SCHOOL OF ECONOMICS AND MANAGEMENT
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Quality in Crowdsourcing

How software quality is ensured in software crowdsourcing

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Abstract

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Abstract: Crowdsourcing is a relatively new technique which aims to make a specific group of people contribute solutions to simple tasks or problems that are published online by some organization. For this they get some reward, which is usually economic in nature. This technique can be embraced by any kind of company, and since it is done online, it can turn out to be a bit problematic, especially when it comes to software development, because the whole process is out of the developing company's hands. Some quality problems may arise during the process, such as a great amount of non-serious submissions and people presenting vague solutions because they are just trying to get the monetary reward.

In order to make crowdsourcing successful these problems need to be solved, and companies which use this method for software development need to have some quality assurance for their products. This study tries to find out how companies using crowdsourcing deal with these problems and how they try to ensure some levels of quality in the final product.

What we found is that companies embracing crowdsourcing use several methods in order to ensure a certain level of quality, such as rating, spam filters and reviews. There are many similarities in the underlying functions behind the methods each company uses such as motivating participants or finding the best solutions. These methods are applied at different stages throughout the crowdsourcing process. The exact relationships between the current use of these methods and the effect on software quality are not entirely apparent.

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1. Introduction

In this study we analyze how companies that provide crowdsourcing deal with quality issues. We begin this chapter by giving some background about crowdsourcing, which is a relatively new term, and continue by presenting some problematic issues that arise within this area. After this the research question that leads our endeavors is presented as is the purpose of the paper. This first chapter ends by giving an overview of what the delimitations of this research are.

1. 1 Background

Man-power costs. When presented with a task that requires certain skills, companies have the choice of either having a prepared department or hiring outside help. Specialists can still be very expensive and off-shoring comes with issues of communication and culture (Walsham, 2001). Another way has become increasingly popular within the last few years, namely crowdsourcing.

This new technique is about breaking a task down into small components and then requesting the help of others to solve them. These others who provide help can be the general public or different groups of specifically qualified people. The tasks vary in difficulty and type and people providing their solutions receive some reward, sometimes economic. Large companies such as Amazon.com and AOL have turned to crowdsourcing and a clear sign showing the increasingly popularity and success of crowdsourcing companies is that they increased their revenue by 74% from 2010 to 2011. (Silverman, 2012)

The difference in costs can be very large as evidenced by the American software company iConclude which in 2006 replaced outsourced work and its cost of 2000 USD per unit with work done by people found through Amazon.com's crowdsourcing service, who did the work for 5 USD per unit. (Howe, 2006)

There are some difficulties related to crowdsourcing, especially when it comes to quality. Amazon's Mechanical Turk system requires people to do tasks which include identifying photos, writing product information or transcribing audio. These are things where humans can perform better than computers, but on the other hand, as described in an article in Wired Magazine, the people who contribute in these tasks might use shortcuts in order to finish the assignments quickly and get paid. This fact can have an impact on quality, making the final solution not as good as it was expected. (Howe, 2006)

Kyle Hawke, co-founder of the entrepreneurial help community Whinot and former manager and consultant at the IT-company Accenture, asks on the website dailycrowdsource.com if the users of crowdsourcing are confusing quantity with quality. Since participating in one of these

small tasks does not take very much effort and the payments are not depending on the quality of the results, there are going to be many solutions provided. And it takes resources to go through these and ensure quality. (Hawke, 2010)

The cost benefits, the different type of development process and the concerns about quality that comes with it are encouraging reasons for analyzing how the quality level is managed throughout the whole process of crowdsourcing. There are limits to what companies can do to manage the quality during the development of the final product, since this is done by people who belong to the crowd. This paper tries to give a better understanding of how quality is managed during the whole process of crowdsourcing, through all the different stages of this approach.

1.2 Problem Area

As stated in the background, this paper is focused on how the quality is ensured in crowdsourcing by the providers of the service. Controlling the quality of a software product comes with a different set of challenges than controlling other sorts of activities that can be done through crowdsourcing, like for example, posting on a blog, identifying a picture or designing a logo for a campaign. When it comes to software, a company should strive to incorporate quality assurance methods in the processes leading up to the finished product, as the earlier a problem or flaw is detected, the lower the cost and repair efforts will be (Gupta, 1989). The process of ensuring quality as a product is being developed is therefore very important.

