Crowdsourcing: Today and Tomorrow

An Interactive Qualifying Project

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by

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Abstract

This project focuses on crowdsourcing, the practice of outsourcing activities that are traditionally performed by a small group of professionals to an unknown, large community of individuals. Our study examines how crowdsourcing has become an important form of labor organization, what major forms of crowdsourcing exist currently, and which trends of crowdsourcing will have potential impacts on the society in the future. The study is conducted through literature study on the derivation and development of crowdsourcing, through examination on current major crowdsourcing platforms, and through surveys and interviews with crowdsourcing participants on their experiences and motivations.

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Chapter 1 Introduction

Crowdsourcing allows activities that were traditionally performed by a certain agent to be outsourced to an unknown, large community of individuals. The concept can also be broadened to include the public actively engaging in an innovation/production process at a large scale. The phenomenon of crowdsourcing is growing rapidly and has the potential to permeate deeply into many aspects of human life. This research focuses on the study of current crowdsourcing methods, and also on the prediction of future trends that will make a significant impact on society.

1.1 Definition of Crowdsourcing

Jeff Howe and Mark Robinson introduced the term "crowdsourcing" in 2005 as a method where companies would use the Internet as a platform to outsource work to the public [1]. Later in June 2006, Howe has defined the term "*crowdsourcing*" as "the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call."[2]

1.2 Research Motivation

The rapid growth of the internet has made crowdsourcing a new form of business and production. Companies and organizations seek help from a broad-scale of online community to complete the tasks that they originally had to hire experts to do, usually at much lower costs. With the evolution of crowdsourcing, the concept has been applied to a wide range of areas,

ranging from very simple tasks, such as naming a newborn baby, to more complicated tasks, such as spotting moon craters by amateurs [3].

In Jeff Howe's book, "*Crowdsourcing: Why the Power of the Crowd is Driving the Future of Business*", he also mentions that crowdsourcing has activated the "transformative power of today's technology, liberating the latent potential" within the public. Crowdsourcing provides a platform where age, gender, race and education no longer matter. Only the quality of work matters. It is a fabulous meritocracy, where every field is open to all the people with diverse backgrounds. Howe also points out that crowdsourcing has also caused dramatic change in the way that "work is organized", "talent is employed", "research is conducted", and "products are made and marketed". Increasingly, crowdsourcing is taking the place of traditional forms of labor [4].

The rapid growth of crowdsourcing illustrates the potential that crowdsourcing has to permeate deeply into people's daily life and work. To make reasonable inference on future trends, it is necessary that we gain a better understanding of how crowdsourcing was derived, developed, and also the current existing forms.

1.3 Research Objectives

There are two main objectives of this research: to study recent forms and models of crowdsourcing, and look into future potential industries, trends and impacts. To guide this work, we have formulated the following research questions:

1. To characterize existing crowdsourcing methods in terms of:
    a. Problems they seek to solve;

b. Typical platforms where they are performed;

c. Types of participants and motivations of participants;

d. Motivational model;

e. Pros and Cons for each type.

2. To assess the likely future impact of crowdsourcing with respect to

   a. Promising industries with crowdsourcing as their potential future form of business/production;

   b. Potential impact of crowdsourcing on society.

Chapter 2 Background

This chapter covers a brief history of crowdsourcing and its recent growth. We also make a comparison to traditional forms of 'contracting' to help understand the key features of crowdsourcing and why it has thrived.

2.1 A brief history of crowdsourcing

Crowdsourcing, or soliciting solutions to traditional jobs from the public, began well before computers and the Internet age. As early as 1714, the British government offered the first well-known crowdsourcing task, "The Longitude Prize," which sought help from the public to develop a reliable way of computing longitude. In 1884, the Oxford English Dictionary asked a wide group of readers to catalog words [5]. These are the earliest examples of crowdsourcing.

In the 20th century, crowdsourcing continued to take hold. In 1936, the famous Japanese motor corporation Toyota offered a logo design competition for the crowd to redesign its logo. They received about 27,000 submissions and the winning logo was the three Japanese katakana letters for "Toyoda" in a circle [6]. The company name was later changed to "Toyota".

In 1955, the Premier of New South Wales state of Australia held a contest that offered £5,000 to design a building for part of Sydney's Harbor [6]. They received 233 submissions from around the world. The final winning design is one of the most famous landmarks in Sydney.

In the early 2000s, the use of crowdsourcing rapidly expanded during the ".com" revolution. A number of crowdsourcing platforms emerged in this period of time, such as the online t-shirt design website Threadless, the online encyclopedia Wikipedia, and the online video community YouTube. This period is known as the 'Web 2.0' era.

Based on the rapid growth of crowdsourcing technologies, Jeff Howe and Mark Robinson introduced the term 'crowdsourcing' in their article "The Rise of Crowdsourcing" in 2006 [6].

2.2 Comparison to traditional contracting models

Crowdsourcing can be seen as a form of contracting: companies and organizations build up a special form of 'contract' with task performers. In this case, task performers are broadened to a wide variety of public instead of certain group of people. Many other contracting models have existed for a long period of time, such as outsourcing and open source. In this section, we will provide a brief comparison between crowdsourcing and two other models.

2.2.1 Crowdsourcing V.S. Outsourcing

In terms of definition, outsourcing usually refers to the processes that people or companies contract out internal business process to some specific third party organizations [7]; however, for crowdsourcing, anyone with any background could participate in crowdsourcing tasks.

Crowdsourcing and outsourcing focus on different functions. Crowdsourcing is a way to subdivide tedious work or to raise funds for start-up companies and charities [8].The combined efforts made by online crowdsourcing participants could add up to relatively significant results. Typically, almost all crowdsourcing activities are performed within an online community. In most cases of outsourcing however, the outsourced tasks are usually not related to the core

business of the company. Sometimes outsourcing processes may also involve transferring employees and assets from one company to the other party [9].

In terms of labor force, crowdsourcing has provided a much more flexible workforce. Everyone online can participate in a crowdsourcing process, can make efforts to tasks they are interested in, and can make money once their idea or work is accepted. However, outsourcing is often limited within a rigid workforce. Clients commit to a fixed staffing model and distribution model [10].

In terms of rewards, crowdsourcing providers just need to pay for the best work based on their quality standards. On the other hand, however, outsourcing usually does headcount pricing which is based on headcount and hourly rate. This makes it difficult for clients to predict the throughput. In terms of payment, there are usually no fixed costs in crowdsourcing processes, but there are usually some prepayments in outsourcing tasks.

In terms of quality assurance, however, the quality of work being outsourced is guaranteed by documentations such as Service Level Agreement (SLA), while the quality of work being crowdsourced is not defined with a bottom line.

2.2.2 Crowdsourcing V.S. Open Source

Open source is a computer science term, which refers to opening the source code of software free to the public for use and development [11]. The difference between crowdsourcing and open source is that open source refers to the phenomenon the original design of a product is open to the public with free license; however, the activities of crowdsourcing are usually proposed by some specific companies or organizations. These tasks could be done by individuals or groups.

Another different point of crowdsourcing and open source lies in the motivations of participants. Participants of open source usually use their own technical skills to improve the current projects and provide free software resources to the public. On the other hand, the participants of crowdsourcing activities are more willing to put their efforts on tasks to get benefits for themselves.

2.3 The rise of crowdsourcing

The spread of the internet has promoted the rapid growth of crowdsourcing. First, information flows quickly through the internet, with fewer barriers. Easier access to the information brings effectiveness to users and makes it easier for them to participate. Second, the greater the number of internet users, the greater number of them gets involved in crowdsourcing activities. This provides a flexible source of labor. Third, the diversity of the users creates opportunities for multi-class online interaction and collaboration involving individuals from different backgrounds. In Jeff Howe's presentation, he suggested that the rise of online communities provides ways to organize online populations, which contributes to the success of crowdsourcing. These advantages have served as a major factor in the growth of crowdsourcing.

Apart from the internet, there are also other factors leading to the trend.

First, the time and space flexibility feature of crowdsourcing attracts more people to participate in such process. Unlike traditional working environment, there are no time or space limitations for the crowdsourcing participants. Individuals are given equal opportunities to do

work and make money in their spare time, which is not considered as part of their regular jobs. This flexibility of crowdsourcing allows people to do their tasks anytime and anywhere.

Second, Jeff Howe mentioned that the open source revolution also plays an important role in promoting the development of crowdsourcing. Open source makes more resources and information accessible to the public, which has formed the informative foundation of their participating in crowdsourcing tasks.

Third, in Jeff Howe's "The Rise of Crowdsourcing" presentation, he pointed out that the decreasing cost of production and increasing accessibility of information is also regarded as a factor leading to the success of crowdsourcing. For example, people who used to use software like AutoCad 3D Labs for technical drawings at a cost of $200,000, can now complete almost the same work by using Google SketchUp for free [12]. Also, the decreasing price of professional devices like digital cameras and music equipment also triggers the prosperity of creative industry, like photography, filmmaking and music [12]. More and more people and organizations are willing to share their information online for free. People can access more professional journals and statistics now, which supports them to do research into crowdsourcing tasks that they are not familiar with.

Chapter 3 Current Types of Crowdsourcing

One of our main research objectives is to characterize current forms of crowdsourcing by their purpose and characteristics. Crowdsourcing models differ from each other by task, platform design, participant demographics, participant motivations, and benefits/risks. In this report, we categorize crowdsourcing tasks into six main categories, and the following table provides a list of example tasks that fit into each of the categories:

Types	Professional Tasks	Solution Finding	Reviews & Ratings	Idea Collection & Data Collection	Design	Crowdfunding
Websites	TopCoder ODesk Kaggle NineSigma ScriptLance UTest	InnoCentive Quora Yahoo Answers Baidu Knowledge Sina Questions	Yelp Amazon eBay IMDb YouTube Google Book Rate my Professor Angie's List Trip Advisor InsiderPages MerchantCircle JudysBook Open Table BBB.org Buzzillions Epinions Wize PowerReviews SiteJabber	AMT CrowdFlower Tomnod eBird iStockPhoto NameThis MinuteWorker Fiverr PollDaddy ClickWorker Challenge.gov Chaordix MicroWorkers MiniFreelance Zhubajie.com InnoCentive Idea Bounty Dell IdeaStorm	99Designs DesignCrowd crowdSPRING Threadless PatternTap 12Designer OpenIDEO Accenture SpreadShirt Fiat Mio Freelancer Choosa IdeaScale Ethics ShopforDesigns 13 Dresses LogoDesignPros Hatchwise Ideaken BootB Big Idea Group	Kickstarter gofundme Crowdrise oocto Indiegogo Crowdfunder spot.us Fundable EarlyShares SterlingFunder giveForward CrowdFundZoom iBankers Angelinvestmentnetwork HyperFund EquityNet PlumFund Lammily Sponsume Foodiecrowdfunding Soylent

Table 1 A Group of Categorized Crowdsourcing Platform

3.1 Professional Tasks

Traditionally, companies hire employees with a certain skill set and certain professional experiences to do technical tasks. Hiring professional employees is usually expensive, and the onboarding process is complicated. Crowdsourcing provides a potential solution to these problems. By giving tasks to the crowd, companies pay less for the short-term labor, save part of the maintenance costs, and have more flexibility because they are able to select the best solution among all submissions.

We define professional crowdsourcing platforms as those that have the following characteristics:

- Participants must possess skills in a particular area of expertise (e.g., programming, testing and design)
- Only a small number of participants (usually the winners) are rewarded with money, usually in the form of large prizes. The remainder of participants is rewarded with points and or other measures of proficiency.

In the following sections, we first present an overview of one professional crowdsourcing platform, TopCoder, in detail. We then discuss other crowdsourcing platforms in this category.

3.1.1 Example (TopCoder)

TopCoder was founded in 2001 and is a company that administers online programming competitions. The main customers of TopCoder are companies that require a programming task

to be completed. Companies can split up a project into several tasks, usually related to software design, development and testing. For each subtask, they choose the best solution and reward the contestants. In this way, instead of completing an entire project, programmers can choose the task that they specialize in, which improves the efficiency of the project.

Figure 1 TopCoder Home Page

3.1.1.1 Types of tasks

TopCoder supports the following types of competitions [13]:

- **Single Round Match**: Short-term (75 minutes) algorithm competitions. Competitors solve as many as problems (at most 3 problems with different difficulties) in the given time limit.

- **Marathon Match**: Long-term (1-2 weeks) algorithm competitions. TopCoder provides one complicated algorithm problem with an extended timeline.

- **Design**: 1 week competition for software architecture design provided by companies. Participants need to make specifications on design details according to the given requirements. For example, contestants taking part in a design competition for a Customer Relationship Management system need to make a project development plan in detail.

- **Development**: Tasks about software development provided by companies. Participants need to develop one or more components of the software that matches the given design specifications, such as developing the search engine in the Customer Relationship Management system described above.

Software Assembly Competitions Active Challenges

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Active Software Assembly Challenges

Challenges		Register by	Submit by	Payment	Reliability Bonus	DR Points	Registrants Rated/ Unrated	Submissions
Technician Scheduling Tool 2nd Frontend Assembly		04.02.2014 16:14 EDT	04.06.2014 16:14 EDT	$2,000.00	$400.00	900	5/5	0
Module Assembly - TC Direct Studio Design First2Finish Challenge Type	TCO14	04.02.2014 11:53 EDT	04.06.2014 11:53 EDT	$1,200.00	$240.00	540	7/1	0
Module Assembly - TCC Web Socket - Coder Profile and Active Users	TCO14	04.02.2014 09:00 EDT	04.05.2014 09:00 EDT	$1,000.00	$200.00	450	7/3	0
Module Assembly - TopCoder NodeJS Auth0 Callback API	TCO14	04.02.2014 09:00 EDT	04.05.2014 09:00 EDT	$1,200.00	$240.00	540	7/4	0
Module Assembly - Genetic Gain Calculator Matlab to Octave	TCO14	04.02.2014 07:00 EDT	04.05.2014 07:00 EDT	$1,800.00	$360.00	810	15/9	0
TC Legacy Site Reskin - SRM and Mrathon Events and Tutorial Related pages	TCO14	04.02.2014 04:59 EDT	04.05.2014 05:04 EDT	$1,400.00	$280.00	630	12/7	0
TruVision v2 iPhone UI Assembly 2	TCO14	04.01.2014 21:00 EDT	04.04.2014 21:00 EDT	$1,400.00	$280.00	630	8/5	0
CSC Data Setup and Receivables Selection page Assembly	TCO14	03.31.2014 09:00 EDT	04.03.2014 09:00 EDT	$1,400.00	$280.00	630	13/8	0
Module Assembly - TopCoder NodeJS Update Password API	TCO14	03.31.2014 05:07 EDT	04.03.2014 05:07 EDT	$600.00	$120.00	270	12/8	1

Figure 2 Active Software Assembly Competitions

3.1.1.2 Motivations of Participants:

Participants of the competitions are more likely to be a group of people with programming skills. Apart from the financial rewards, there are additional motivations related to career and glory.

Task Performers:

To get rewarded: Since the professional tasks require more time, energy and skills, the rewards of the tasks are typically higher than the other tasks. The winners of the competitions

are rewarded with both score and cash. Each of the other contestants would also receive a score, which could reflect their programming skills and help them with job finding.

The desire for glory: The competitions are real-world cases released by companies, thus they make good practice for solving real-world problems, and there is glory associated in winning over other contestants. Participants have a stronger desire towards winning the competitions.

Task Providers:

Inexpensive labor: Usually the cash reward of one software task is $1000 - $2000 USD. TopCoder would earn a small commission from each task. The main attraction for the companies is its fairly low price, compared to the price of hiring professional employees.

Coder availability: there are many professional developers and CS students on TopCoder who are ready to work at any time.

Best Solution: by breaking down tasks into pieces and choosing the best solution of each task, companies may come up with a project solution that is better than what would have been achieved by any single programmer.

3.1.2 Other Examples:

Many other professional crowdsourcing platforms exist in addition to TopCoder, each targeting at a different professional field. Examples include ODesk for doing micro-tasks, Kaggle for data mining and uTest for programs' quality assurance. Below we discuss two other examples, which we compare to the TopCoder model.

3.1.2.1 ODesk

ODesk is a crowdsourcing platform which offers professionals chances to complete micro-tasks provided by companies, ranging from graphic design to software development.

Unlike the individual competitions in TopCoder, ODesk allows task performers to work in teams. It is also impressive that task providers can post jobs or projects on ODesk for free. ODesk only gets paid once task solvers begin to work, and they receive 10% of each payment. Another difference is that ODesk guarantees that tasks providers only need to pay for the performers' actual working hours. The Work Diary tracks the time and takes work-in-progress snapshots, giving the task providers visibility into project time and progress [14].

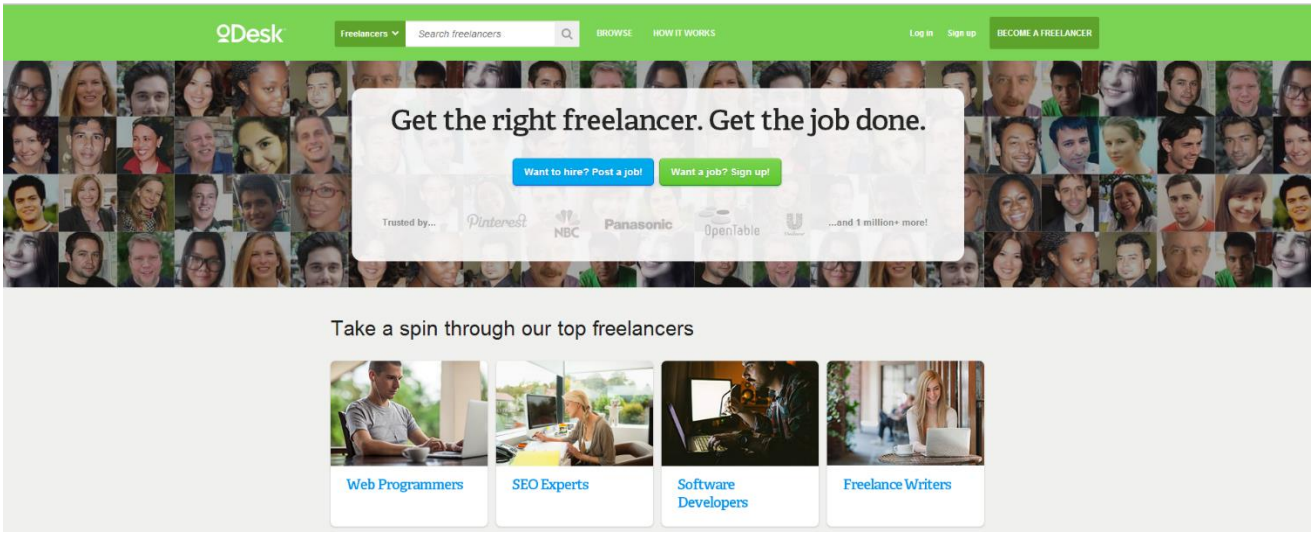


Figure 3 Screenshot of ODesk Front Page

3.1.2.2 Kaggle

Kaggle is another example of online crowdsourcing platform for doing professional tasks, but it focuses on data mining tasks. Similarly to TopCoder, Kaggle also has a system for

calculating/ evaluating the score of each solution from participants, and has a ranking for these solutions and participants in each competition. The winners are also rewarded by cash and scores.

