task. Therefore, companies should consider *the open call for participation* or *the open call for solution approach* for performing such tasks. If the *open call for participation approach* is adopted, companies should ensure easy access to the task for the crowd and facilitate the process of idea submission. If *the open call for solution approach* is adopted, companies should divide the task into small and measurable parts so that they can easily evaluate and pay for the results of task completion.

Table 5: Task Type and Crowdsourcing Approach Framework			
Task type	Crowdsourcing approach	Requirement specificity	Motivations for participation
Simple task with low outcome variety	Open call for participation, open call for solution	Specific	Extrinsic: Micro-paid Intrinsic: Enjoyment, sense of achievement, solvers' need fulfillment
Simple task with high outcome variety	Open call for solution, open call for participation	General	Extrinsic: Financial rewards, visibility in the job market Intrinsic: Skill enhancement, enjoyment in solving novel tasks
Complex task with low outcome variety	Open call for candidates, open call for solution	Specific	Extrinsic: Financial rewards, peer reputation Intrinsic: Solvers' need fulfillment and autonomy
Complex task with high outcome variety	Open call for candidates	Specific at a higher level, general at a lower level	Extrinsic: Financial rewards Intrinsic: Enjoyment in solving challenges, sense of achievement

For *simple tasks with high outcome variety*, task solving requires creativity. To obtain distinct solutions, interactions between participants are not encouraged [Shaft and Vessey, 2006] and unique viewpoints should be included into submitted solutions. The *open call for solution approach* is a productive way to recruit participants since it encourages solvers to rely on their proprietary skills to engage in task contests and allows for divergent solutions. Alternatively, the *open call for participation approach* marginally fits this type of task, since it can allow for recruitment of a large group of diverse people for task solving.

For *complex tasks with low outcome variety*, task completion requires specialized skills. These tasks usually involve accumulating the knowledge contributions from different participants. Collaboration and multiple interactions may be required for completing the entire task. Therefore, the *open call for candidates approach* is considered appropriate here. Complex tasks with low outcome variety should be decomposed into smaller sub-tasks so that companies can integrate sub-task results from individual solutions. The *open call for solution approach* marginally fits this type of task, since it allows for greater size and diversity of the crowd.

For *complex tasks with high outcome variety*, task completion requires specialized skills and context-specific knowledge. These tasks need creativity as well as intensive interaction with companies or peers. Usually, these tasks will be divided into several stages with smaller sub-tasks. For the consistency of task solving during the different stages, the *open call for candidate approach* would be appropriate. This would mean that companies first select the relevant talent and then assign them to collaborate with each other and/or with the company. Companies should ensure the diversity of candidates chosen in the first stage, which is crucial for the creativity of task solutions.

Task Requirement Specificity

The way companies codify their task requirements determines the results they can obtain from the crowdsourcing process. From our analysis, we found that a general codification of requirements was more appropriate for *simple tasks with high outcome variety* such as logo design. This is because if the task requirements were specific, people would tend to use specific basic exemplars from that domain, select one or more of those instances as a starting point, and project the properties of the instances onto the ideas being developed [Ward, Dodds, Saunders and Sifonis, 2000]. Consequently, specific task requirements may result in solutions that resemble previous exemplars (i.e., low originality and creativity in proposed solutions [Ward et al., 2004]). Instead, general task requirements will allow individuals to draw from multiple conceptual domains for properties of instances, recombine them into new ideas, and propose more original solutions [Baughman and Mumford, 1995; Ward et al., 2000]. Thus, for simple, high outcome-variety tasks, a general codification can retain flexibility by encouraging multiple interpretations of the requirements and cultivating the creation of diverse solutions.

For *simple tasks with low outcome variety* such as data input, it was found more appropriate to provide specific requirements since these tasks do not seek multiple interpretations or creative solutions of the problem. Task requirements specificity allows better understanding of details of such tasks, deters different interpretations, and standardizes criteria for solutions [Leimeister et al., 2009; Ward et al., 2000]. An example is provided by Amazon Mechanical Turk [Schulze et al., 2011], in which specific requirements are suitable for tasks like audio transcription or image labeling. In most cases, a large amount of such tasks may be crowdsourced. Thus, providing specific requirements and standardizing criteria will allow seekers to easily and cost-effectively assess the results for these tasks.