The main problem with crowdsourcing is that it is hard to make sure people participate enough and submit work of a certain quality, especially when there is the allure of using shortcuts to get paid which is a problem many crowdsource platforms currently have to deal with (Ipeirotis, Provost & Wang, 2010; Howe, 2006; Hawke, 2010). We look at how the procedure of maintaining quality is done, and how different people involved in the process of crowdsourcing deal with it. The combination of quality and crowdsourcing is thus the object of our study.

1.3 Research Question

The moment in which the employers start defining the task to be crowdsourced can be considered the beginning of the crowdsourcing method, and when they or those acting on their behalf check the quality of the provided solution in order to see if it is good enough would be the last stage. Everything that happens in between can be thought as the crowdsourcing process. This leads to the following research question:

> - How is software quality managed in crowdsourcing companies?

With this question we aim to find out how quality is handled by different crowdsource companies, from the very first step of this process to the last one, once a final solution has been provided.

1.4 Purpose

Thanks to the previously stated research question, we will be able to discover how people involved in the process of crowdsourcing deal with the software quality issue during the process of developing a software solution. The purpose of this study is to find techniques and/or methods that are used to get solutions provided by crowdsourcing to meet quality requirements as well as checking if those are achieved. Any identified methods could prove to be useful for those who want to use crowdsourcing to create software solutions as it could give a greater insight into the process. Such an insight could be used to act upon the possibilities present and possibly improve participation leading to quality.

1.5 Delimitations

This paper focuses on the use of crowdsourcing for the development of software products. The process of crowdsourcing can also be relevant to other fields, which are out of the scope of this paper. In these other fields, the quality of the final product might not be as relevant as in the software case.

The product itself and its properties fall outside the scope of this paper. This paper is limited to study how the quality is managed during the process of crowdsourcing. In other words, we focus on how the quality issue is managed from the moment when a company decides to use crowdsourcing until one final solution is provided by the crowd and accepted by the requesting organization or individual.

2. Theoretical starting-points

In order to find out how quality is managed during the process of crowdsourcing, first we need to have a better understanding of what crowdsourcing is, as well as what it implies. It is also important to know what makes crowdsourcing different from other types of software development approaches which can be confusing sometimes, such as open source and open innovation.

Once the differences between the approaches are clear, we need a better understanding of quality management, since it is a vital part of the main issue we are studying in this paper. A review of general quality management theory will be provided, followed by theories on software quality that can be helpful for our study. We also provide an overview on how social relationships or motivations can influence the quality of a product, since the crowd is formed by different people who sometimes interact and work together and whose reasons for participating is of interest.

At the end of the chapter we define our research model based on the theories provided. The research model is used to identify six categories. These categories or classifications deal with different aspects of the process that are related to quality and they will be helpful when studying the management of quality throughout the crowdsourcing process.

2.1 Crowdsourcing

The term "Crowdsourcing" was originally introduced by Howe in 2006 in Wired Magazine. He described it as a web-based movement of ideas and opinions of the crowd. It is a problem-solving and innovation mechanism (Way et al., 2011). Crowdsourcing is a spin-off of outsourcing but adds the advantage of global capabilities; it outsources a task or problem to the public rather than to another company. The crowdsourcing process starts with the broadcast of problems or ideas to an unidentified and generally large open group of people (Breul, 2010). This group of people is known as the crowd and will give some suggestions, solutions and/or ideas and the best ones are then used and possibly owned by the crowdsourcer. Often, individuals who originally suggested the best ideas are rewarded. (Way et al., 2011; Breul, 2010; Brandel, 2008)

Crowdsourcing is not a model that produces new knowledge, it is a model which is used to obtain the best existing knowledge from the crowd. As Breul (2010) described in his study:

> *[Knowledge that's been obtained from crowd] is not new knowledge, but accessing, acculturating, and applying knowledge that already exists globally. Too often, lessons are learned but never applied. Instead, knowledge that is critical to development programs or the success of reconstruction operations is unintentionally compartmentalized by geographic distance or institutional barriers.* (Breul, 2010, p. 198)