This crowdsourcing model is different from TopCoder in that instead of an IT competition platform, it is the biggest online community of data scientists in the world, offering many online events and competitions on data mining and data analysis that are provided by companies, research agencies and government organizations.

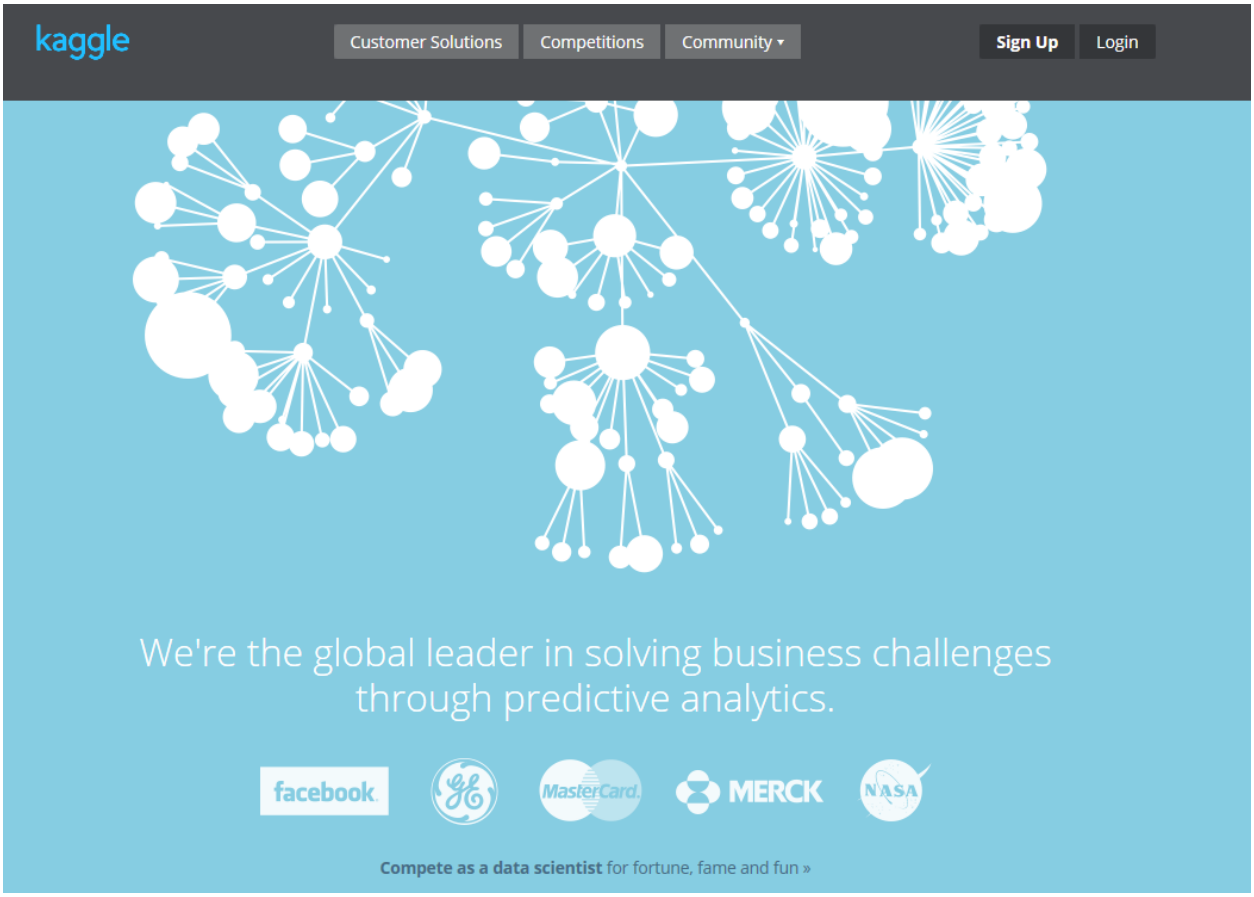


Figure 4 Screenshot of Kaggle Front Page

3.1.3 Strengths & Weakness:

Companies commonly outsource technical tasks to countries with inexpensive skilled labor, such as China and India. However, it takes more time to do the paperwork for setting up outsourcing contracts, and also, communication and maintenance are harder to conduct.

The factors of cost and efficiency have made crowdsourcing an attractive alternative for some short-term tasks. Companies post their short-term technical projects on the crowdsourcing platform and only reward the best solution. The paperwork and maintenance processes are both simple and the hiring process is within seconds. This has largely simplified the entire process.

However, there are weaknesses as well. For example, companies have their own standards and regulations. It might be a large amount of work doing adjustments and modifications on the performers' work to meet such standards. In addition, for IT companies, there might also be liability issues with the maintenance.

From a participant's standpoint, professional crowdsourcing has strengths and weaknesses as well. One of the strengths is that participants are able to gain experience in their professional field and measure up to others in their area. By earning points, they are able to develop a reputation which can enhance their resume and lead to hiring opportunities.

However, many professional crowdsourcing tasks require significant effort and time. Since only the best solutions are awarded monetary prizes, the other task performers may feel exploited for their unpaid work. Framing this process as a competition avoids disheartening workers, since the feeling of losing a competition is better than that of doing unpaid work.

However, some risk remains that job creators will exploit the situation and, knowingly or not, borrow ideas from submissions that did not ultimately win.

3.1.4 Summary

On platforms such as TopCoder, ODesk and Kaggle, tasks are disguised as competitions or auctions. With such guises, task performers get more internal motivations, such as the desire to get a high ranking or win a competition, and feel less exploited if they do not get paid due to the failure in a competition or auction. And of course, task providers pay much less on a project since they only have to pay the winners. Both task providers and performers benefit from the process, which makes such type of crowdsourcing popular these days.

3.2 Solution Finding

Another very important application of crowdsourcing is solution finding. Individuals or companies seek help from the crowd to solve problems that even skilled employees have difficulties with. Sheer-sized public sometimes have unexpected capability with problem solving, due to their great passion, diverse backgrounds, and different perspectives on the same problem.

We define solution finding crowdsourcing platforms as those that have the following characteristics:

- The tasks are usually challenging. Task solvers need specific background knowledge within a certain academic area to come up with ideas and solutions. Collaboration is encouraged in the solution finding tasks.

- The monetary rewards are typically smaller compared to rewards from professional tasks and competitions.

3.2.1 Example (InnoCentive)

InnoCentive was founded in 2001 and is one of the global leaders in crowdsourcing with innovation problems. Their mission is to group smart people to provide ideas and solutions to challenges in the fields of business, society, policy, science and technology [15].

Task providers post challenges on InnoCentive along with the financial rewards to pay the solvers, and with a fixed portion of commission to pay the company. Task solvers can choose and submit solutions to any of the challenges. If the task provider is satisfied with the solution, they will reward the solver and gain acquisition to the intellectual property rights to the solutions. In such way, InnoCentive protects intellectual property rights for both task providers and task solvers.

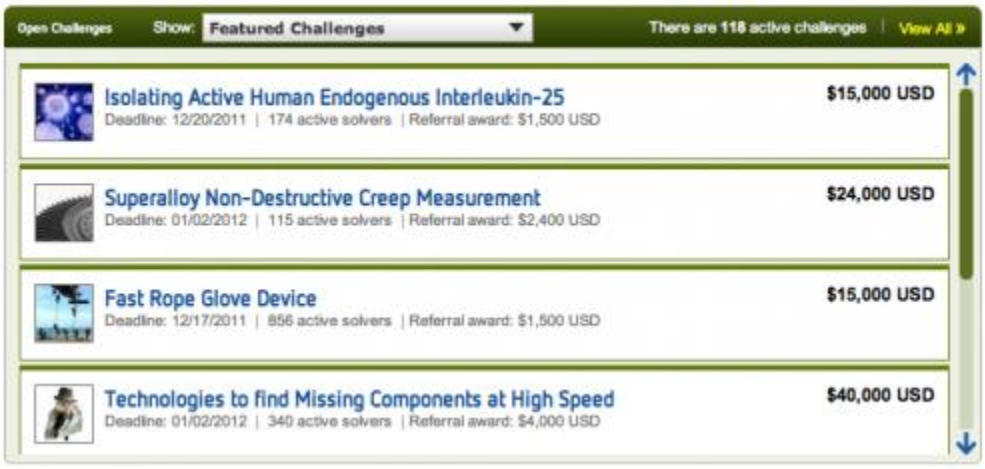


Figure 5 A List of Paid Tasks

3.2.1.1 Typical Tasks

These are several types of tasks called Challenges on InnoCentive [16].

Ideation: Challenges for generating ideas for new product lines, new product features and solutions to the current product. The posting period is usually shorter than the other types of Challenges, and at least one solver will win the award.

Theoretical: Challenges for feasible design with detailed description of a solution that meets the task providers' requirements. If the solution is chosen, the intellectual property of the solution is transferred or licensed to the task provider.

Reduction-to-Practice (RTP): In addition to theoretical solutions, tasks performers also need to build an actual prototype and provide physical evidence to prove that their solution is the best one. Data is generated within a longer period. If the solution is not chosen, the task performer will get explanation on why their solutions are not selected.

Novel Molecule Challenge (NMC): Challenges in the chemistry and biology fields, where task performers submit the compounds or structures that they have or are willing to make, and receive award if companies decide to obtain the IP rights for them.

3.2.1.2 User Motivation

There are several possible motivations of problem solving crowdsourcing task participants.

Task performers

Monetary rewards: similarly to the situation in other tasks, the financial reward is obviously one of the main factors that attract the problem solvers.

Intellectual reputation: some of the tasks are on cutting-edge topics. Solving such tasks can bring the task solver great reputation in the academic field, and can catch attention from the other professionals and experts.

Task providers:

Global talent: solvers come from all over the world. Task providers are able to collect wisdom from individuals with diverse backgrounds, which could be very helpful for some of the very tough tasks.

Multi-disciplinary solution: problem solvers specializing in different fields can collaborate and provide ideas from different perspectives, which would be inspiring in some of the very complicated cross-disciplinary cases.

3.2.2 Other Examples

In addition to InnoCentive, there are many other solution finding platforms, such as Yahoo Answers, Quora, Idea Bounty and Dell IdeaStorm. Below we discuss two other examples.

3.2.2.1 Yahoo Answers

Yahoo Answers is an online question-and-answer community launched by Yahoo!, where members could share their questions and seek answers from the community. Yahoo Answers differentiate the questions into several categories such as Art & Humanities, Beauty & Style, Business & Finance and Consumer Electronics.

Compared to Challenges on InnoCentive, there is a wider range of questions on Yahoo Answers, from basic daily-life questions to academic problems. Moreover, there are usually fewer or no financial rewards for the best solutions selected.

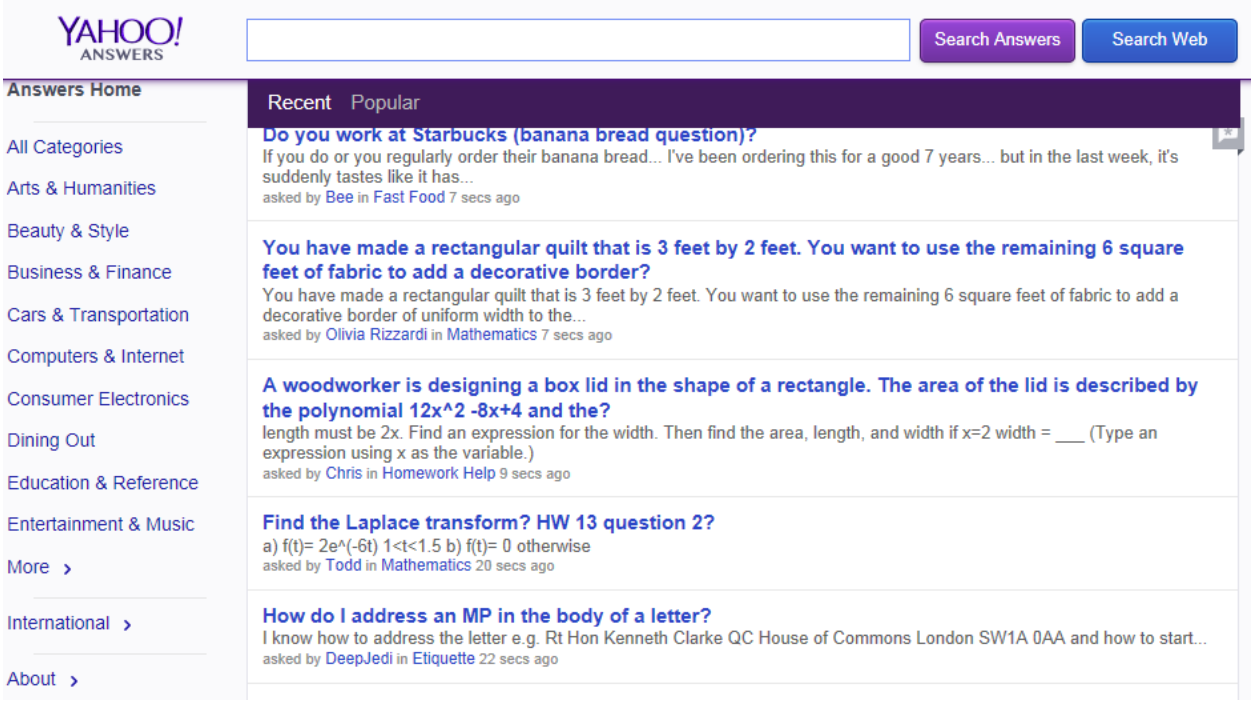


Figure 6 Screenshot of Yahoo Answers

3.2.2.2 Quora

Quora is another solution finding platform where people seek help for any questions from people who have proper background or have first-hand experience [17]. Besides this, people could also post short blogs on Quora to share knowledge or experience on any topic.

Unlike InnoCentive or Yahoo Answers, Quora requires its users to register with their real names and backgrounds in order to ensure the qualities and trustworthiness of answers and shares. Based on the statistics until 2014, around 40% of Quora users are from India [18].

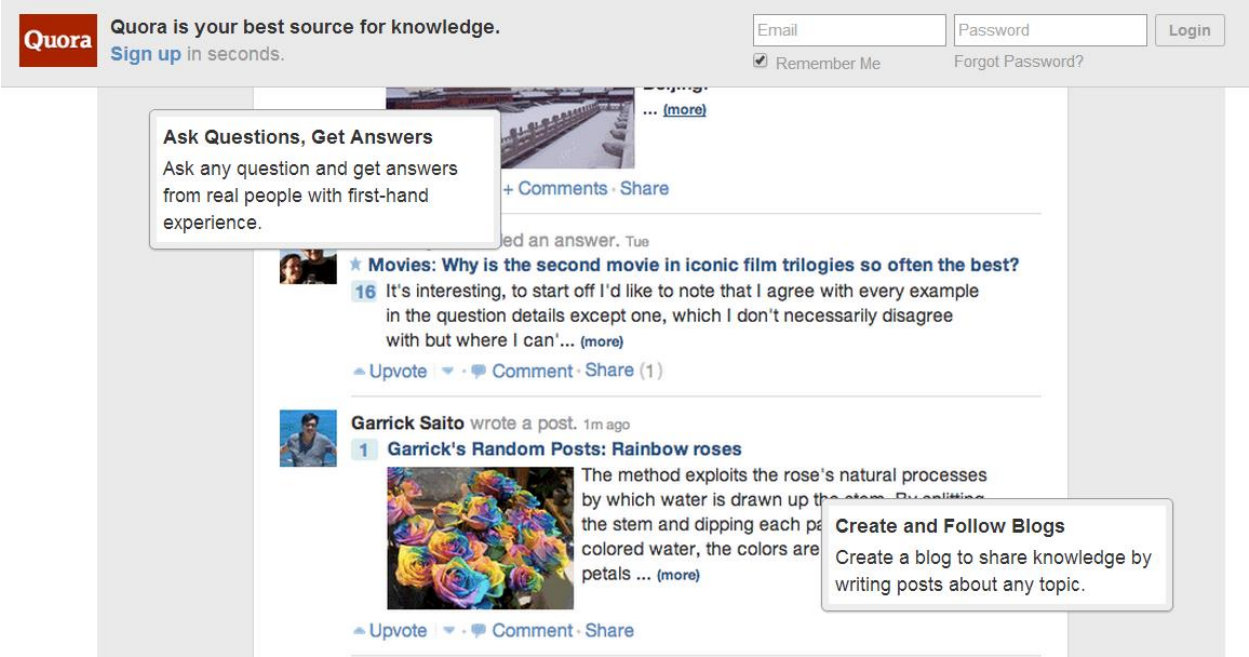


Figure 7 Some Sample Posts from Quora.

3.2.3 Strengths and Weaknesses

KarimR. Lakhani, Lars Bo Jeppesen, Peter A. Lohse and Jill A. Panetta did a survey on 166 discrete scientific problems posted on InnoCentive, from 26 science-driven firms that had tried to solve these problems on their own with years of efforts [19]. The study has resulted in 29.5% resolution rate. They have also found that the 'broadcast search' has involved scientists with diverse research directions, some of whom has provided solutions outside of their expertise fields. The researchers came out with the conclusion in their report *The Value of Openness in Scientific Problem Solving* that 'opening up the search process and broadcasting problem information to outsiders can alleviate the negative effects of local search'. The research indicates that diversity is one of the major advantages of problem solving with crowdsourcing. Amateurs provide fresh perspectives on the problems, and experts can possibly be inspired by

these ideas and are able to solve the problem in an easier way. If no one is able to solve the problem individually, they can make progress by improving other's ideas, and this will lead to a final solution incrementally.

However, there are also some drawbacks in this form of problem solving. The most significant one is that the involved public is so huge that it may include people from experts to those who are completely laymen, thus the quality of the answers is not guaranteed. If one person makes a tiny mistake, the result could be completely wrong under the effect of Domino Effect, and this could lead to serious problems for some of the scientific research areas.

3.2.4 Summary

When there is a complicated problem, the common idea is to seek help from senior experts. Having the crowd to solve complicated scientific problems seems to be unbelievable, but indeed it could bring unexpected inspiration and provide innovative solution due to their different perspectives on the problem. However, task providers should also pay attention to information filtering due to inconsistent quality of answers.

3.3 Reviews and ratings

The expansion of the internet has led to the explosion of information. To save time costs and achieve effective production, it is essential to have rapid information filtering. It is hard for the authority to make reports on every single piece of information, and on the other hand, the crowd is unlikely to trust these reports from the official. Thus the task of making reviews and ratings are crowd-sourced to the public, typically the users. An increasing number of people

depend on these reviews to filter bad choices and make decisions. For example, the customer reviews on Amazon might help a prospective buyer with his/her selection, and the ratings on Yelp can help families with the choice of restaurant they will go for dinner.

Ratings and reviews crowdsourcing has the following characteristics:

- In general, there is no task providers or task rewards. Reviewers are usually customers who have purchased a certain product or have experienced specific service. Ratings and reviews entirely depend on the users' subjective feelings.
- Compared to other crowdsourcing models, the Ratings and Reviews model involves a much wider user group and does not need any professional background.