From our analysis, we found specific requirements to be more appropriate for *complex tasks with low outcome variety* such as translation tasks. Since complex tasks can introduce uncertainty in solution approaches [Anderson, 2006], a general description of requirements would entail time and effort to comprehend the task and would likely need further clarification of the requirements [Ward et al., 2004]. On the other hand, specific requirements can reduce the uncertainty related to these tasks by decomposing them into subtasks. This can ease the process of drawing from exemplars for solutions [Ward et al., 2000] and attract more solvers to participate [Yang et al., 2009]. Specific requirements are also suitable since such tasks do not require original solutions.

For *complex tasks with high outcome variety* such as in R&D innovation problems, the requirements should be specific on what types of elements are required (at a higher level) and general on what is required for particular elements (at a lower level). Specific requirements at a higher level are necessary for companies to subdivide the tasks into less complex elements and satisfy their task objectives [Morgan and Wang, 2010]. This will reduce solvers' difficulty in recalling specific types of domain knowledge pertaining to these elements [Ward et al., 2000]. For the task elements, it is important to have general requirements so that solution creativity and variety can be encouraged [Ward et al., 2004]. Thus, a combination of specific and general task requirements is suitable in this case.

Motivations for Participation

Providing appropriate incentives for different types of tasks is critical for companies to attract the necessary talent to solve their problems. As mentioned earlier, we interviewed 16 solvers from the eight crowdsourcing websites (two per website) to understand their participation motivations. Deriving from the interviews, the results regarding participation motivations are also shown in Table 5.

Incentives for *simple tasks with low outcome variety* are typically non-financial. Participation in these tasks is usually voluntary or micro-paid. Companies rely on other incentives/motivations, such as trying to make the task fun [Kaufman et al., 2011], fulfilling solvers' needs, and invoking their sense of achievement by emphasizing the tasks' importance. To motivate participation in crowdsourcing, the fun of task solving is a key criterion for task design. As participants in Galaxy Zoo noted (see Table B–2 in the Appendix B):

> *"It is pretty fun to label different kinds of stellar pictures… I can fulfill my imagination about the cosmos through Galaxy Zoo."*
>
> *"I feel a sense of achievement after I complete … the tasks."*

Also, participants in Amazon Mechanical Turk observed:

> *"It is easy to earn money from it although I do not have any specialized skills."*
>
> *"I can earn some money by spending my spare time to solve tasks."*

Incentives for crowds to solve *simple tasks with high outcome variety* are usually both monetary and non-monetary. Participants in this type of task are self-motivated to differentiate themselves, to provide novel solutions, and to protect rather than share their knowledge. This is because participants have spent much time and effort in constructing the solutions and do not want others to copy their ideas. Therefore, they also expect returns for their creativity and work. They are usually compensated by financial rewards and visibility in the job market [Boudreau and Lakhani, 2009]. Besides the extrinsic rewards, participants are likely to be motivated by the enjoyment of solving novel tasks and their skill enhancement during the process. As a participant in Wilogo mentioned:

> *"I can earn money through selling my own design skills.… Companies can easily find me and offer me a job through Wilogo.… Through undertaking tasks in Wilogo, I can try different styles of design and experiment new skills."*

Also, participants in TaskCn noted:

> *"It is easy for me to find a related job through TaskCn."*
>
> *"It is possible for companies to find me and offer me a job in TaskCn."*

For *complex tasks with low outcome variety*, participants are likely to expect monetary rewards for their efforts and time involved. They are motivated by financial rewards and peer reputation enhanced by the task completion. Also, solvers' need fulfillment and autonomy both attract participants to work on these tasks. As a participant in TaskCn noted:

> *"It is a place for us to earn some money.… I have a lot of freedom in choosing the tasks and deciding how and when I will complete the tasks.… Besides, I will be respected by others for my skills in TaskCn."*

Also, participants in iStockPhoto mentioned:

> *"I design some photos or flashes for my own use and I will share them in iStockPhoto."*

> *"I will design some photos, videos, flashes, as well as PowerPoint to fulfill the job requirements. For most cases, I will upload what I have designed to iStockPhoto."*

For *complex tasks with high outcome variety*, it may not be feasible to obtain full solutions through the crowdsourcing process but it may be possible to obtain a proposal for solutions [Morgan and Wang, 2010]. These tasks may require reward-winning participants' further collaboration for proposal implementation. Providing attractive financial incentives for these tasks is found to motivate the crowd to participate. For example, substantial financial rewards in InnoCentive motivate individuals from different domains to crack the challenges that cannot be solved by a company's internal talents. However, risks exist in that the substantial time and effort invested in problem solving may be wasted if the solution does not win. Enjoyment in solving challenges and a sense of achievement may compensate for the risks involved in participation. As a participant in InnoCentive noted:

> *"The reward for task solving is very competitive in this website.… Besides, I enjoy solving difficult problems, especially those that cannot be solved by others."*

This concurs with the observations from a NineSigma participant:

> *"I can earn decent money from the website for my effort.... When I work out a difficult problem, I feel a sense of achievement."*

In the next section, we conclude the article by discussing its contributions to research and practice, its limitations, and avenues for future work.

V. DISCUSSION AND CONCLUSION

As the open innovation paradigm gains momentum and new information technologies emerge, companies are increasingly leveraging crowdsourcing for their task solving. To obtain satisfactory solutions from crowdsourcing, companies may need to understand what crowdsourcing approach should be used for their tasks, how to codify their task requirements, and what incentives to provide to solvers. However, limited previous research has investigated the fit between task type and crowdsourcing approach, task requirement specificity, and incentives. Based on the analysis of eighty successful tasks and the interview of sixteen participants from eight popular crowdsourcing websites, we propose a framework to match task types with appropriate crowdsourcing approaches, requirement specificity, and motivations of the crowd.

The findings of this article should be interpreted in light of its limitations. First, this article is based on content analysis and interviews. Future studies can explore this phenomenon by using a survey method to collect data from participants of crowdsourcing platforms and employing statistical techniques such as regression analysis or SEM to test the fit framework. Second, this study focused on the match between task type, crowdsourcing approaches, task requirement specificity, and incentives. Future work may go beyond this research to investigate the process of crowdsourcing (e.g., the influence of communication between companies and participants, and multi-selection criteria for ensuring solution quality).

Nevertheless, by highlighting the crowdsourcing approaches, task requirement specificity, and incentives for a particular type of task, this research provides guidelines to companies on how to obtain the desired benefits through crowdsourcing. This study may also inform researchers who are interested in understanding how companies can leverage crowdsourcing approaches for value co-creation. In general, this research contributes to research and practice.

This article contributes to IS research in several ways. First, this study adds to the literature on crowdsourcing by proposing a typology of tasks that is based on theoretically derived criteria. While previous literature has classified crowdsourcing tasks, a theoretical basis was not provided for the classification (e.g., Schenk and Guittard [2011] proposed a categorization of crowdsourcing tasks as routine, complex, and creative, while Schulze et al. [2011] classified crowdsourcing tasks as quick profit, informed, and challenge tasks). On the other hand, this article developed the typology of tasks based on two task characteristics (i.e., outcome variety and task complexity), and further suggests that the task type should be matched with the crowdsourcing approach, specificity of task requirements, and incentive schema for better outcomes.

Second, the literature has largely focused on identifying motivations for solvers' participation in particular crowdsourcing platforms (e.g., Kaufman et al. [2011] for AMT; Zheng et al. [2011] for TaskCn). Prior work did not seek to differentiate the motivations for performing various kinds of tasks hosted on crowdsourcing platforms with differing approaches. In contrast, we identify the motivations and appropriate incentives for each type of task in our framework tied to a specific crowdsourcing approach. This is useful since solvers' motivations are not uniform across different types of tasks and crowdsourcing approaches. Assuming uniformity and providing inappropriate incentives may deter solvers' participation in crowdsourcing.

Further, we compared the motivations of solver participation in crowdsourcing found in our study with prior research. Consistent with Kaufman et al. [2011], we found that financial rewards and enjoyment are salient motivations for solvers' participation in Amazon Mechanical Turk (AMT). However, there were other motivations stated in Kaufman et al. [2011] that did not surface in our study. This could result from the methodological differences, where Kaufman et al. [2011] asked respondents to rate participation motivations from an exhaustive list of motivations compiled from crowdsourcing studies irrespective of platform, whereas our study asked them to state their most salient motivations for participation. In comparison to studies in TaskCn (e.g., Sun et al. [2012]; Yang et al. [2008, 2009]; Zheng et al. [2011]), our study showed an additional motivation for solver participation in crowdsourcing (i.e., visibility in the job market). Overall, the qualitative approach employed in our study was able to highlight the salient participation motivations for various crowdsourcing approaches and tasks, which had not been attempted in previous research.