Generally, the crowd consists of people from various disciplines. It brings people from different backgrounds, age and education level together to produce a solution. It brings professionals and amateurs together to form a collective intelligence. The specialists of each field will have particular ways of thinking, so the crowd brings diversity of approaches. (Howe, 2010) A problem can be explored by using a large diversity of people requiring minimal cost and time. (Way, et al., 2011)

However, there are some cautions to be taken when using crowdsourcing. It could be exploited as sources of cheap labor. The crowd is hard to manage and what people say or do can be hard to predict or control. It requires additional staff training, creation of a role inside the crowd to handle and control the direction of the group and awareness of the fact that participants may not be very diverse. Companies need to be careful not to let a narrow group of people have too large an influence on their decisions. The important thing is to clearly define the aim, what is to be achieved and what the community is all about in the early stages of the process. Another hurdle is building a crowd and maintaining it as gathering the right type of people and keeping their interest can be challenging. Lastly, intellectual property theft may be a concern and has to be taken into account. The owner of an idea should get credit for it. (Brandel, 2008)

InnoCentive Inc, a community based problem solving network, uses an agreement prohibiting contributors from spreading confidential information, as well as having only the client organization be able to see the solutions brought forward by the crowd. (Brandel, 2008)

2.1.1 Characteristics of Crowdsourcing as opposed to other terms

Because of the way it works, with open calls allowing anyone to participate, it may be confusing to clearly distinct between crowdsourcing and other forms of software development in which people get involved and make contributions freely, such as open innovation and open source software, which share some similarities. Open Innovation (OI) is a paradigm in which firms looking for solutions use external as well as internal ideas, as the firms look to advance their technology (Chesbrough, 2003). Using external ideas and implementation can be especially good for projects where there is not an accepted way to do things or the problem is not fully understood, as you can get outside inspiration from people knowledgeable in a variety of areas (Boudreu & Lakhani, 2009). Open Source Software (OSS) is similar to open innovation, and the former may even be viewed as a subset of the latter. Open Source Software's source code is available to everyone and it is the distributed first version of a single developer or a group of developers' source code or idea that is made freely available for everyone, allowing other developers to contribute coding, improving, testing and adding new functions. Thus, it is freely used, modified and redistributed software (Samoladas, et al., 2004; Sauer, 2007).

Compared to traditional software development approaches, open innovation, crowdsourcing and open source have shown the possibility to produce better quality, higher reliability and more flexible products with lower costs and briefer amount of time (Samoladas et al., 2004; Sauer, 2007; Brandel, 2008; Craig-Wood, 2010; Way et al., 2011). According to Howe (2006) crowdsourcing is to take the principles which have worked for open source software projects and apply them right across the entire spectrum of the business world.

The specific characteristic of crowdsourcing was defined and evaluated by Estellés-Arolas and Gonzáles-Ladrón-de-Guevara (2012) by identifying three elements of crowdsourcing and extracting them into eight characteristics which can be found by asking eight questions. Those elements consist of the crowd, initiator, and process.

The crowd:

Who forms the crowd? – A large group of individuals in which the optimal number and skills required will depend on the crowdsourcing initiator. Some tasks may not require a specific skill and can be done by a number of people, whereas some others may require a heterogeneous crowd where each person can provide personal knowledge which may be important to fulfill the task.

What does the crowd have to do? – A crowdsourcing task must be divisible into lower level tasks and be accomplished by individual members of the crowd. The tasks must have a clear objective. The goal of the crowd is to develop the solution of the task.

What does the crowd get in return? – The compensation varies depending on the crowdsourcer but it should satisfy one or more of people's needs, among which we can find economic reward, social recognition, self-esteem or developing individual skills. The amount of money varies, ranging from the form of micro-payments, with payments of the size of roughly 0,01 USD or 0,10 USD per task, to competition prizes as big as one million dollars.

(Estellés-Arolas & Gonzáles-Ladrón-de-Guevara, 2012)

The initiator:

Who is the initiator? – The initiator can be anyone: a company, an institution, a non-profit organization or even an individual who has the means to carry out the initiative considered.

What does the initiator gets in return? – Crowdsourcers will obtain access to the skills, knowledge and experience of the crowd which can lead to the solution to the problem. (Estellés-Arolas & Gonzáles-Ladrón-de-Guevara, 2012)

The process:

What type of process is it? - It can be viewed from three different points of view as: a production model, an innovation process and an outsourcing method. This usually depends on how the initiator uses crowdsourcing. In general, it is a participative distributed online process that allows people to find the solution of a problem.