3.3.1 Example (Yelp)

Yelp is a social networking site that allows users to post reviews and rate business, such as cafes, restaurants, hotels, and local services. Using the power of crowdsourcing, Yelp has built the biggest online business rating community, with around 200 employees, 4 million reviews, and millions of visitors each month [20].

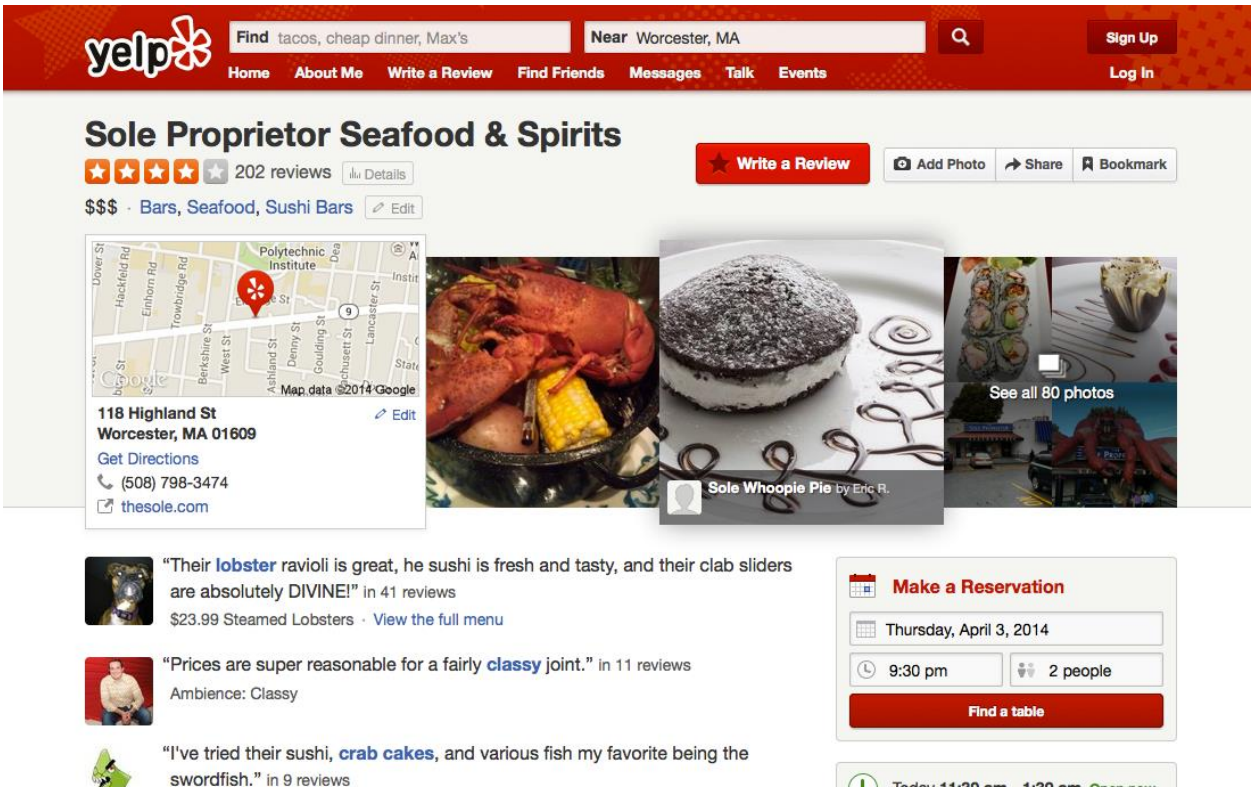


Figure 8 A Screenshot of a Page of a Restaurant

3.3.1.1 Typical Tasks

Unlike the other crowdsourcing models, there are no typical task providers. On the reviewers' side, the only task is to make reviews and ratings on specific product, such as a dish in a restaurant, or on certain piece of service, such as a haircut. On the viewers' side, there is no absolute best answer. Decisions are made not only based on the ratings and reviews, but also on their current conditions, such as locations, preferences, and consumption abilities.

3.3.1.2 User Motivations

The user motivation of this particular type of crowdsourcing is a bit different from that of the other models. In most cases, users posting ratings and reviews do not get financially or intellectually rewarded, thus money is not a major attraction. There are more internal motivations:

The desire for expressing ideas and influencing others: when a user feels strongly against a movie, he/she will have a desire to stop the other prospective audiences from watching the movie by making negative reviews.

The desire to compare opinions: If the user hates a certain movie that is positively commented by other reviewers, he/she might want to compare their own opinions to the others, and make the others do so by replying to his/her comments.

The desire for public attention: If the comment becomes popular and harvests a great number of hits and likes, the reviewer's desire for public attention will be satisfied to a large extent.

3.3.2 Other Examples

Apart from Yelp, there are many other ratings and reviews platforms specializing in different fields, such as IMDb for ratings on movie, television and video games, Angie's List for ratings on local businesses, and Google Books for ratings on books. The following section introduces two examples with comparison to Yelp.

3.3.2.1 Amazon Customer Ratings

Amazon is the world's largest online retailer. On its website, there is a customer review section under each of the products, where customers who have bought the particular product could make ratings and comments on it. The review section provides noteworthy information for other online shoppers.

The major difference between Amazon customer ratings and Yelp is that Amazon customers can only make comments on products that have already existed in the Amazon online market; however, Yelp users can create new page for any business that has not yet been available on Yelp.

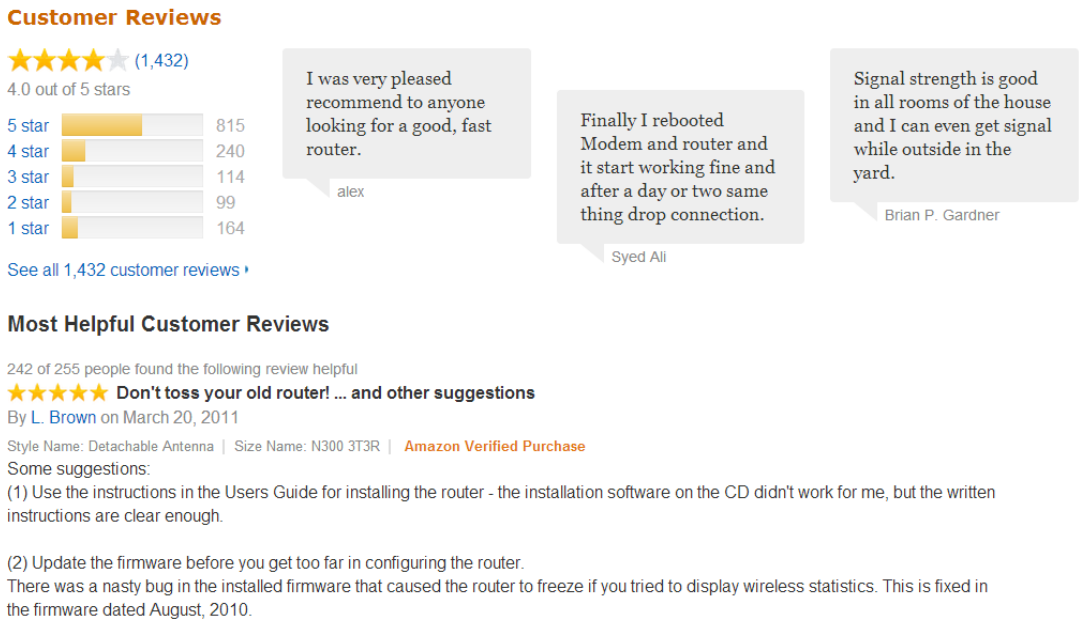
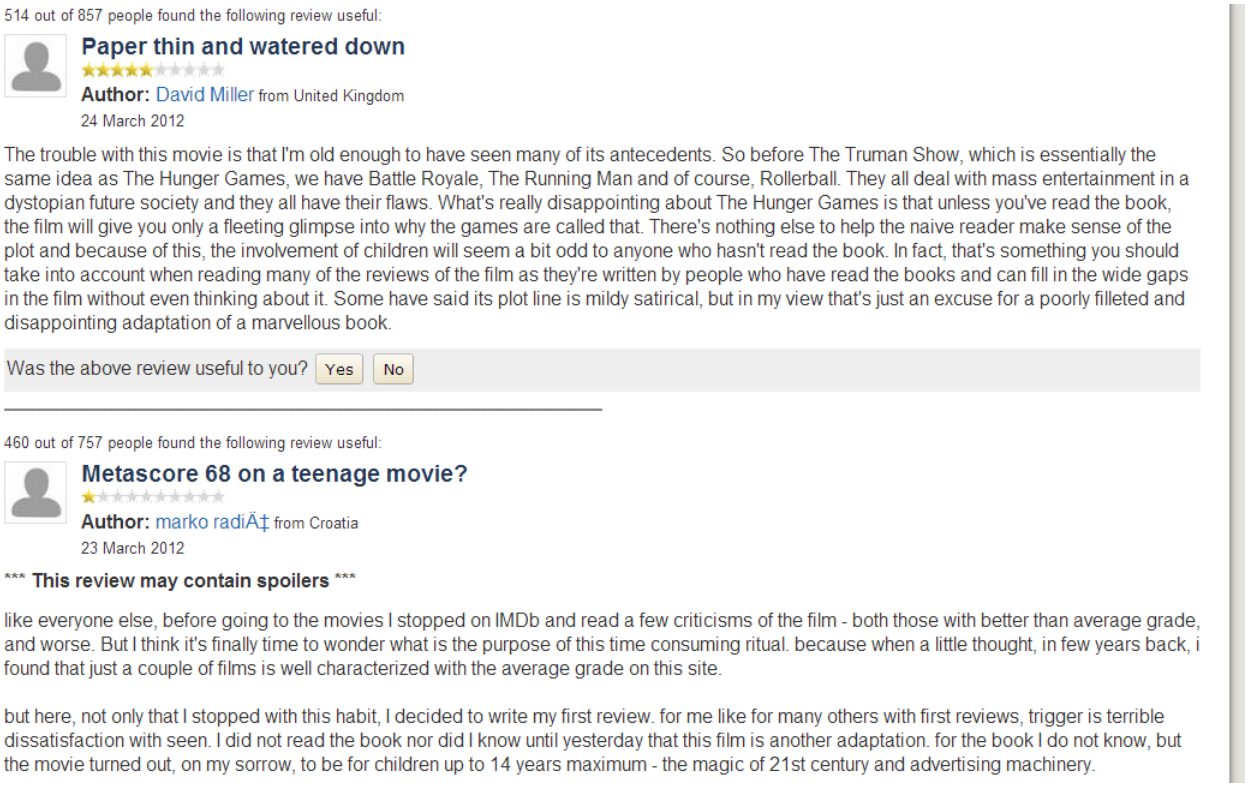


Figure 9 A Screenshot for the Customer Review Section of Amazon

3.3.2.2 IMDb

IMDb refers to “Internet Movie Database”, which is an online database of information about movies, television and video games. Audiences and game players can make comments and ratings on this platform as well as making comments and ratings for the other comments.

The ratings and reviews on Yelp affect people within a certain geographical region. Ratings and reviews on a restaurant in New York can hardly affect residents in Los Angeles. On the other hand, user ratings on IMDb are regarded highly and have a global impact.


514 out of 857 people found the following review useful:

Paper thin and watered down

Author: David Miller from United Kingdom

24 March 2012

The trouble with this movie is that I'm old enough to have seen many of its antecedents. So before The Truman Show, which is essentially the same idea as The Hunger Games, we have Battle Royale, The Running Man and of course, Rollerball. They all deal with mass entertainment in a dystopian future society and they all have their flaws. What's really disappointing about The Hunger Games is that unless you've read the book, the film will give you only a fleeting glimpse into why the games are called that. There's nothing else to help the naive reader make sense of the plot and because of this, the involvement of children will seem a bit odd to anyone who hasn't read the book. In fact, that's something you should take into account when reading many of the reviews of the film as they're written by people who have read the books and can fill in the wide gaps in the film without even thinking about it. Some have said its plot line is mildy satirical, but in my view that's just an excuse for a poorly filleted and disappointing adaptation of a marvellous book.

Was the above review useful to you? Yes No

460 out of 757 people found the following review useful:

Metascore 68 on a teenage movie?

Author: marko radiÄ‡ from Croatia

23 March 2012

*** **This review may contain spoilers** ***

like everyone else, before going to the movies I stopped on IMDb and read a few criticisms of the film - both those with better than average grade, and worse. But I think it's finally time to wonder what is the purpose of this time consuming ritual. because when a little thought, in few years back, i found that just a couple of films is well characterized with the average grade on this site.

but here, not only that I stopped with this habit, I decided to write my first review. for me like for many others with first reviews, trigger is terrible dissatisfaction with seen. I did not read the book nor did I know until yesterday that this film is another adaptation. for the book I do not know, but the movie turned out, on my sorrow, to be for children up to 14 years maximum - the magic of 21st century and advertising machinery.

Figure 10 A Screenshot of Reviews for the *Hunger Game*.

3.3.3 Strengths and Weaknesses

There are many advantages of crowdsourcing the ratings and reviews on products or services. Customers can filter out information of poor quality and make quick and efficient decisions by referring to the other's opinions, which leads to higher customer satisfaction. Businesses can treat the crowdsourcing platforms as a way of advertising and marketing. The collective feedbacks from the crowd can make the ratings more authoritative. A large quantity of ratings and reviews from the crowd is usually more persuasive than a single seller's description.

Although crowdsourcing ratings and reviews is beneficial for both businesses and customers, there are also some weaknesses in this model. First of all, the ratings could be biased if they are manipulated by the crowdsourcing platforms under some hidden rules, such as if the platforms hides poor ratings for businesses who pays them. Secondly, customers might blindly trust the ratings regardless of their own condition. Thirdly, negative comments have greater effects than positive ones. There could be damaging effects from one poor piece of comments made by some disgruntled reviewers.

3.3.4 Summary

Ratings and reviews is the most common form of crowdsourcing. It helps people filter out information of low quality by referring to the crowd's overall opinions. However, there could be doubt on the trustworthiness of the ratings if they are possibly manipulated by the rating platforms for some commercial purposes. Companies like Yelp needs to make sure that

the information isn't biased due to deliberate promotion or demotion. Transparency and honesty are the crucial factors of the future development of such kind of crowdsourcing.

3.4. Idea & data Collection

Brainstorming is a very good source of idea collection. Individuals and companies seek opinions and suggestions from the public for data collection or product improvement purposes. For idea generation, the task providers assigns a task to the public, usually about collecting new ideas or suggestions on a certain product or service, and choose the best or most practical one among all submissions. For data collection, instead of assigning a complete project, the task providers usually send out surveys to collect data for a certain phase of a project, and make analysis based on the collected data. Idea & data collection is a very commonplace type of crowdsourcing.

The idea & data collection crowdsourcing has the following features:

- The idea collection crowdsourcing task providers can be businesses that want to collect ideas on their new products or recommendations on their existing products. The task providers can also be individuals who want to collect the ideas of others through brainstorming.

- The data collection crowdsourcing task providers can be professional agents or individuals who want to collect data for a study through surveys. The surveys are typically micro-tasks that take a short time to complete.

- There is usually no single winner in this type of tasks. The rewards are relatively modest, but it is given to all participants.

3.4.1 Example (CrowdFlower)

CrowdFlower is an online crowdsourcing platform founded in 2009 those targets at enterprise customers. CrowdFlower offers high-quality enterprise solutions with large amount of data using crowdsourcing techniques. They take complicated projects and divide them into small tasks to be assigned to different task performers, who are referred to as Contributors.

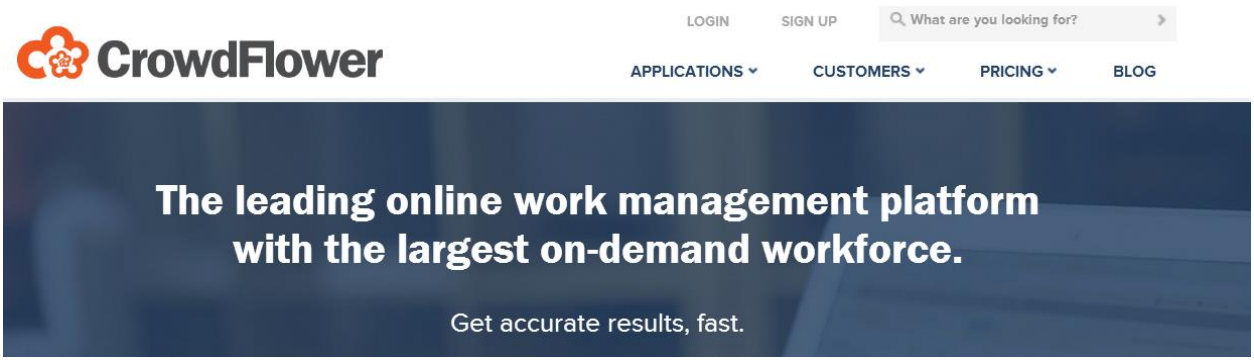


Figure 11 A Screenshot of CrowdFlower

CrowdFlower has collaborated with many companies and individuals with data collection tasks. Here we introduce the collaboration with Artimys as an example.

Artimys is a company that provides children guardian services. Using natural language and information processing, Artimys helps parents protect their children from the danger of the internet by detecting harmful contents and behaviors [21].

CrowdFlower has assisted Artimys to train machine learning models. This process starts from a collection of 2 million messages from several online data sources, out of which 40,000 suspicious messages are sent to CrowdFlower where online Contributors quickly created accurate labels on those messages. Approximately 150,000 responses were collected within a few hours. Artimys then uses the collected sample dataset to train its bully-detection model. The fast speed, large scale and high accuracy of responses have largely helped with the data collection process of the project.

3.4.2 Other Examples

While CrowdFlower is a major platform focusing on data collection tasks, there are many other platforms that target at idea generation and collection. We introduce two of these platforms in the following section.

3.4.2.1 Dell IdeaStorm

Dell IdeaStorm was launched by Dell in Feb. 2007 [22]. It is a platform where Dell can collect ideas for its new products and services. Users can post their ideas and suggestions on a certain product or service, and vote for promotion or demotion on the other ideas. Once the idea is accepted, it could be turned into reality by Dell. Dell also hosts some sections where customers provide ideas for a certain topic designed by Dell. Dell will then share the plans on how to implement these ideas. “IdeaStorm has crossed the 16,000 idea mark and implemented nearly 500 ideas“, reported by Dell in 2013 [22].