Third, we extend the previous findings on knowledge contribution in online communities (e.g., Jeppesen and Fredericksen [2006]; Ma and Agarwal [2007]; Sun et al. [2012]; Wasko and Faraj [2005]) to understand solvers' participation in crowdsourcing platforms, which could be viewed as a form of knowledge contribution. Consistent with previous literature on knowledge contribution motivations, we found that individuals are motivated to participate in crowdsourcing by extrinsic rewards, enjoyment, reputation, recognition, and a sense of achievement. However, our results depart from this literature by observing that need fulfillment, skill enhancement, and task autonomy are additional motivations for individuals to participate in crowdsourcing. Particularly, need fulfillment could be salient in the context of crowdsourcing, where people may innovate or solve tasks to fulfill their own needs. Also, skill enhancement through participation allows solvers to improve their employability or likelihood of winning rewards, while task autonomy is a benefit for those who like to do such freelance work for additional earnings.

Fourth and most importantly, this study serves as an initial effort to investigate the influence of the fit between task type, crowdsourcing approach, requirements specificity, and solvers' motivations for each task on crowdsourcing success. It contributes to the literature on crowdsourcing (see Table A–1) by proposing that the task type should be matched to the crowdsourcing approach, specificity of task requirements, and incentives for solvers for better outcomes. Past literature has suggested parts of this fit (e.g., task requirement specificity as an important factor to crowdsourcing success [Yang et al., 2009]). Also, this study goes beyond previous research suggesting that companies can use wiki technologies to include external knowledge sources for collaboration [Tapscott and Williams, 2006] by proposing that crowdsourcing can be an effective mechanism to leverage external knowledge sources if the task type is appropriately matched to the crowdsourcing design.

In practice, this article offers insights to companies on how to leverage crowdsourcing for value co-creation through analyzing a sample of eighty successful tasks and interviewing sixteen participants from eight popular crowdsourcing websites. Based on our analysis, we provide suggestions to companies on how to select the appropriate crowdsourcing approach for different tasks, how to specify task requirements, and what incentives to provide to the crowd. This can help companies better leverage the crowdsourcing strategy for task solving.

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1. These links existed as of the date of publication but are not guaranteed to be working thereafter.
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APPENDIX A: RELATED LITERATURE REVIEW

The details of the methodology employed in this study are given in this appendix.

Table A–1: Literature Review on Crowdsourcing

	Task type	Crowdsourcing approach	Requirements specificity	Motivations for participation
Archak and Sundararajan [2009]		√		
Brabham [2008, 2010]; Kaufman et al. [2010]; Yang et al. [2008]; Zheng et al. [2011]				√
Bullinger et al. [2010]		√	√	
Doan et al. [2011]		√		
Hallerstede and Bullinger [2010]		√	√	
Leimeister et al. [2009]			√	√
Sun et al. [2012]	√			√
Schenk and Guittard [2011]; Schulze et al. (2011)	√			
Yang et al. [2009]			√	√

APPENDIX B: METHODOLOGY FOR CROWDSOURCING TASK ANALYSIS

The details of the methodology employed in this study are given in this appendix. First, we show how the eighty tasks from eight popular crowdsourcing websites were coded in Table B–1. The results from the two coders are shown in each cell for the task parameters (i.e., coder 1| coder 2). Second, in Table B–2, we provide detailed information about the interviews of the sixteen participants. This includes information about the interviewees, interview methods, and the quotes about the participation motivations from the interviews.

Table B–1: Task Analysis (Code 1| Code 2)