What type of call is used? – Everybody can answer the call, which can be of one of these three types: a true open call; a call limited to a community with specific knowledge and expertise; a combination of both which has an open call but the ones participating are controlled

Which medium is used? – Crowdsourcing is an online collaboration activity so the medium used by crowdsourcing is the Internet. (Estellés-Arolas & Gonzáles-Ladrón-de-Guevara, 2012)

By integrating these elements and characteristics together, a more precise definition of crowdsourcing and the differences between crowdsourcing and other similar terms become clearer. From above, crowdsourcing is a process which seems to have all of these following characteristics:

1. There is a clearly defined crowd.
2. There exists a task with a clear goal.
3. The compensation received by the crowd is clear.
4. The crowdsourcer is clearly identified.
5. The compensation to be received by the crowdsourcer is clearly defined.
6. It is an online assigned process of participative type.
7. It uses an open call of variable extent.
8. It uses the Internet.

 (Estellés-Arolas & Gonzáles-Ladrón-de-Guevara, 2012)

This means, for instance, that open source projects, with code open to anyone interested and where no reward is offered, would not count as crowdsourcing. Neither would a company assigning a software development project to a consultant, as no open call was used and it is one specific person doing the job. Presumably such an example would not require the Internet either.

2.1.2 Crowdsourcing strategies

When using Open Innovation, which as previously mentioned is a term closely related to crowdsourcing, a question regarding which strategy to take comes up. There are two general approaches, namely having competitions or communities. Building a community is good when cumulative knowledge is required and where various components are meant to be integrated as it allows the contribution and cooperation of several individuals. The way a community is built up also means there are predisposed tools and norms for sharing and

learning. Another positive aspect when dealing with communities is that the members can be willing to work and share the results for free, which is something we explain better in section 2.6.2. (Boudreau & Lakhani, 2009)

Contests could be more suitable in those cases where experiments and a wide array of approaches are needed to give the best result. In these cases sharing would not be beneficial because it would lead to a less heterogeneous group of proposed solutions. (Boudreau & Lakhani, 2009)

2.2 Quality Issues in Crowdsourcing

Ipeirotis, Provost and Wang (2010) raise the problem of quality control within crowdsourcing platforms like the Amazon Mechanical Turk. When small tasks are performed by many there is a difficulty of ensuring quality results. Currently the system works by redundancy as many workers do the same tasks, such as labeling a website, and the most commonly picked label is seen as the correct one. This can be considered the best solution, because a company trying to go through and verify each answer would lose more time and it would present a cost in resources comparable to having done the work themselves or having outsourced it. Ipeitotis, Provost and Wang present an algorithm designed to measure the probability of a labeler giving a correct and unbiased answer. Wrong results could be the results of spammers, people making little effort or having a recurring bias. The formula measures a cost of trusting the labelers where a certain amount is suggested as a cut-off point. The algorithm was tested and yielded a 30 % decrease in costs of annotation and an increase in quality of annotation from 0,95 to 0,998. (Ipeirotis, Provost & Wang, 2010)

2.3 Quality Management

When developing a product, quality is an important issue. According to Economides (1999), disintegrated companies, where not all of a process is handled by the same company, face more issues concerning quality than integrated companies. Not only this, but he also states that costs are higher, and all these things lead to a lower market coverage, lower consumer surplus and lower profits.

Lu et al. (2012) also studied this relation, but in the particular case of outsourcing. They found out that disintegrated companies do have more quality issues, even though they seem to be lowered with high contract enforcement levels. The contracts governing people's involvement in crowdsourcing are often limited to simplified terms and conditions so issues of quality may arise, which is why some sort of quality management is required.

The origin of Quality Management (QM) can be traced back to the 1920s, when W. A. Shewhart introduced the use of statistical quality control (Yong and Wilkilson, 2001). This mechanism consisted on using mathematical and statistical tools in order to improve the

mass-production processes. The statistical approaches were adopted by Japanese companies, and they expanded the QM concept to the management of work in general. Afterwards, this approach spread to the western countries as well.