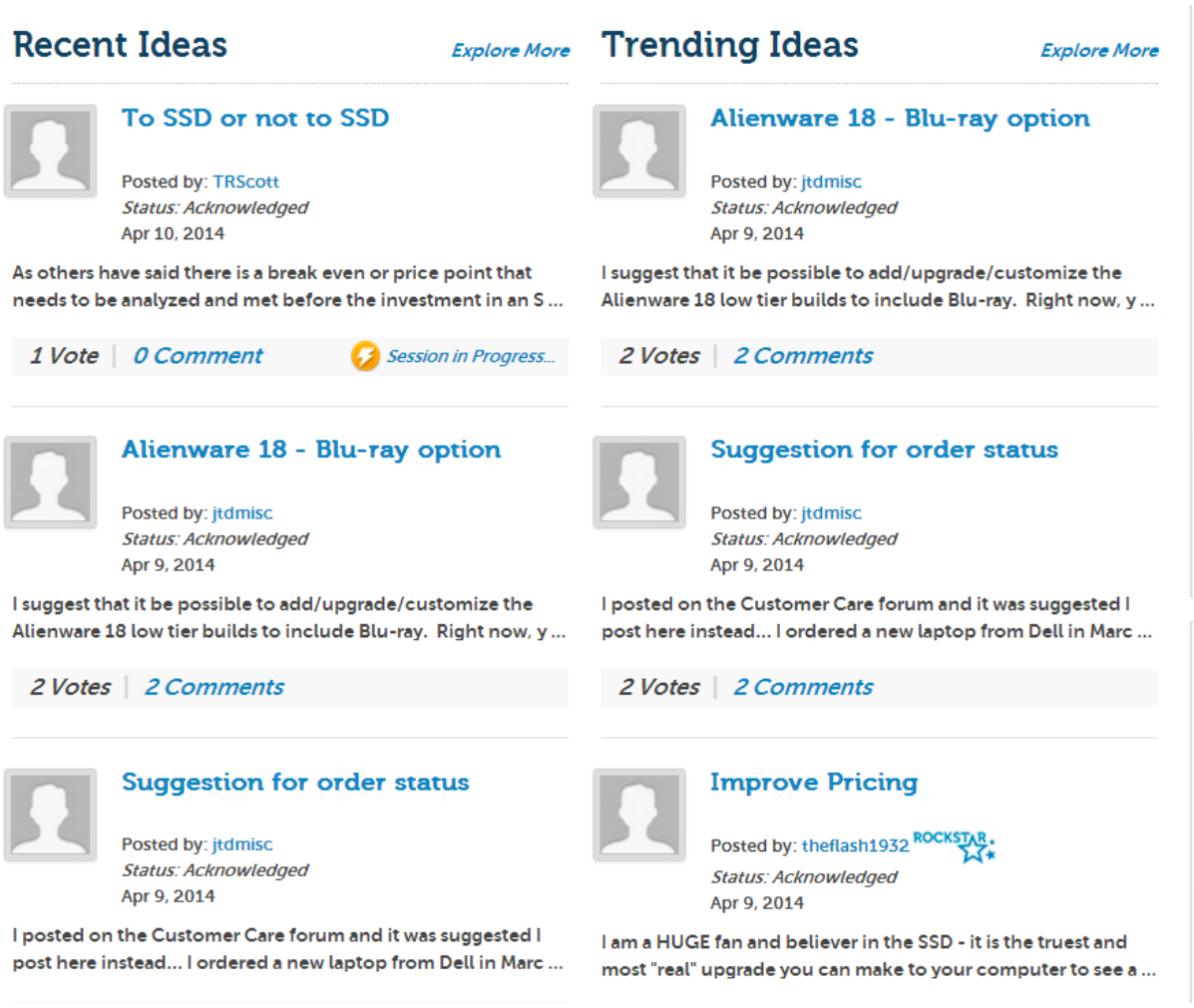


Figure 12 Ideas on Dell IdeaStorm

3.4.2.2 Idea Bounty

Idea Bounty is a small online crowdsourcing platform for creative ideas. Compared to IdeaStorm where users can only provide ideas on Dell products, clients on Idea Bounty can post briefs on any topics interested, and the registered members will offer their ideas on these posts. Clients can only pay for the ideas they feel most satisfied in exchange for the IP rights of these ideas.

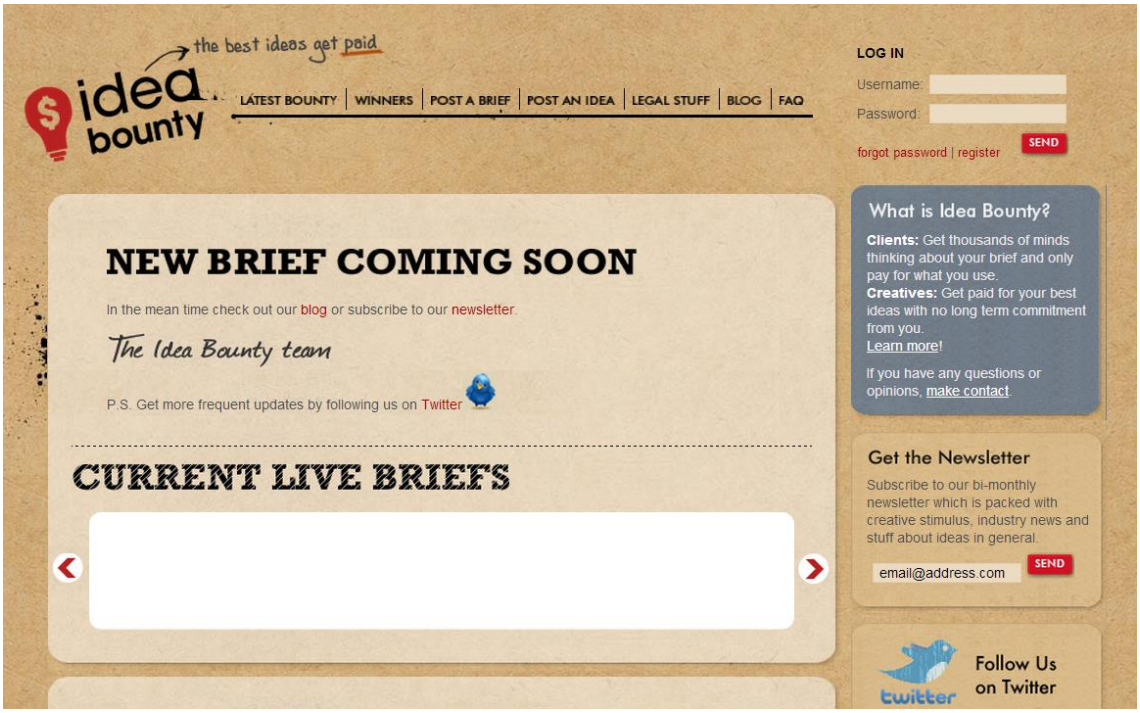


Figure 13 A Screenshot of Idea Bounty Front Page

3.4.3 User Motivations

Because most idea and data collection tasks are small, the financial reward of performing such form of tasks is very limited, thus the user is more motivated by internal factors.

Idea Collection:

The disappointment or frustration towards a certain product or company: if a user is very unsatisfied by a product, they will complain about it and demand for improvements.

The love for a certain product or company: if the user admires a company or product, it's very likely that they want to contribute to the production process and help them become more successful.

Data Collection:

The financial reward: data collections tasks are usually micro-tasks with less rewards, while idea collection tasks could be larger with more compensations. Participants can make money by completing these tasks.

The kindness and willing to be helpful: in some cases, people taking a survey is not directly related to the project. They cannot see the final outcome of the project, cannot improve skills or innovation, and cannot benefit from the task. The motivation here is the willing to be kind and help others.

3.4.4 Strengths and Weaknesses

Using crowdsourcing platforms for collecting data and ideas brings a lot of benefits. For idea collection, users with first-hand experience with the products are more likely to come up with great ideas and practical suggestions. Comparing to the traditional suggestion boxes to collect customer feedbacks, the crowdsourcing method provides a more convenient and flexible way of idea collection. For data collection, the crowdsourcing method can not only save time and money, but also broaden the range of sample data, especially for research that requires diversity in the dataset.

On the other hand, however, there are also some drawbacks. For idea collection, the challenge lies in the quality of suggestions. There might be only a few really helpful or practical suggestions among all submissions, thus it might take the company a long time to filter out the other ideas. For data collection, there could be problems with participant selection and data authenticity. For example, there could be deliberate promotion or demotion by those

participants who wants to influence the result of the survey, and there could also be dishonest answers because people want to hide some of their real feelings about a certain issue.

3.4.5 Summary

Crowdsourcing provide a great way for companies and individuals to collect data and ideas, but there are still some constraints. The various backgrounds of the crowd helps with the diversity of sample data, but task providers should also pay attention to some limitations of such type of data collection. The power of brainstorming could bring fresh ideas, but data filtering could be a complicated process.

3.5 Design

Innovation is a crucial factor in product design. Companies assign their product design tasks to the public to benefit from collective wisdom. Typically, companies give their product design tasks to the same group of people as their target customers. In this way, they'll get first-hand opinions from their potential customers and promote the sales because the product can largely fit with the needs of this certain group of customers'. It also helps the companies with marketing, since the process of collecting designs can be an advertisement at the same time.

The design crowdsourcing can be easily distinguished by the following features:

- Instead of materials and structures, the tasks particularly focus on the design of the products' visual appearances that can intuitively attract potential buyers, such designing for logo, graphic and web.

- The tasks usually have a time limitation. The best solution is selected by the task provider, and the designer is rewarded in exchange for the IP right.
- Since only very few winning designs are selected, the quality of work is more important than the quantity of work, comparing to the situation of data collection where the quantity of work matters.

3.5.1 Example (99designs)

99designs is the top marketplace for online web, logo and graphics design contests. Almost 300,000 registered designers from around the world have taken over 100,000 contests on 99designs. They design a wide range of products, ranging from logos, icons, business cards, product packages, brochures, T-shirts to websites.

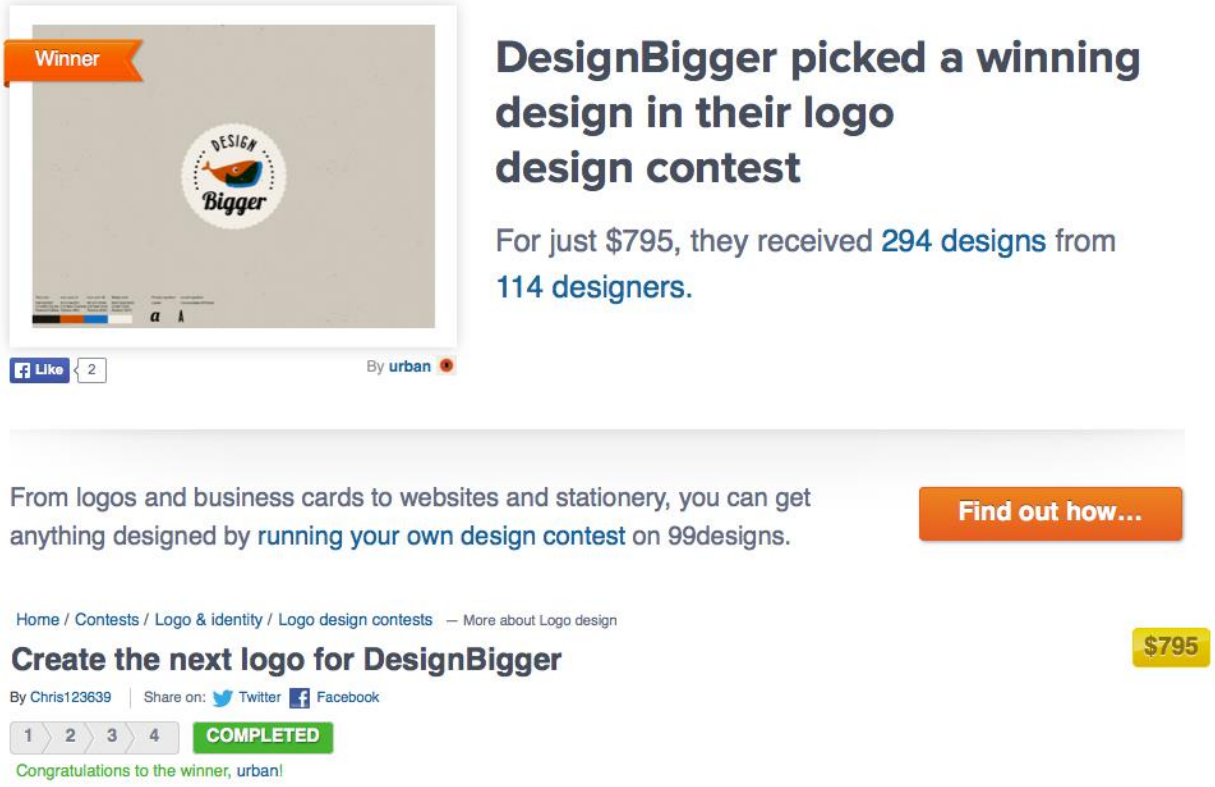


Figure 14 One Example Task on 99designs

99designs has been partnered with many large companies. For example, Doritos, the famous chips brand, posted an advertisement design contest on 99designs to seek a video commercial design for their new mystery flavor chips. Doritos has not only rewarded the final winner with 1 million dollars, but will also put the winning video on air during the Super Bowl games [23].

3.5.1.1 Typical Tasks

The following is a list of tasks from 99designs:

- **Logo Design**: including business logos, photography logos, sports logos and automotive logos.

- **Website Design**: including website design/redesign, website illustration, and blogs.
- **App Design**: including iOS apps, Android apps, and mobile websites.
- **Advertising Design**: including postcards, leaflets, posters, invitations, and menus.
- **Clothing Design**: including t-shirts, jerseys, baby apparels and hoodies.
- **Art Design**: including graphics, characters, business illustrations, and album covers
- **Packaging Design**: including product packaging, food packaging, beverage packaging, retail packaging and cosmetics packaging.
- **Book Design**: including book covers, and eBook covers

3.5.1.2 User Motivations

There are several possible motivations of design crowdsourcing task participants:

Financial reward: the reward of designing tasks is usually greater than the other types of tasks, thus it is a major motivation of the task performers. But it is also a weakness that only selected designs is paid. Users might be unsatisfied if they spend a long time but do not get enough rewards as compensation.

To seek for potential job opportunities: it is very possible that the winner in a design contest will be hired as the designer of the company. The potential job opportunities are another major attractiveness of the design crowdsourcing.

To improve innovation skills: innovation is people's core competitiveness. Participants can improve their ability to turn creative ideas into mature designs, and practice innovation skills.

The desire for sense of achievement: It brings great sense of achievement if a user's design has been accepted and put into production.

The desire for networking: designers communicate with each other via these competitions. Amateurs might get the chance to meet people with same interests and interact with them. Their networks will be broadened and potentially there's a reward.

3.5.2 Other Examples

There are usually rich awards for the winners in the design contests, thus the design crowdsourcing is popular among all types of crowdsourcing and there is a long list of platforms. We choose the popular t-shirt design platform Threadless to make a comparison to 99Designs.

3.5.2.1 Threadless

Threadless, founded in 2000, is a crowdsourcing platform that focuses on graphic designs for clothes, particularly t-shirts.

The biggest difference between Threadless and 99Designs is that instead of taking contests that are provided by companies, designers on Threadless can post any of their t-shirt designs on the website where everybody else can buy the designs. The designs are also voted by visitors, and Threadless selects the top 10 designs every week based on the voting results and makes them available for customer purchase. Designers will receive a portion of the profits from the sales of the t-shirt.

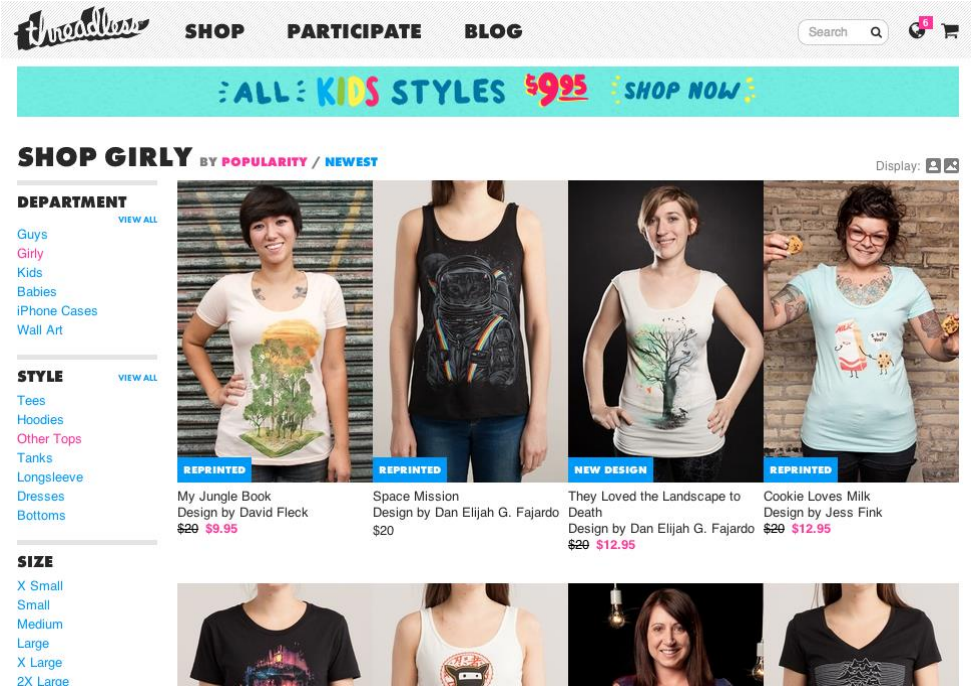


Figure 15 Threadless Sells the Designed T-shirts

3.5.3 Strengths and Weaknesses

Crowdsourcing design tasks bring designers a lot of benefits. First of all, instead of having the restrictions that full-time designers can only work for one specific company, designers on the design crowdsourcing platforms could take any tasks they are interested in. Secondly, on platforms like Threadless, designers do not have to change their design to meet the taste of some specific customers. They could post any designs that they truly like. Their inspirations are not bound by a fixed structure. Thirdly, designers can work anytime and anywhere of their own choice. A comfortable working environment is a major factor for genius ideas. Moreover, the design crowdsourcing platforms provide opportunities for not only professional designers, but also design lovers, and there are potential job opportunities for the winners.

However, there are also some drawbacks. Firstly, the quality of the designs is more important than the quantity. Since only a few designs will be chosen, many designers would feel exploited since their time cost cannot be rewarded with proper compensations. Secondly, designs with high quality usually require the assistance from professional graphing software. Such software could cost a lot of money and cannot be afforded by everyone.

3.5.4 Summary

Crowdsourcing the design of a certain product is a good way of marketing for companies that want to sell the product to the same group of customers. Having a community of professional designers, amateurs or fans compete on the online platforms could help broaden the public awareness of the product, and serving advertising purposes. For the participants, the competitions offer them chances to make money, as well as job opportunities.

3.6 Crowdfunding

Fundraising has been popular among college students and organizations. But the traditional face-to-face fundraising faces some problems, such as targeting at wrong audiences, and suffering from time and space limitations. Crowdfunding provides a solution to these problems. Browsing a set of project or product posted on Crowdfunding platforms, the crowd can choose to invest in any of the interesting projects and help them with further development.

In the other types of crowdsourcing, typically the task providers pay task contributors for their efforts. But situations reverse in cases of Crowdfunding. Backers, taking the roles of task contributors, pay the task initiators for their ideas and works.

3.6.1 Types of Crowdfunding

There are several types of Crowdfunding in terms of their forms of returns and rewards:

- **Donation-based Crowdfunding:** Supporters donate money to some projects they are interested in and receive gratitude instead of gratuity, such as a thank you note.
- **Reward-based Crowdfunding:** A pledged amount of money will be rewarded directly to the backers. In this case, the pledged reward resembles the payment for the pre-order of a product.
- **Credit-based Crowdfunding:** Backers lend money to fundraisers, and get interests as return.
- **Equity-based Crowdfunding:** Similarly to the stock, backers receive shares of a company in exchange for their investment.