Websites	Task name	Task complexity*	Outcome variety*	Requirement specificity*
Ideastorm	Bring back the 16:10 screen format in high end business laptops	Simple| Simple	Low| Low	Specific| Specific
	Non-glare high-resolution LED displays	Complex| Simple	Low| Low	Specific| Specific
	Remove metallic Windows sticker	Simple| Simple	High| Low	Specific| Specific
	Replacement parts under warranty should be NEW not refurbished.	Simple| Simple	Low| Low	Specific| Specific
	Alien FX full game implementation	Simple| Simple	Low| Low	Specific| Specific
	Allow third-party batteries or mention clearly that they are actively being blocked	Simple| Simple	Low| Low	General| Specific
	Supply anti-glare screens with all flat screen monitors	Simple| Simple	Low| Low	Specific| Specific
	DELL XPS 15zx—the real MacBook killer!	Simple| Simple	Low| Low	Specific| Specific
	SSD + HDD option in desktop XPS	Simple| Simple	Low| Low	Specific| Specific
	Bring back non-glossy displays on the Inspiron notebooks!	Simple| Simple	Low| Low	Specific| Specific
Galaxy Zoo	Irregular Galaxies	Simple| Simple	High| Low	Specific| Specific
	Spirals (a type of Galaxy)	Simple| Simple	Low| Low	General| Specific
	Gorgeous ellipticals	Simple| Simple	Low| Low	Specific| Specific
	Cosmic trainwrecks—Mergers	Simple| Simple	Low| Low	Specific| Specific
	Galaxy pairs which overlap but are not merging	Simple| Simple	Low| Low	Specific| Specific
	White dwarf stars	Simple| Simple	Low| Low	Specific| Specific
	Lensed quasar	Simple| Simple	Low| Low	Specific| Specific
	Hickson compact groups (a type of Galaxy)	Simple| Simple	Low| Low	Specific| Specific
	The possible polar ring thread (a type of Galaxy)	Simple| Simple	Low| Low	Specific| Specific
	Weirdest spectra (a type of Galaxy)	Simple| Simple	Low| Low	Specific| Specific
Amazon Mechanical Turk	Audio transcription: Denver Ida	Simple| Simple	Low| Low	Specific| Specific
	Find the contact info of blog	Simple| Simple	Low| Low	Specific| Specific
	Which product category does this item belong to?	Simple| Simple	Low| Low	Specific| Specific
	How relevant/satisfactory are these search engine results?	Simple| Simple	Low| Low	Specific| Specific
	Summarize a new book	Simple| Simple	Low| Low	Specific| Specific
	Translate Mandarin Chinese to English (mand_cts_train_3)	Simple| Simple	Low| Low	Specific| Specific
	Transcribe a Short Audio Clip (~10 seconds)	Simple| Simple	Low| Low	Specific| Specific
	Consumption and personality survey	Simple| Simple	Low| Low	Specific| Specific
	Product search relevance	Simple| Simple	Low| Low	Specific| Specific
	Classify text about consumer electronics	Simple| Simple	Low| Low	Specific| Specific
Wilogo	Logos design for international cosmetics	Simple| Simple	High| High	General| General
	Logos gallery<<MEX&CO>>	Simple| Simple	High| High	General| General
	Logos gallery<< JCI JUSTICE COOPÉRATION INTERNATIONALE>>	Simple| Complex	High| High	General| General
	Logos gallery<<RYTHMIC>>	Simple| Simple	High| High	General| General
	Logos gallery<<BLAST>>	Simple| Simple	High| High	General| General
	Logo for Researu—bureau website	Simple| Simple	High| High	General| General
	Logo for the product name “Blue cat”	Simple| Simple	High| High	General| General
	Logo for “Smoovie”	Simple| Simple	High| High	General| General
	Logo for “FMS Fenetress”	Simple| Simple	High| High	Specific| Specific
	Logo for “Nature Solution”	Simple| Simple	High| High	General| General