3.6.2 Example (Kickstarter)

Kickstarter is an online Crowdfunding platform where owners of innovative projects or products collect funds to bring them into life. Kickstarter has hold fundraising for 135,000 projects, such as video-games, music, comics, animations, artworks, books, mobile applications and local services [24]. Backers on Kickstarter receive tangible rewards for their pledges.

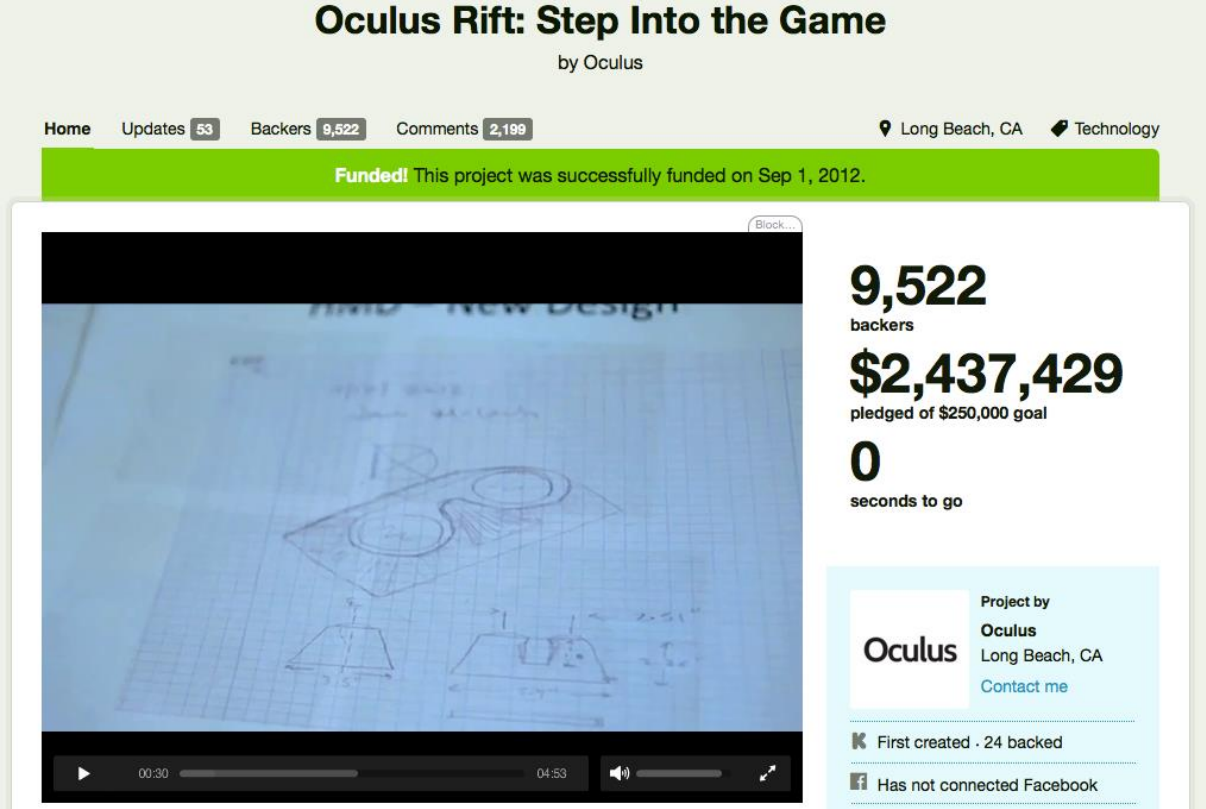


Figure 16 One Example Project on Kickstarter

There are many successful fundraising cases on the Kickstarter platform. Palmer Luckey, founder of the virtual reality headset called Oculus Rift, posted his idea of this product on Kickstarter in September 2012. It has received great supports from a lot of backers on the website, and has ultimately raised $2,437,429 USD for the product. Palmer Luckey has later founded a company due to the great success of Oculus Rift.

3.6.3 Other Examples

Apart from Kickstarter, there are other popular Crowdfunding platforms.

3.6.3.1 GoFundMe

GoFundMe is a Crowdfunding platform for people to raise money for almost any events, for their own business or for the others.

Distinctively, in order to keep the authenticity and transparency of the funds, GoFundMe requires its users to sign up with their real names. Besides, once the fundraising campaign receives the first donation, fundraisers can easily request a withdrawal at any time [25].

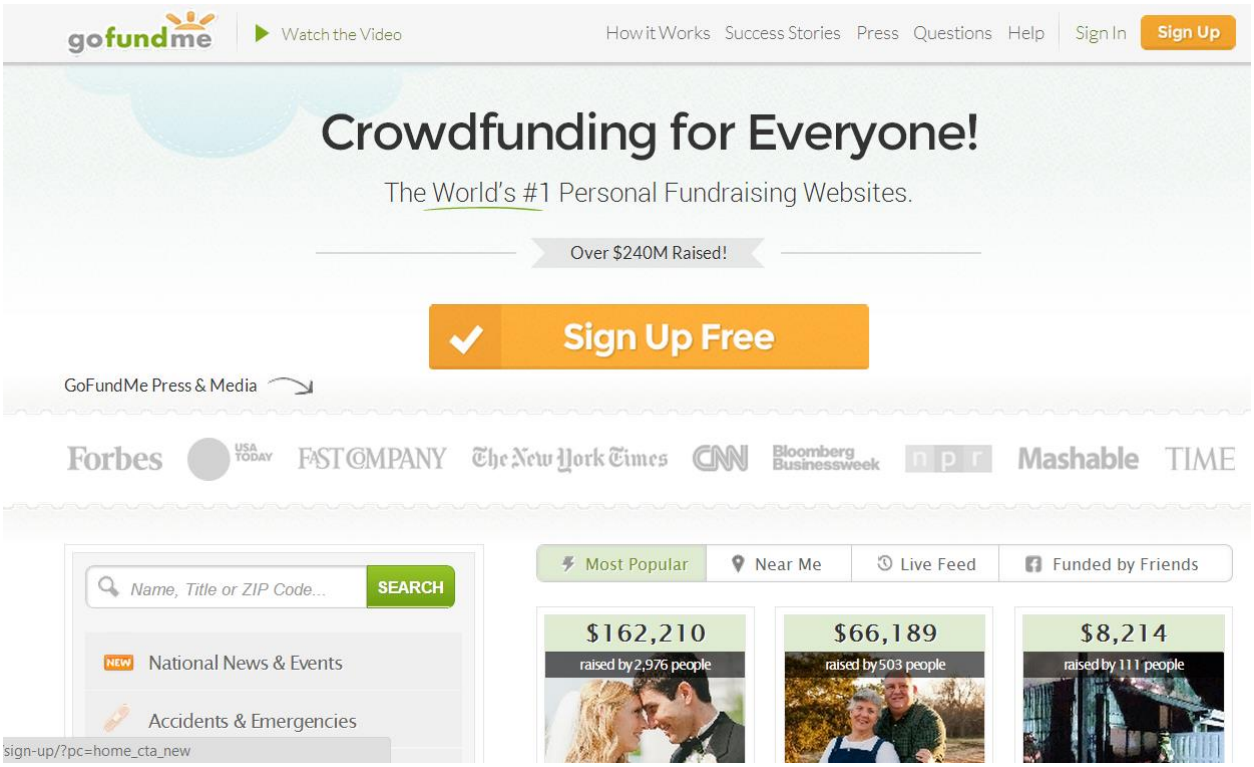


Figure 17 A Screenshot for the Front Page of GoFundMe

3.6.3.2 Oocto

Oocto is a European-based Crowdfunding platform particularly for musicians and artists to raise money. Artists can easily create fundraising campaigns to raise money from their fans

or other organizations for projects such as concerts, albums or exhibitions. Moreover, in addition to crowdfunding, oocto is also a platform for artists or musicians to find partners for collaboration.

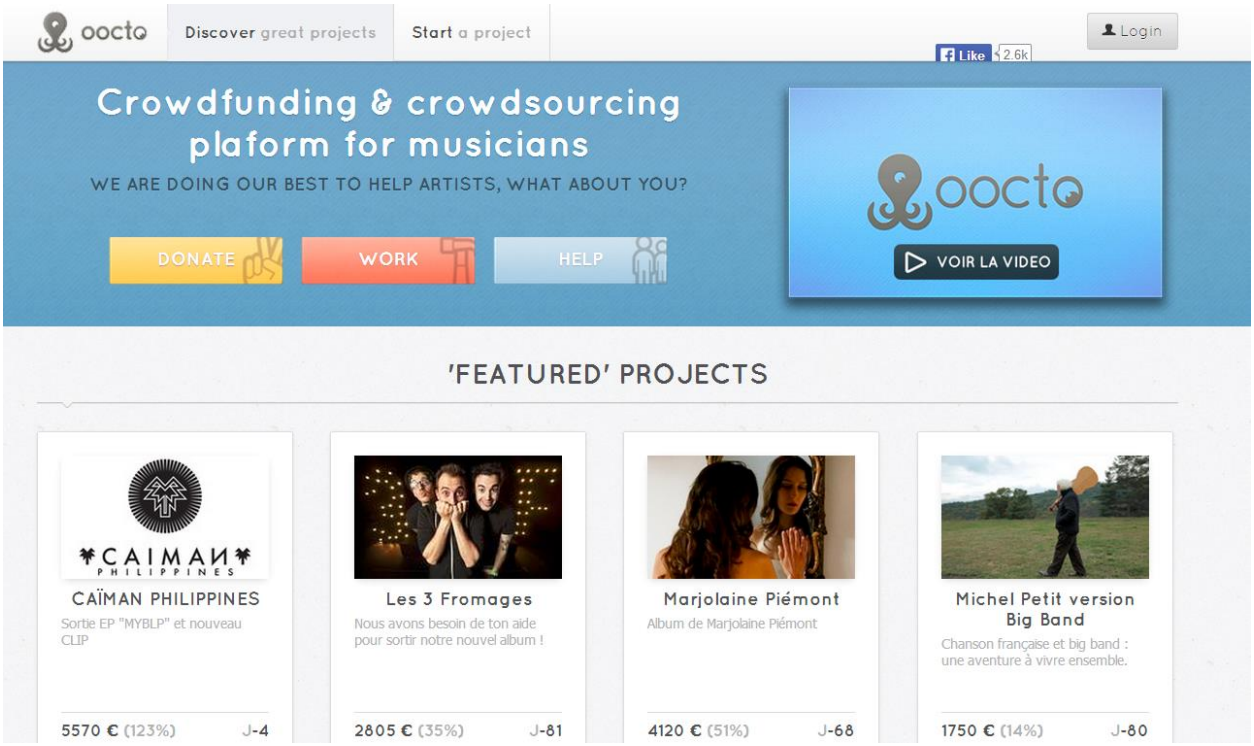


Figure 18 A Screenshot of oocto

3.6.4 User Motivations

There are several possible motivations for fundraisers and backers.

Fundraisers:

Fundraising from a large community: Crowdfunding breaks the time and space limits of traditional face-to-face fundraising. The process is available to the entire online community. A project in Silicon Valley can receive supports from people from Toronto, London and Sidney, leading to a greater possibility of success.

Backers:

Financial rewards: people seek for promising projects and products that are currently in the R&D phase. With the maturity of the projects, they are having potential rewards from their early investment.

To support innovative inventions and technologies: some of the foresighted backers see a potential impact that an idea or project can have on the society. They want to help them with further research and make turn the protocol into practice.

3.6.5 Strengths and Weaknesses

Crowdfunding potentially has a great impact on the society. Many genius ideas end up with nothing definite due to a lack of fund supporting further research and development. The fund collected from Crowdfunding can support continuous R&D and thus leads to a greater possibility to turn these ideas into reality

There are also some limitations on Crowdfunding. Only limited amount of description can be presented to visitors. For ordinary people, it is unlikely that they are spending a long time understanding the projects and see the future potentials. The value of many projects could be underestimated and thus cannot collect enough funds. Also, there is a lack of monitoring on the project progress. Some of the project owners are likely to abandon their projects, which is unfair to the backers.

3.6.6 Summary

Crowdfunding offers great opportunities for turning ideas into practice. It is a virtuous cycle that projects gain financial support from backers to have continuous development and

potential success, out of which benefits come back to the backers. But there should be more regulations and supervisions to avoid frauds and protect backers' benefits.

Chapter 4 Survey and Interview

In the introduction to different types of crowdsourcing above, possible user motivations are discussed within each type. In order to gain a better understanding of the behaviors and motivations of crowdsourcing participants, we designed and conducted a survey for crowdsourcing task performers, and an interview for crowdsourcing task providers. The questions and detailed results of the survey and interview is in the appendix.

4.1 Design of Survey and Interview

In the survey for task performers, we first designed questions to collect some basic background information of the participants for user group classification and analysis. Then, we made a list of crowdsourcing types along with some typical tasks, and asked them to choose those tasks they have taken. Finally we asked them what motivated them to perform these tasks.

In the interview for tasks providers, we asked them about the quantity of tasks they have posted, the rate that these tasks are successfully solved, the average number of participants in each of these tasks, and the average time it takes for them to be solved. The purpose of these questions is to help us understand why task providers choose crowdsourcing as the method of problem solving, and therefore helps with our prediction into the future trends.

4.2 Methodology of Survey and Interview

In order to gain diversity in the results, we have sent the survey to two groups of people: the students on WPI campus with Computer Science and Robotic Engineering majors, and the users on several crowdsourcing websites, such as TopCoder, Yahoo Answers and Baidu Knowledge, and also on some social networking websites, such as Facebook and RenRen.

We had interviews with three WPI students who have been using crowdsourcing websites. We sent them interview questions, and they replied with the answers to the questions.

4.3 Survey Results and Analysis

Survey with WPI Students

We received 67 responses in total. Since this is an on-campus survey sent to the WPI student community, most of the participants are from North America within the range of 21-30 years of age, and are unemployed or employed with part-time jobs.

Among all types of crowdsourcing tasks, Ratings and Reviews has the most participants with a participation rate to be 32%. Solution Finding has won the second place with a rate of 21%, and CrowdFunding has ranked the third place with 19%. For all types of motivations, there is a tie between the love for innovation and problem solving, and the love for the power of the community, with around 30% of participant selections. The least popular motivation is the chance to make some money.

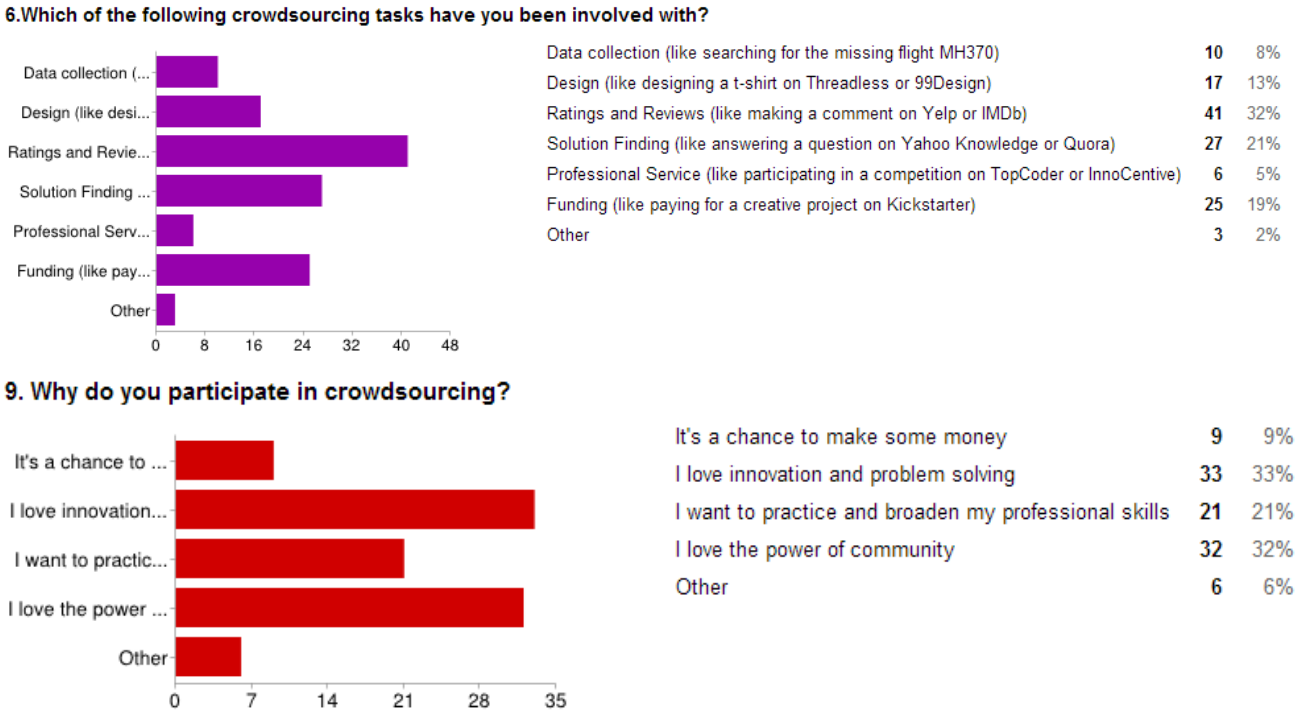


Figure 19 Results from the WPI Community

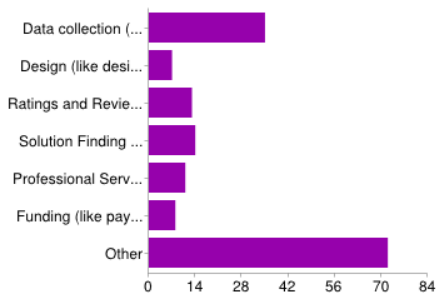
Survey with Online Survey Participants

We received 81 responses in total. Student is still the largest portion of participant group, and a lot of them are from Asia.

The result to the participation in different types of crowdsourcing tasks is a bit different. Around 45% of survey participants have chosen 'Other', indicating that they have participated in tasks other than those listed, or they have never participated in any tasks before. Among all existing types, the most popular type of tasks is Data Collection, with a participation rate to be 22%, and solution finding to rank the second place with 9%.

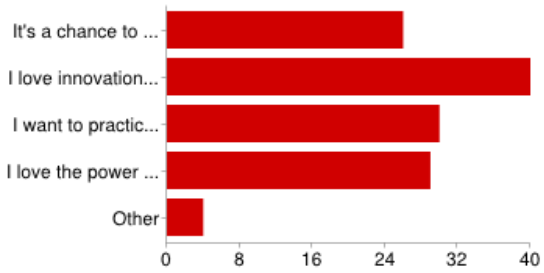
The most popular motivation is still the love for innovation, but there is a large growth in other choices, particularly the chance to make money, and to practice professional skills.

6.Which of the following crowdsourcing tasks have you been involved with?



Data collection (like searching for the missing flight MH370)	35	22%
Design (like designing a t-shirt on Threadless or 99Design)	7	4%
Ratings and Reviews (like making a comment on Yelp or IMDb)	13	8%
Solution Finding (like answering a question on Yahoo Knowledge or Quora)	14	9%
Professional Service (like participating in a competition on TopCoder or InnoCentive)	11	7%
Funding (like paying for a creative project on Kickstarter)	8	5%
Other	72	45%

9. Why do you participate in crowdsourcing?



It's a chance to make some money	26	20%
I love innovation and problem solving	40	31%
I want to practice and broaden my professional skills	30	23%
I love the power of community	29	22%
Other	4	3%

Figure 20 Results from the Websites

4.4 Analysis on Survey Results

Among all types of crowdsourcing that have been introduced in this report, Ratings and Reviews is the most popular type. There might be several possible reasons. First, smartphones has become an indispensable part of people's daily life. People nowadays use mobile phone apps like Yelp very often for information filtering. Second, making comments and reviews is the simplest type of crowdsourcing that does not require any professional backgrounds or tools.

Solution finding is the second popular type. The reasons could be that for platforms such as Yahoo Answers, students can seek for solutions to any type of questions for free, with very simple post-and-respond model.

The data collection type is noteworthy. The survey was done one month after the Malaysian missing flight accident. A lot of people had experience in searching for the missing flight on Data Collection crowdsourcing platforms such as Tomcod, which was the biggest crowdsourcing project ever.

Among all kinds of motivations, the love for innovation and problem solving is the most popular one. The reason could be that most participants taking the survey are students. They have a stronger desire for innovation and weak pursue for financial rewards. This could also explain why the 'chance to make money' is relatively unpopular.

4.5 Constraints

There are some constraints of these surveys. Firstly, we posted the survey for participants on some specific crowdsourcing websites like TopCoder and Yahoo Answers. This could actually make the answer for 'What crowdsourcing tasks do you do?' Answers are affected by the platforms, such as coders writing code on TopCoder. Secondly, most participants are students, which could give a partial reflection on the motivations. If the survey is conducted within a broader range of people, the motivations could be different.

Chapter 5 the Future Trends of Crowdsourcing

In his book *Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business*, Jeff Howe states that 'crowdsourcing is rooted in a fundamentally egalitarian principle: Every individual possesses some knowledge or talent that some other individual will find valuable' [26]. This concept, together with the rapid growth of the internet, has made crowdsourcing an unstoppable trend. This chapter discusses some of the potential future directions crowdsourcing can take.

5.1 Offline Crowdsourcing

Currently, the majority of crowdsourcing tasks are conducted within the online community. However, one of the key motivations of crowdsourcing is to make use of idle resources, and this could also involve offline resources. By making use of fragmented time periods and excessed energy, the crowd can become part-time couriers, promoters, or reporters. The combination of both online and offline crowdsourcing is a promising future trend.

5.1.1 The Existing Models

Some of the offline crowdsourcing models, such as house and apartment rental, have already existed. We take Lyft and Airbnb as two example platforms.

5.1.1.1. Lyft

Lyft is an online transportation company, which provides peer-to-peer ridesharing networks [27]. It is a San Francisco-based company whose business has now expanded to more than 20 cities across the US. Users can request a ride using the Lyft mobile app, and anyone who has a driver license can take the chance to become a Lyft community driver.

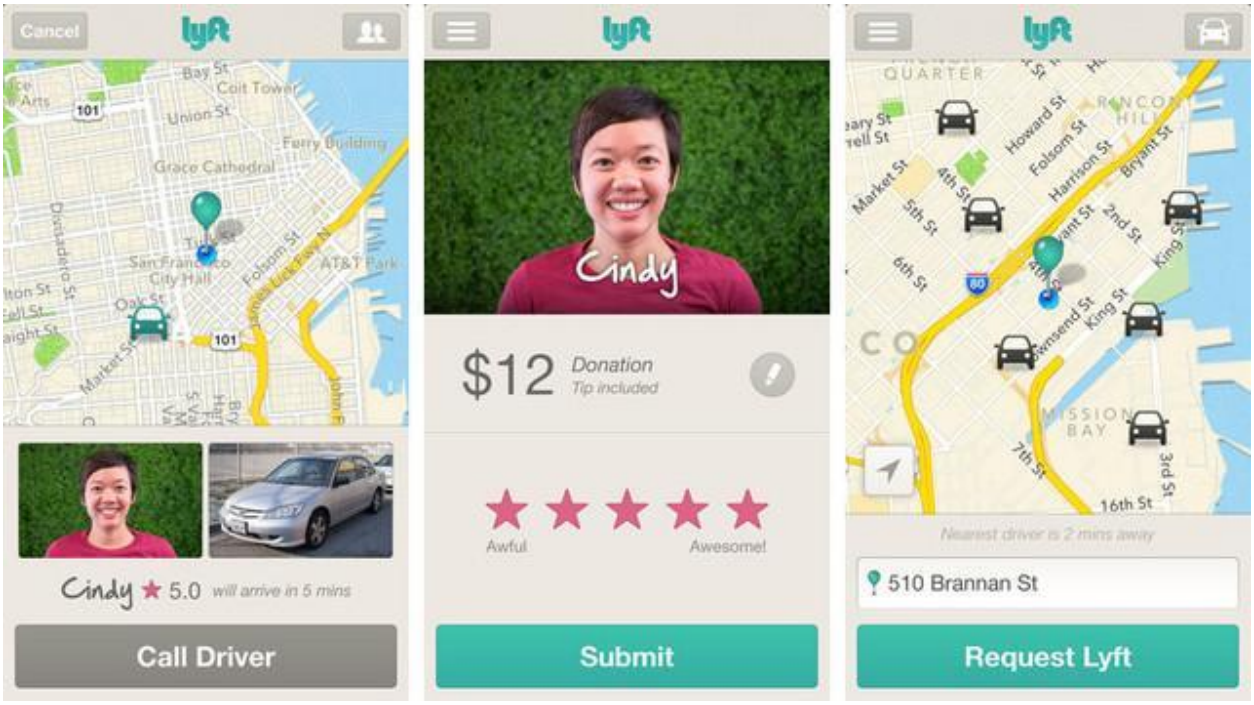


Figure 21 User Interface of Lyft App on iOS

Users requesting for a ride can follow the following steps:

- Users deposit money into their Lyft account;
- Users request a ride on Lyft mobile app;
- Lyft finds an available community driver who meets the requirement;
- Users make a 'donation' to the driver as a reward;
- User can choose to provide ratings and comments for the driver after the ride;

Community drivers can follow these steps:

- Drivers have to pass the background-check from Lyft;
- Lyft provides drivers with liability insurance;
- Drivers can register their particular route on Lyft (optional);
- Lyft assigns the drivers to the passengers;
- Drivers get 80% of the total 'donation' from the passengers;
- Money is deposited into driver's bank account each week;

The Lyft model is similar to that of the other crowdsourcing platforms. Instead of assigning work to full-time professional taxi drivers, everyone can apply to become a part-time community driver.

The crowdsourcing way of public transportation is beneficial for both drivers and passengers. For drivers, there are fewer limitations to become a Lyft driver compared to a taxi driver, and they can have more flexible schedules. For passengers, the biggest benefit is definitely lower costs. In addition, traditionally they need to call the service center. This is not efficient during busy hours when too many people are calling the service center concurrently, with only limited customer service available. The new model can solve this problem. Passengers can make registrations through their mobile phones, and the server will do the scheduling job.

5.1.1.2. Airbnb

Airbnb is an online platform for lodging rental. It was founded in August 2008 in San Francisco. Now, the hosts on Airbnb come from more than 34,000 cities and 192 countries, and served more than 11,000,000 guests already [28].

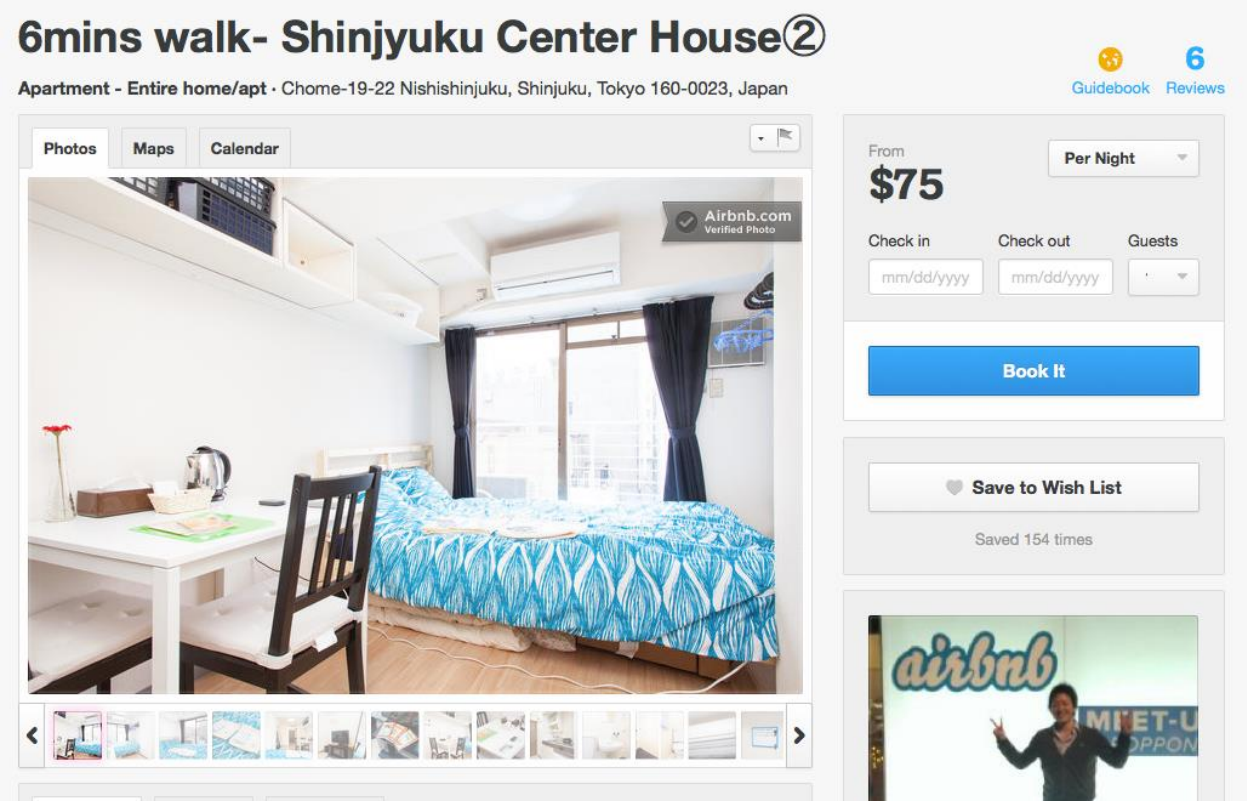


Figure 22 A Lodge Post in Tokyo

The rental service could be a single house, apartment, private room or even a boat. Hosts can create and modify a list of available lodgings on Airbnb. Airbnb will then provide them with some web-based screening tools that help with communications with the tenants. In the meantime, tenants can search for available rooms, houses and apartments on Airbnb, and can also book the lodge and contact the lodge host online.

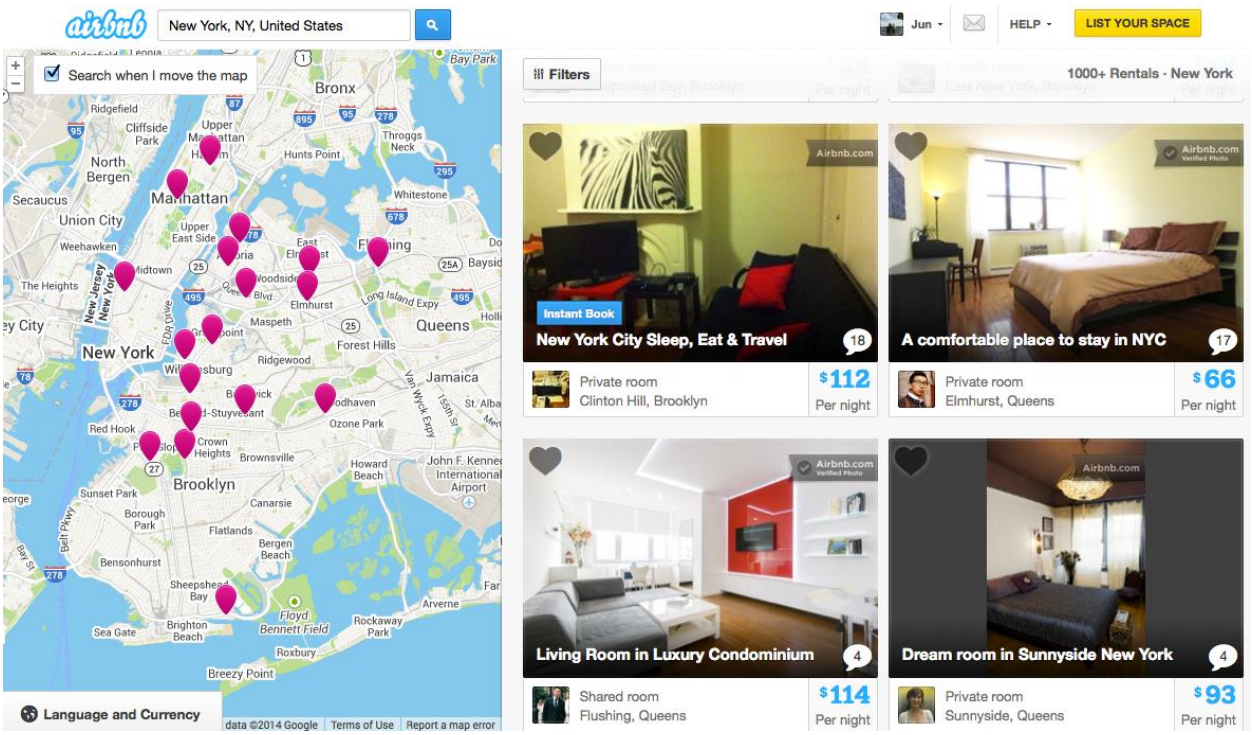


Figure 23 A List of Lodges in New York City

Airbnb becomes an authoritative marketplace where millions of people have rented lodging and booked accommodations. Instead of traditional models where people can only have short-term rentals with hotels and long-term rentals with landlords, Airbnb offers a more flexible way for real estate rentals, at lower costs and with more choices. Typically, it is a good choice for visitors to live in the homes of the local hosts to gain better experience with local cultures. Thus, more and more people are willing to book accommodations on Airbnb rather than traditional hotels.

5.1.2 The New Approach - Crowd-Delivering

The phenomenon that people make money by renting out their rooms and cars has brought an inspiration to a retailer--Wal-Mart. In 2013 it has unveiled a plan to have store customers rent out the idle space in their vehicle and deliver packages to online customers [29].

5.1.2.1 Wal-Mart's Customer Delivery Plan

In the competition with the major online retailers such as Amazon, Wal-Mart has a huge weakness with regard to storage expenses. In order to gain an edge, Wal-Mart wants to cut down their transportation expenses.

Currently, Wal-Mart's online store delivers packages to customers by carriers, or sometimes by their own delivery trucks. They have come up with a new plan to have store customers deliver packages for online customers. By offering discounts, they believe that some of the in-store customers would be willing to deliver packages to customers on their way back home.

5.1.2.2 Crowd-Delivery

With the rapid development of the e-commerce market, online retailers have carried out a variety of promotional activities. How to control costs becomes the key factor in winning the brutal competition. As a very important part of the e-commerce network, goods distribution has been under great pressure due to the quick rise of transportation costs. Retailers are forced to intensify the construction of the existing logistics system, and also build innovative systems to meet the growing needs.

As a latecomer in the e-commerce market who didn't gain first mover advantage in the competition, Wal-Mart is definitely thinking outside the box. Although they are not sure whether this plan will be implemented, it has sparked a new way of thinking in the ecommerce industry -- we call it Crowd-Delivery.

Ideally, Crowd-Delivery can reduce costs for every online retailer. Before buyers make payments, they will choose if they want their packages to be delivered by people who are not couriers -- hopefully at lower shipping costs. At the same time, drivers who are about to have long-distance travel, for example from LA to San Francisco, can also sign up online with their exact departure time. What happens next is that goods will be gathered to a transit center in LA, where registered drivers can pick up the goods, and drop them in another transit center in San Francisco. In this way, the long-distance transportation costs are saved, and the tedious transit process can be simplified.

Crowd-Delivery has potential to have an even greater impact in other areas of the globe. Taobao, the largest online retail network in Asia, has 35 billion RMB (5.75 billion USD) of trading volume on Nov.11th 2014, China's Cyber Monday [30]. Such tremendous scale of sales has revealed a huge demand for logistics, which could also be a challenge to the traditional distribution industry. Meanwhile, Chinese consumers have bought over 20 million vehicles In 2013, according to International Business Times [31]. The huge supply of vehicles and the huge demand of logistics will make Crowd-Delivering an effective solution to the distribution challenge.

5.1.2.3 Boundaries

The new Crowd-Delivery model will have huge impact on the traditional logistics industry as well as it is management. The biggest concern is that the packages will never reach their destinations by fraud, theft or accident. However, this risk also exists in traditional logistics, although at a lower level. The industry may take steps to prevent this problem by asking for deposit from crowd-couriers, or doing a background check.

5.1.3 Impact of this Trend

We believe offline crowdsourcing to be one of the most important future trends. It can bring tremendous benefits and have huge impact on the society.

Most importantly, by offline crowdsourcing, the idle social resources can be utilized. Crowd-Delivery makes use of idle human resource to complete tasks that originally require massive amount of work and tedious transit process by the courier companies. This could save a great amount of resources and potentially be beneficial to the environment.

Second, the idea of offline crowdsourcing introduces a new business model which provides more flexibility in both space and time. In the example of Airbnb, travelers have more flexibility in their choice for places to stay during their trips. Hotels near famous scenic are usually expensive and hard to reserve. If local hosts have empty rooms ready for rental, travelers will be able to book them online and enjoy a cheaper and more convenient trip. On the room providers' side, they can make extra money from their spare space, in addition to their regular full-time job.

Third, offline crowdsourcing business provides people more chances to have different life experience. For instance, wealthy people are likely to have more than one apartment, house or villa. They can post the information on crowdsourcing platforms. People who live in narrow spaces could find a short-term villa or castle and spend a couple of days enjoying a very different life style.

All in all, the above strengths make offline crowdsourcing business as a potential trend for the future crowdsourcing development.

5.2 Human Intelligence Tasks

Computers, or artificial intelligence, follow a set of rules and algorithms to solve a certain types of problems. However, there are a lot of tasks that are difficult to encode in an algorithm and thus cannot yet be solved by computer algorithms. Human Intelligence Tasks (HITs) are such type of tasks that are difficult to be solved by machines, but are easy to be solved by human intelligence, such as comparing photos, identifying human faces, or writing product descriptions. In such cases, crowdsourcing has been used to solve such tasks. Suppose that a studio is developing voice recognition software. They need a pool of voice samples for data training, but it is hard for computers to generate human voices. A good solution is to crowdsource the task of sample collection to the public on HIT crowdsourcing platforms such as AMT.