Table B–1: Task Analysis (Code 1| Code 2) – Continued				
TaskCn	Configure IIS in Win 7 operation systems only for Internal network	Complex| Simple	Low| High	Specific| Specific
	Website design for a small company	Complex| Complex	Low| Low	Specific| General
	Promotion and advertisement brochure design	Complex| Complex	Low| Low	Specific| Specific
	System design for an agricultural company	Complex| Complex	Low| Low	Specific| Specific
	Fast food box design	Simple| Complex	High| High	General| General
	Call for brand name for a new product	Simple| Simple	High| High	General| General
	Call for marketing plans for Taobao stores	Simple| Simple	High| High	General| General
	Name card design	Simple| Simple	High| High	General| General
	New Year card design	Simple| Simple	High| High	General| General
	Webpage design for small C2C stores in Taobao	Simple| Simple	High| High	General| General
iStockPhoto	Simulation animations for a business plan	Complex| Complex	Low| Low	Specific| Specific
	Jack O' Lantern	Complex| Complex	Low| Low	Specific| Specific
	Smiling businessman with colleagues in the background	Complex| Complex	Low| Low	Specific| Specific
	Beautiful zebra-centaur	Complex| Complex	Low| Low	Specific| Specific
	1940s Style. A Road Trip. (Road Signboard)	Complex| Complex	Low| Low	Specific| Specific
	New year gift box	Simple| Complex	Low| Low	Specific| General
	University sign close up (Close-up Signboard)	Complex| Complex	Low| Low	Specific| Specific
	The Blue Mosque in Istanbul Turkey	Complex| Complex	Low| Low	Specific| Specific
	Grey Gondoliere	Complex| Complex	Low| Low	Specific| Specific
	Business deal (Pictures for deal making)	Complex| Complex	Low| Low	Specific| General
InnoCentive	Molecular encapsulation of volatile odor compounds for controlled thermal release	Complex| Complex	High| High	General| General
	Increasing fat perception in low-fat food products	Complex| Complex	High| High	General| General
	Seeking tertiary aniline and amino-pyridyl amides	Complex| Complex	High| High	General| General
	Process for direct oxidation of propylene to propylene oxide	Complex| Complex	High| High	General| General
	Seeking inhibitors of stearoyl-CoA desaturase-1 (EC 1.14.19.1)	Complex| Complex	High| High	Specific| General
	Fast rope glove device	Complex| Complex	Low| High	General| General
	Technologies to find missing components at high speed	Complex| Complex	High| High	General| General
	Isolating active human endogenous interleukin-25	Complex| Complex	High| High	General| General
	Improving the nutritional value of plant tissues	Complex| Complex	High| High	Specific| Specific
	Technologies to find missing components at high speed	Complex| Complex	High| High	General| General
NineSigma	Easy-clean gas kitchen hobs	Complex| Complex	High| High	General| General
	Novel ways for making watertight joint housings to connect high-voltage cables	Complex| Complex	High| High	General| General
	Cost effective fluoride removal from drinking water	Complex| Complex	High| Low	Specific| General
	Anti-adherence to skin and hard surfaces	Complex| Complex	High| High	General| General
	Detection mechanisms to signal bacterial contamination in cleaning implements	Complex| Complex	High| High	General| General
	Affordable variation of valve stroke and/or phasing for small combustion engines	Complex| Complex	High| High	General| General
	Preventing liner separation	Complex| Complex	High| High	General| General
	Hand hygiene products which incorporate skin health benefits	Complex| Complex	High| High	General| General
	Filling the torque hole in automated manual transmissions	Complex| Complex	High| High	General| General
	Ethylene scavenging additives/technologies	Complex| Complex	High| High	General| General
Note: * The characteristics of the websites were derived based on the features that the majority of tasks demonstrated in terms of task complexity, outcome variety, and requirement specificity.				

Table B–2: Participant Interview Details				
Websites	Interviewees details	Interview method	Date	Sample quotes from the interview
Ideastorm	Participant 1: Dell product user, 2-year tenure in Ideastorm	Google talk Duration: 20 minutes	Aug 11, 2011	Need fulfillment: *"I want Dell to address my problem."* Enjoyment: *"I like to contribute my idea to Dell."*
	Participant 2: Dell product user, 1.5-year tenure in Ideastorm	Google talk Duration: 15 minutes	Aug 11, 2011	Need fulfillment: *"To express what I need and what I am concerned about."* Enjoyment: *"I enjoy revealing my idea to Dell."*
Galaxy Zoo	Participant 1: White collar worker, 1-year tenure in Galaxy Zoo	Google talk Duration: 15 minutes	Aug 10, 2011	Enjoyment: *"It is interesting to label the galaxy pictures."* Need fulfillment: *"It is a good place for us to fulfill our curiosity about the cosmos."* Sense of Achievement: *"I feel a sense of achievement after I complete the tasks."*
	Participant 2: College student, 1-year tenure in Galaxy Zoo	Google talk Duration: 15 minutes	Aug 10, 2011	Enjoyment: *"It is pretty fun to label different kinds of stellar pictures."* Need fulfillment: *"I can fulfill my imagination about the cosmos through Galaxy Zoo."* Sense of Achievement: *"The achievement of completing the tasks really cheers me up in Galaxy Zoo."*
Amazon Mechanical Turk	Participant 1: Freelancer, 1-year tenure in Amazon Mechanical Turk	Google talk Duration: 25 minutes	Aug 16, 2011	Financial Rewards: *"It is easy to earn money from it although I do not have any specialized skills."* Enjoyment: *"Solving tasks in AMT really helps me kill boredom."*
	Participant 2: White collar worker, 1-year tenure in Amazon Mechanical Turk	Google talk Duration: 26 minutes	Aug 17, 2011	Financial Rewards: *"I can earn some money by spending my spare time to solve tasks."* Enjoyment: *"I really enjoy solving tasks in AMT. It can give me a break from my boring routine work."* Sense of Achievement: *"It also makes me feel a sense of achievement when I finish the tasks. "*
Wilogo	Participant 1: Employee in advertisement company, 1-year tenure in Wilogo	MSN Duration: 35 minutes	Aug 12, 2011	Financial Rewards**:** *"I can earn money through selling my own design skills."* Visibility in the Job Market: *"Companies can easily find me and offer me a job through Wilogo."* Skill Enhancement: *"I can try different styles of design and experiment new skills."* Enjoyment: *"I enjoy solving different tasks regarding designing new logos."*
	Participant 2: College student, 1-year tenure in Wilogo	MSN Duration: 35 minutes	Aug 12, 2011	Financial Rewards: *"Money is the main reason why I participate in Wilogo."* Skill Enhancement: *"By the way, it is a good place for me to practice what I learn from school and improve my skills from practice."* Visibility in the Job Market: *"It is important for me to be known by companies through Wilogo."* Enjoyment: *"Solving creative tasks cheers me up."*
TaskCn	Participant 1: College student, 1-year tenure in Wilogo	Google talk Duration: 45 minutes	Aug 15, 2011	Financial Rewards: *"It is a place for us to earn some money."* Visibility in the job market: *"It is easy for me to find a related job through TaskCn."* Enjoyment: **"***It is interesting to solve novel tasks from TaskCn."* Reputation: *"I will be respected by others for my skills."* Autonomy: *"I have a lot of freedom in choosing the tasks and deciding how and when I will complete the tasks."*

Table B–2: Participant Interview Details – Continued				
	Participant 2: Freelancer, 2-year tenure in Wilogo	Google talk Duration: 35 minutes	Aug 15, 2011	Financial Rewards**:** *"I can sell my skills and earn some money through TaskCn."* Visibility in the Job Market: *"It is possible for companies to find me and offer me a job in TaskCn."* Enjoyment: *"I can choose to solve different and novel tasks from TaskCn. And I enjoy it."* Reputation: *"I like to be known by my peers."* Autonomy: *"I do not have to commute and stick to the schedule in the company. I can work on the tasks anytime."*
iStockPhoto	Participant 1: Professional photographer, 1.5-year tenure in iStockPhoto	Email	Aug 11, 2011	Financial Rewards: *"I can earn money through iStockPhoto."* Need Fulfillment: *"I design some photos or flashes for my own use and I will share them in iStockPhoto."* Reputation: *"I will be admired by peers for my fantastic pictures."*
	Participant 2: Employee in advertisement company, 1-year tenure in iStockPhoto	Skype Duration: 35 minutes	Aug 11, 2011	Financial Rewards: *"I can earn some extra money from my skills."* Need Fulfillment: *"I will design some photos, videos, flashes, as well as PowerPoint to fulfill the job requirements. For most cases, I will upload what I have designed to iStockPhoto."* Reputation: *"I want to earn peers' respect regarding my photographic skills."*
InnoCentive	Participant 1: Freelancer, 2-year tenure in InnoCentive	MSN Duration: 25 minutes	Aug 15, 2011	Financial Rewards: *"The reward for task solving is very competitive in this website."* Enjoyment in Solving Challenges**:** *"I enjoy solving difficult problems, especially those that cannot be solved by others."*
	Participant 2: Researcher, 1-year tenure in InnoCentive	Skype Duration: 30 minutes	Aug 15, 2011	Financial Rewards: *"Very high reward for task solving."* Enjoyment in Solving Challenges: *"I enjoy thinking about difficult questions."*
NineSigma	Participant 1: Institute Researcher, 2-year tenure in NineSigma	Email	Aug 16, 2011	Financial Rewards: *"I can earn decent money from the website for my effort."* Sense of Achievement: *"When I work out a difficult problem, I feel a sense of achievement."*
	Participant 2: Freelancer, 1-year tenure in NineSigma	MSN Duration: 20 minutes	Aug 16, 2011	Financial Rewards: *"It is worth working on the tasks in NineSigma since the price for the tasks is very high."* Sense of Achievement: *"I feel a sense of achievement when I solved the tasks that may revolutionize the current status of the digital camera industry."*

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