5.2.1 Amazon Mechanical Turk (AMT)

Amazon was the first to popularize human Intelligence Tasks with their online crowdsourcing platform – Amazon Mechanical Turk (AMT). AMT allows anyone to post and participate in Human Intelligence Tasks. Mechanical Turk was initially designed and developed for Amazon's own projects, but was later release for public use. Today many companies and individuals post tasks on Mechanical Turk that are not related to Amazon, ranging from image tagging, URL matching, product descripting to face recognition. The following screenshot shows some of the templates for different categories of HITs on AMT.

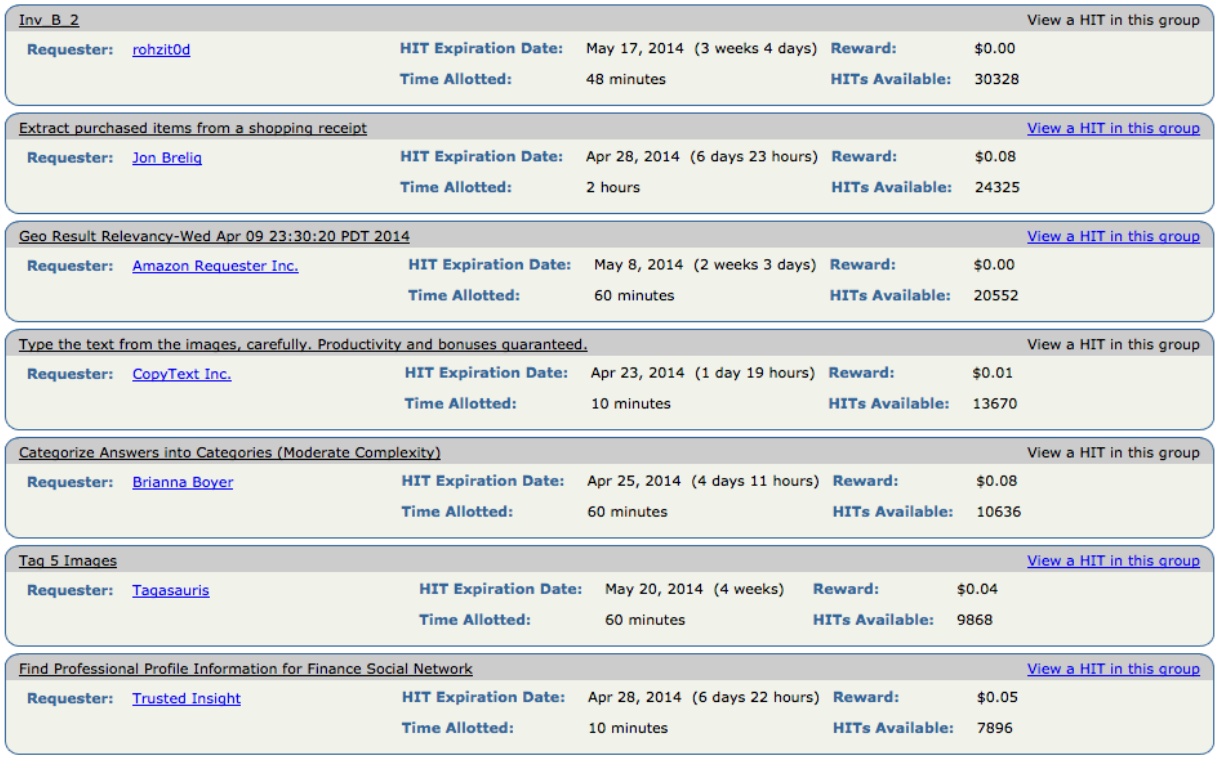


Figure 24 A List of Tasks on Amazon Mechanical Turk

Task providers can follow these templates to describe their tasks. They need to fund their account, load the tasks onto AMT, and wait for the results. It is noteworthy that task providers can reject certain results they are unsatisfied with, which will result in a lower satisfactory rate of the task performer.

Task performers, on the other hand, can find tasks they are interested in and earn money out of it. Certain tasks have some restrictions, such as the minimum satisfactory rate of the task performer which indicates the rate of tasks that has historically been accepted by task providers.

5.2.1.1 Tasks on AMT

According to the introduction on AMT website, there are mainly four types of tasks [32]:

Photo/Video Processing: tasks focused on image or voice processing and recognition, such as tagging specific objects, selecting the best image, and classifying objects among a set of images.

Data Verification/ Clean-Up: tasks from companies with large online datasets to reduce duplicate entries in their data directories, and verify details of data, such as manually verifying restaurants' addresses or phone numbers.

Information Gathering: tasks focused on information gathering, such as doing a survey, writing reviews, and find a certain piece of data in a large file.

Data Processing: tasks focused on data processing, such as online real-time translation services and rating the accuracy of data from a certain resource.

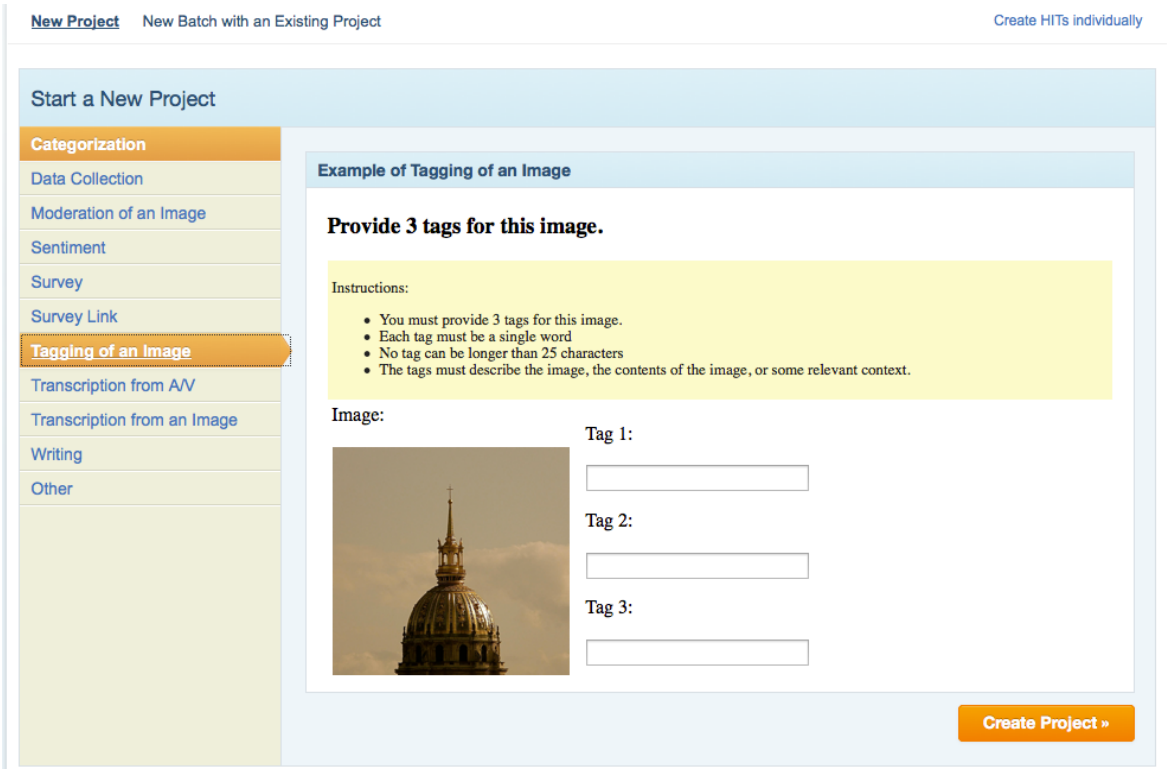


Figure 25 A Task about Tagging Images

5.2.1.2 Benefits and Drawbacks

AMT provides a platform to provide simple, scalable and cost-effective solutions to HITs. There are several significant benefits for using AMT for solution seeking. First, AMT provides a large scale of on-demand, elastic workforce. Some tasks do not require professional skills, and can be done by hiring a large amount of temporary workforce. AMT supplies such type of workforce. Second, compared to hiring employees, having HIT tasks crowdsourced to the public is cost effective since each task performers is paid with very modest compensations. Third, tasks can be completed sooner than the situation in which employees are hired, since southlands of workers can work concurrently.

On the other hand, every model has its drawbacks. In some of the tasks, the diversity of the performers' backgrounds is not a beneficial factor, and the large scale of workers can also bring problems with information filtering and quality assurance. There is also a lack of monitoring on the minimum compensation to be paid to the workers.

5.2.2 The Upcoming Trend – CrowdDB

The definition of CrowdDB is introduced in Sukriti Ramesh's report as 'a database system that enables difficult queries to be answered by using crowdsourcing to integrate human knowledge with electronically available data' [33]. Researched and developed by the UC Berkeley AMP Lab, CrowdDB is a database system that seeks to use the power of crowdsourcing to answer queries that are difficult to answer by traditional database systems.

5.2.2.1 Motivation

Machines follow a set of back-end rules and algorithms to implement queries. In reality, it is hard for machines to solve queries that involve difficult matching, ranking or aggregation functions based on fuzzy criteria [34]. For instance, when users do the query: "SELECT department name FROM schools WHERE s.name = 'W.P.I.'" The desired return is a set of department names from the 'schools' table whose name is "W.P.I". However, in practice, there might be several factors that can cause the failure of the query. One possibility is that there are typos when records were originally entered into the table, "W.P.O." for example. The other possibility is that records were input correctly into the database, but with a different name such

as “Worcester Polytechnic Institute” or “WPI”. In such case, the participation of human input is necessary.

Although machines today have rich and powerful applications to perform complicated operations, they are still facing some limitations. First, machine languages follow a standard set of rules. But ambiguity is everywhere in real life, and there cannot absolute criterion for everything. Machines identify the most delicate distinctions and make corresponding responses. Second, for queries that involve subjective comparison or aggregations, it is difficult for machines to make correct responses. Thus, humans still play an irreplaceable role in information systems, which have led to the idea of CrowdDB that human intelligence is integrated into database systems.

5.2.2.2 Overview of CrowdDB

As the name suggests, CrowdDB involves two major entities: the database, and the crowd. The database, or the machine, can be the carrier for data storing, processing and retrieving, and human can make subjective decisions. The machines and human can compensate for the deficiencies in each other’s abilities and can thus complete complicated queries that each individual of them cannot do.

The following figure shows the basic architecture design of CrowdDB. The left half of the graph shows the ‘machine’ component of the CrowdDB system, with traditional query compilers, parsers, optimizers and executors. The right component demonstrates the ‘human’ component of the system. That is, how the CrowdDB system interacts with the crowd.

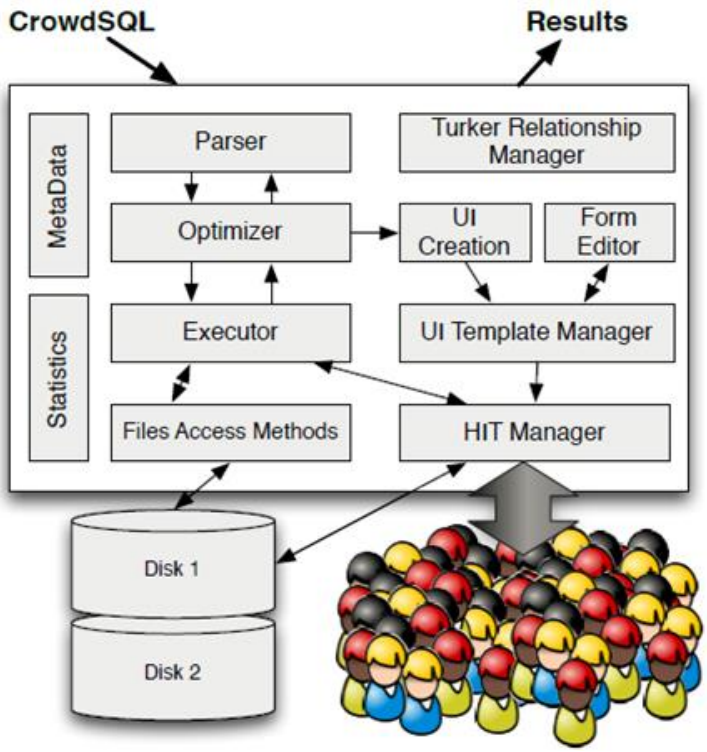


Figure 26 Architecture Design for CrowdDB

Turker Relationship Manager: It is used to facilitate some of the most duties of requesters such as approving or rejecting tasks, paying and granting rewards and so on [34].

User Interface Management: HITs require graphical user interfaces with well understandable instructions. For general tasks, CrowdDB system can automatically generate standard user interfaces for HITs at runtime. And programmer could also manually overwrite or create some specific UI designs for some complex tasks. Following figures are some examples for the CrowdDB UI design [34].

HIT Manager: This part is used to manage the interaction between crowdsourcing platforms and the CrowdDB system [34].

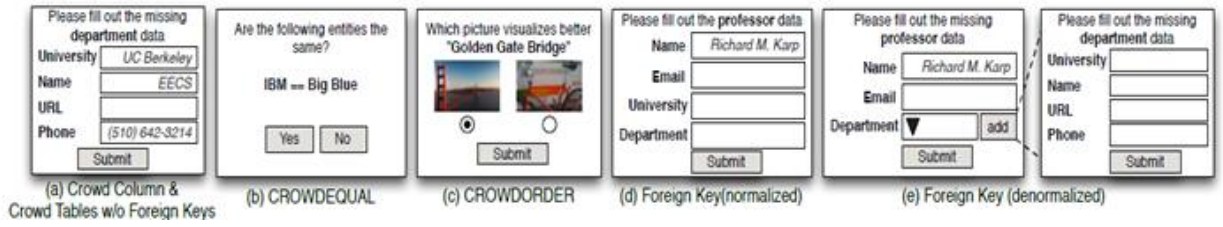


Figure 27 CrowdDB UI Designs

5.2.2.3 Weakness of CrowdDB

Because CrowdDB is still in the R&D phase, it does have some drawbacks.

First, data security issues must be taken into consideration. When providers crowdsource their databases tasks, they need to build strong security systems to ensure that their core databases cannot be invaded by hackers. Second, since the crowd could have various skills with queries, quality assurance systems are needed to check the qualities of the input answers. Companies need to make sure that the system is not affected adversely by the crowd inputs. Furthermore, providers need to have robust servers to prevent the data overloading issues when huge numbers of workers try to work on the same task concurrently.

5.2.3 Cause of the Trend

Although artificial intelligence grows by leaps and bounds, humans still play an irreplaceable role in many tasks. Crowdsourcing has become a trend to provide rapid, scalable and cost-effective solutions to Human Intelligence Tasks. There are several factors leading to such trend.

First, the rapid growth of technology has resulted in an increasing pace of human life. However, in the web 2.0 era, the explosion of information has added difficulties to information

filtering. For HITs that require tremendous amount of information processing by humans, crowdsourcing provides faster solutions, and as a consequence, increases productivity and saves time, which are crucial factors to success.

Second, the development of cloud storage has encouraged more companies to implement online management for their database. This has enabled the crowd to participate in the data processing and verification processes.

Third, big data has been a trend, but there is also an increasing need for the accuracy of data. It could be very difficult and expensive to develop advanced machine prototypes and algorithms for machine-based solutions, and it could be very low efficiency for employee-based solutions. Having the crowd to solve such type of HITs regarding information verification can not only help with reducing costs, but also improves efficiency.

5.3 Real-time Interaction

The speed of information flow plays a crucial role in today's society. The delay of information can lead to redundant work or incorrect methods in many cases, including crowdsourcing tasks. Thus, there is a trend in real-time crowdsourcing.

5.3.1 The Existing Approach - Tomnod

There are many existing real-time crowdsourcing platforms, among which Tomnod has recently stood out since it has experienced an unprecedented number of users searching for the Malaysian missing flight in March 2014. In the following section, we take Tomnod as the example of real-time interaction crowdsourcing.

5.3.1.1 Tomnod

Tomnod, powered by the space imagery vendor DigitalGlobe, is a web application that enables the crowd to identify objects and places in satellite images [35]. Tomnod provides real-time satellite images for the public to help solving real-world problems. In addition, users can also use this website to explore great images of the earth. Once users find something interesting in the images, they can mark it, and if many other users agree, Tomnod would report that something interesting is found [35].

5.3.1.2 Missing Flight Searching

Tomnod has recently gained public attention after playing an important role in the campaign of searching for the missing Malaysia Airlines Flight MH370 in March 2014, which was the largest crowdsourcing project in history. Tomnod launched the campaign on Monday, March 10th. Within the first 24 hours of this campaign, more than 80,000 visitors joined the campaign, leading to a crash of their servers. When users found something that are likely to be airplane wreckage, life raft or oil slick, they marked that point with corresponding symbols, and these suspicious evidences were pushed for review by other users. Tomnod then collected these data and generate data analysis reports. By the end of March, more than 3 million of users have joined this campaign, covering about 15,500 square miles of ocean with almost 3 million features [36]. The following figure shows the current results of the campaign.

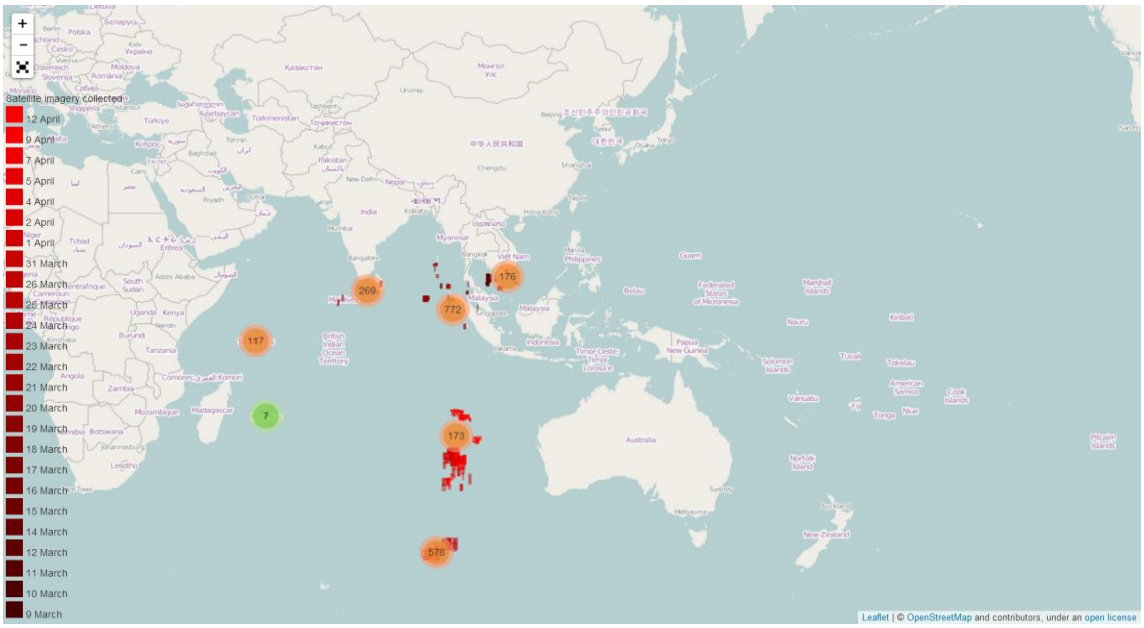


Figure 28 Results of Searching for Flight MH370 on Tomnod

5.3.1.3 Benefits and Drawbacks

Crowdsourcing platforms like Tomnod offer many advantages to the society. First, real-time interactions on crowdsourcing platforms can help solve problems much more efficiently. Campaigns or projects can be raised on these platforms once anything emergent or interesting occurs. Numerous online users can work concurrently on these projects, with the others' discoveries updated at any moment. Second, through these crowdsourcing platforms, more and more people volunteer to participate in the projects and make contributions to the public welfare. This could have positive impact on the society.

On the other hands, although real-time interaction crowdsourcing platforms are generally beneficial, there are also some drawbacks. First, the quality of answers is not guaranteed. Huge quantities of answers are submitted every minute, thus the authenticity of

information might raise red flags. Second, for projects regarding hot social issues, it is possible that the number of visitors grows dramatically. Servers might be down due to an overload.

5.3.2 The New Approach – Mobile Crowdsourcing

Some crowdsourcing platforms, such as Kickstarter, have already developed and popularized mobile applications. It is a trend that mobile devices will become a major carrier of crowdsourcing in the future.

5.3.2.1 The students' Attempt on Twitch

Twitch is a web-based online video streaming community for users to share live gaming experiences. Users register as a channel host, and then broadcast their computer screens to viewers.

A group of student from Stanford University of California Santa Cruz is doing a project called 'Twitch Crowdsourcing' to bring Twitch to mobile devices. It is an approach to coordinate millions of micro-contributions through mobile phone crowdsourcing [37]. Taking the advantage that people usually turn their mobile devices on in their spare time, the project owners want to build an online crowdsourcing community for mobile users. The idea is that users can participate in micro-tasks in their spare time through their mobile devices. Real-time tasks are sent to the mobile clients according to users subscriptions. This project is one of the pioneers in real-time mobile crowdsourcing field.

Figure 29 UI of Twitch Crowdsourcing - Selection

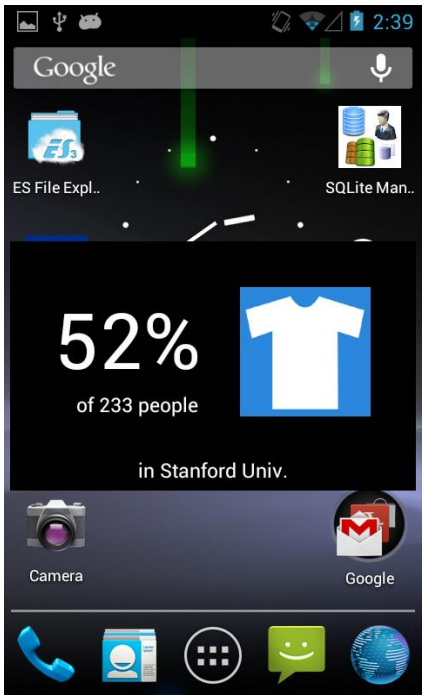


Figure 30 UI of Twitch Crowdsourcing – Current Users and Tasks

5.3.2.2 Benefits and Drawbacks

Mobile devices are playing a dominant role in people's daily life nowadays. Mobile Crowdsourcing can potentially take advantage from the convenience of mobile devices. The portability of the smartphones breaks the space limitations of traditional form of crowdsourcing. In addition, users can make use of their fragmented time to complete micro-tasks on their mobile devices. Problems can be solved sooner since they are sent to task performers in real-time.

Mobile crowdsourcing allows users to complete tasks quickly, but users are more likely to make mistakes. The other limitation is that complicated tasks are unlikely to be solved by mobile crowdsourcing due to a limitation on tools or hardware performances.

5.3.3 Cause of Trend

Real-time crowdsourcing is still a developing technology, but it is potentially a trend for the following reasons:

First, the dominant spread of mobile devices illustrates a potential model of crowdsourcing. Crowdsourcing is no longer an indoor activity; instead, it can be implemented with more time and space flexibility due to the portability of mobile devices. In addition, it is more convenient for users to make contributions in their fragmented spare time.

For major tasks that require large-scale participation from users worldwide, real-time interaction crowdsourcing increases the working efficiency of collaborations among a great number of participants. Updates can be presented to all participants in real-time, which increase the speed of information flow.

Chapter 6 Conclusion

This report presents a study of crowdsourcing with respect to its derivation and development, current methods and status, and predictions of future trends. Every person has some skills and talents that are valuable to the others. Traditionally, people seek assistance from their social networks. Crowdsourcing brings forth a new model in which individuals or groups receive help from an online community of strangers via the internet. It can also be viewed as a form of contract between task providers and the crowd.

Although techniques that leveraged data from the crowd can be dated well before the computer age, the rapid growth of the internet has led to the rise of crowdsourcing in recent years. In this report, we characterized existing crowdsourcing methods into six different types of crowdsourcing tasks according to different purposes, platforms and participant groups. We also examined the motivations of crowdsourcing participants, which vary between external motivations, such as financial rewards, to intrinsic motivations, such as self-actualization.

Additionally, we discussed our prediction of the future trends of crowdsourcing with respect to offline crowdsourcing, mobile crowdsourcing and Human Intelligence Tasks, all of which have the potential to influence daily life.

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Appendix A: Survey for Crowdsourcing Task Performers

Survey for Crowdsourcing Participants

Form Description

1. What is your age?*

- 10 ~ 20
- 21 ~ 30
- 31 ~ 40
- 41 ~ 50
- >50

2. What is your gender?*

- Male
- Female

3. What region of the world do you live in?

- Asia (including Australia)
- Europe
- North America
- South America
- Africa

4. What is your education level?

- Less than High School
- High School
- Bachelor
- Master
- Phd
- Other:

5. What is your employment status?

- ○ Employed (Full-time)
- ○ Employed (Part-time)
- ○ Currently Unemployed

6.Which of the following crowdsourcing tasks have you been involved with?
(multiple choice)

- ☐ Data collection (like searching for the missing flight MH370)
- ☐ Design (like designing a t-shirt on Threadless or 99Design)
- ☐ Ratings and Reviews (like making a comment on Yelp or IMDb)
- ☐ Solution Finding (like answering a question on Yahoo Knowledge or Quora)
- ☐ Professional Service (like participating in a competition on TopCoder or InnoCentive)
- ☐ Funding (like paying for a creative project on Kickstarter)
- ☐ Other:

7. How many hours do you spend on crowdsourcing work (such as above examples) every week?

- ○ 0 ~ 5
- ○ 6 ~ 10
- ○ 11 ~ 15
- ○ 16 ~ 20
- ○ > 20

8. How long have you worked on crowsourcing tasks?

- ○ < 1 year
- ○ 1 ~ 5 years
- ○ 5 ~ 10 years
- ○ > 10 years

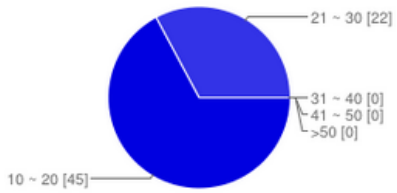
9. Why do you participate in crowdsourcing?
(multiple choice)

- ☐ It's a chance to make some money
- ☐ I love innovation and problem solving
- ☐ I want to practice and broaden my professional skills
- ☐ I love the power of community
- ☐ Other:

Appendix B: Survey Statistics for WPI Students

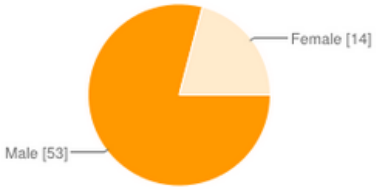
Summary

1. What is your age?



10 ~ 20	**45**	67%
21 ~ 30	**22**	33%
31 ~ 40	**0**	0%
41 ~ 50	**0**	0%
>50	**0**	0%

2. What is your gender?

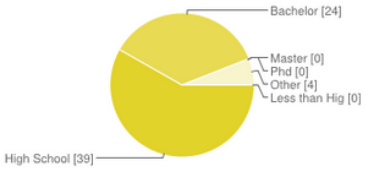


Male	**53**	79%
Female	**14**	21%

3. What region of the world do you live in?

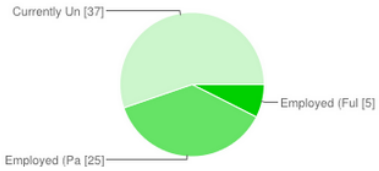
Asia (including Australia)	**4**	6%
Europe	**0**	0%
North America	**63**	94%
South America	**0**	0%
Africa	**0**	0%

4. What is your education level?



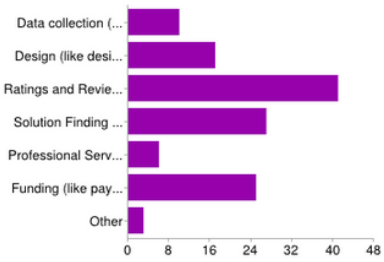
Less than High School	0	0%
High School	39	58%
Bachelor	24	36%
Master	0	0%
Phd	0	0%
Other	4	6%

5. What is your employment status?



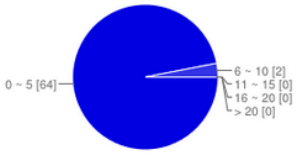
Employed (Full-time)	5	7%
Employed (Part-time)	25	37%
Currently Unemployed	37	55%

6.Which of the following crowdsourcing tasks have you been involved with?



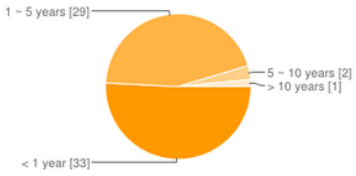
Data collection (like searching for the missing flight MH370)	10	8%
Design (like designing a t-shirt on Threadless or 99Design)	17	13%
Ratings and Reviews (like making a comment on Yelp or IMDb)	41	32%
Solution Finding (like answering a question on Yahoo Knowledge or Quora)	27	21%
Professional Service (like participating in a competition on TopCoder or InnoCentive)	6	5%
Funding (like paying for a creative project on Kickstarter)	25	19%
Other	3	2%

7. How many hours do you spend on crowdsourcing work (such as above examples) every week?



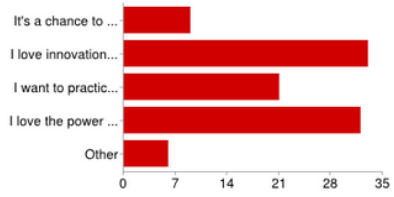
0 ~ 5	64	97%
6 ~ 10	2	3%
11 ~ 15	0	0%
16 ~ 20	0	0%
> 20	0	0%

8. How long have you worked on crowsourcing tasks?



< 1 year	33	51%
1 ~ 5 years	29	45%
5 ~ 10 years	2	3%
> 10 years	1	2%

9. Why do you participate in crowdsourcing?

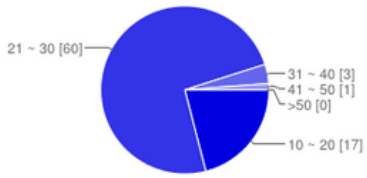


It's a chance to make some money	9	9%
I love innovation and problem solving	33	33%
I want to practice and broaden my professional skills	21	21%
I love the power of community	32	32%
Other	6	6%

Appendix C: Survey Statistics from Crowdsourcing Platforms

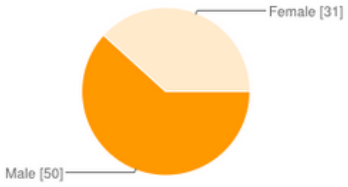
Summary

1. What is your age?



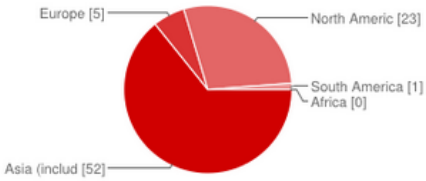
10 ~ 20	**17**	21%
21 ~ 30	**60**	74%
31 ~ 40	**3**	4%
41 ~ 50	**1**	1%
>50	**0**	0%

2. What is your gender?



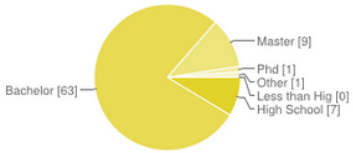
Male	**50**	62%
Female	**31**	38%

3. What region of the world do you live in?



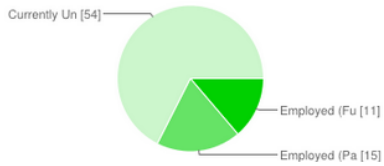
Asia (including Australia)	**52**	64%
Europe	**5**	6%
North America	**23**	28%
South America	**1**	1%
Africa	**0**	0%

4. What is your education level?



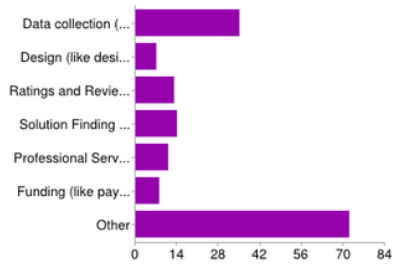
Less than High School	0	0%
High School	7	9%
Bachelor	63	78%
Master	9	11%
Phd	1	1%
Other	1	1%

5. What is your employment status?



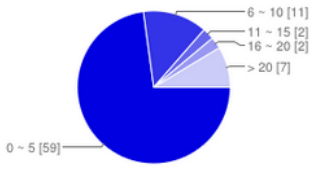
Employed (Full-time)	11	14%
Employed (Part-time)	15	19%
Currently Unemployed	54	68%

6.Which of the following crowdsourcing tasks have you been involved with?



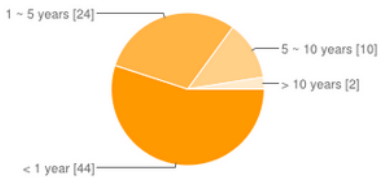
Data collection (like searching for the missing flight MH370)	35	22%
Design (like designing a t-shirt on Threadless or 99Design)	7	4%
Ratings and Reviews (like making a comment on Yelp or IMDb)	13	8%
Solution Finding (like answering a question on Yahoo Knowledge or Quora)	14	9%
Professional Service (like participating in a competition on TopCoder or InnoCentive)	11	7%
Funding (like paying for a creative project on Kickstarter)	8	5%
Other	72	45%

7. How many hours do you spend on crowdsourcing work (such as above examples) every week?



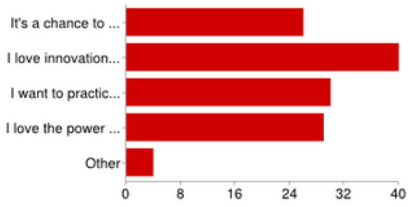
0 ~ 5	59	73%
6 ~ 10	11	14%
11 ~ 15	2	2%
16 ~ 20	2	2%
> 20	7	9%

8. How long have you worked on crowsourcing tasks?



< 1 year	44	55%
1 ~ 5 years	24	30%
5 ~ 10 years	10	13%
> 10 years	2	3%

9. Why do you participate in crowdsourcing?



It's a chance to make some money	26	20%
I love innovation and problem solving	40	31%
I want to practice and broaden my professional skills	30	23%
I love the power of community	29	22%
Other	4	3%

Appendix B: Interview with Crowdsourcing Task Providers

Interview Questions

1. Have long have you worked on crowdsourcing tasks?
2. What crowdsourcing platforms are you using?
3. How many tasks have you posted on crowdsourcing websites?
4. What kinds of tasks are they?
5. On average, how many responses have you got for each task?
6. How many tasks are successfully solved?
7. How long does it usually take to complete a task?
8. How satisfied are you with the completed tasks?
9. Why do you use crowdsourcing?
10. Is there any another way to solve the tasks you posted on crowdsourcing websites?
11. Will you recommend others to use crowdsourcing platforms, why?

Answers from Kent, David Eben

1. Have long have you worked on crowdsourcing tasks?

   - 2 years

2. What crowdsourcing platforms are you using?

   - I've only used our own system, the Robot Management System (RMS)

3. How many tasks have you posted on crowdsourcing websites?

   - 2 tasks, although they were much more complex than typical crowdsourcing tasks

4. What kinds of tasks are they?

   - One was a mobile pick-and-place task, the other was an object recognition and manipulation demonstration task, both of which involved teleoperation of a PR2 robot.

5. On average, how many responses have you got for each task?

   - 33 for the pick-and-place, 40 for the manipulation task.

6. How many tasks are successfully solved?

   - Neither are solved, both are ongoing research areas.

7. How long does it usually take to complete a task?

   - About an hour for the first task, 20 minutes for the second.

8. How satisfied are you with the completed tasks?

   - I'm satisfied with the results, as they were just as much research into crowdsourcing itself as a specific task to be completed.

9. Why do you use crowdsourcing?

   - Crowdsourcing enables us to get a wide variety of data with a small amount of effort per individual user. It also allows us to see how non-roboticists interact with our robots.

10. Is there any another way to solve the tasks you posted on crowdsourcing websites?

    - The first task was a study specifically to see if online users could teleoperate a robot comparably with co-present users, so no, crowdsourcing was required. The second task could have been completed without crowdsourcing, but it would require large amounts of tedious grasping demonstration and object labeling from a single person.

11. Will you recommend others to use crowdsourcing platforms, why?
    - Yes, crowdsourcing is a useful way of gathering large amounts of data in a short period of time.

Answers from Toris, Russell Charles

1. Have long have you worked on crowdsourcing tasks?

    - About two years now.

2. What crowdsourcing platforms are you using?

   - Crowdflower and our own framework (the Robot Management System).

3. How many tasks have you posted on crowdsourcing websites?

   - 3 on an actual crowd-sourcing website (for micro-tasks), 1 on our own framework (the Robot Management System).

4. What kinds of tasks are they?

   - The first three are micro-tasks where users were asked to place household items around a 3D house, and the robot one was asking people to control a robot through an hour-long mobile pick-and-place task.

5. On average, how many responses have you got for each task?

   - About 100-150 for the first three, and 33 on the robot one.

6. How many tasks are successfully solved?

   - It's hard to judge "success" in my cases since I am trying to learn a ground truth, so there was no verification as to a "correct" or "finished" response.

7. How long does it usually take to complete a task?

   - The micro-tasks took about 2 hours to complete.

8. How satisfied are you with the completed tasks?

   - Very satisfied.

9. Why do you use crowdsourcing?

   - I need large sets of data in order to learn the models I am looking for.

10. Is there any another way to solve the tasks you posted on crowdsourcing websites?

    - Not that I can think of off the top of my head!

Answers from Adrian Boteanu

1. Have long have you worked on crowdsourcing tasks?

   - 3 years

2. What crowdsourcing platforms are you using?

- AMT, Crowdflower

3. How many tasks have you posted on crowdsourcing websites?

   - ~2000

4. What kinds of tasks are they?

   - Dialog transcription from audio, word problems.

5. On average, how many responses have you got for each task?

   - 3 to 20, usually 5.

6. How many tasks are successfully solved?

   - 95% on Crowdflower, 30% on AMT.

7. How long does it usually take to complete a task?

   - All if resubmitted.

8. How satisfied are you with the completed tasks?

   - Under a minute.

9. Why do you use crowdsourcing?

   - AMT - not at all, Crowdflower – very.

10. Is there any another way to solve the tasks you posted on crowdsourcing websites?

    - Because I need responses from a larger group of people.