2.3.1 Total Quality Management

Along with QM, the concept of Total Quality Management (TQM) was created. This term became very popular in the 1990s, but it has always been a bit controversial. Hellsten and Klefsjö (2000) point out several problems of TQM. The first one is related to the fact that IT-gurus do not like the term, which makes some people confused and doubtful about it. Furthermore the term TQM is vague, has shifted over time and is not the only term for the processes and strategies outlined.

According to Yong and Wilkinson (1999) the main problem with TQM is that companies are adopting TQM practices only in a partial manner instead of total TQM. The main obstacles organizations face are the lack of senior-level management, lack of long-term vision, lack of time, lack of resources and infrastructure, lack of action and consistency, lack of middle-management commitment and fear among employees.

Besides, Lagrosen (2001) argues that TQM is not enough to satisfy the customer because of the way it is used. Some consumer behavior theories as well as marketing research have to be included when developing TQM in order to understand customers and thus, be able to develop innovations based on customers' needs that allow companies to be successful in the nowadays dynamic market.

Furthermore, Lagrosen (2002) states that there are differences among countries and cultures regarding quality. These differences can be divided into categories such as meaning of quality, problems concerning quality and the essential requirements for it. This is also confirmed by Mathews et al. (2001), whose findings point out that different countries implement quality systems in different ways due to differences in national cultures.

The Success of TQM

In order to avoid all these problems, and trying to make the implementation of TQM possible, Hellsten and Klefsjö (2000) try to define what TQM is. They understand TQM as a management system made of three different components that influence each other and are interdependent: core values, techniques and tools. Core values such as customer focus, continuous improvement and everybody's commitment are the basis for the culture of the firm. Techniques are described as a sequence of activities done in some concrete order. Tools are supposed to make the decision and the data analysis processes easier.

Radovilsky et al. (1996) point out that the success of TQM implementation depends on whether it covers all the principles and elements of TQM. Furthermore, information regarding

the results of the implementation has to be created; employees and managers have to be trained; communication methods between involved departments should be re-evaluated; and standards to measure the cost of quality have to be developed. In their findings, it can also be found a strong relation between the number of quality controls used and the reduction of defects, as well as between the latter and cost of quality.

2.3.2 Total Product Quality

The quality of a product can be measured in terms of quality of performance, quality of conformance and quality of service (Murthy and Ravi Kumar, 2000), and it is called "total product quality". This is the case in general manufacturing factories. In the case of crowdsourcing, we would argue that the quality of performance is related to the quality of the different options presented as possible solutions to the proposed problem. The quality of conformance refers to how it is tested that the product fulfills all the necessary requirements. The quality of services depends on some factors such as customer service and so on, which are not within the scope of this paper.

2.4 Software Quality Management

There is no absolute way to guarantee quality in software products but there are certain considerations that developers would be wise to take into account. Models and industry standards have been formed over the years. There are different measures used to determine a software component's attributes and values. These attributes measured can be either internal or external. Internal attributes can be measured directly by examining the component or entity, and external attributes are measured indirectly by its relation to the environment. (Van Vliet, 2007)

Quality measures can counter-act each other. In order to obtain high quality in one area, another area must sometimes have lesser quality than possible. It is important to decide these compromises at an early stage of development and to make the stakeholders aware and accepting of them. As Van Vliet (2007, p. 123) puts it; "By doing so, we are better able to build in the desired qualities, as opposed to merely assess them after the fact". Different sets of qualities can be offered, such as offering different services. The environment of the entity or service also plays a part, as it might require or will provide a certain quality to its use context. As this context is not always known ahead of time, choosing a quality level can present a problem, although one that can be handled with the option for the user to choose configurations that suit their environment the best. (Van Vliet, 2007)

2.4.1 Standards and Models

Like previously discussed Total Quality Management applies to the whole organization and several models for improving quality, such as the Capability Maturity Model (CMM) and the ISO standards share that notion. ISO is the International Organization for Standardization and has created the ISO 9000 series of standards which are designed for quality management systems. ISO certification is granted to a company by a third party accredited body after investigating the company's quality system. Once obtained, ISO certifications must be renewed every three years and are to be audited every six months. Thus it is costly and complicated for a company to get and keep ISO certifications. (Van Vliet, 2007)

Ashrafi (2003) studied the impact of using both the CMM approach as well as adopting the ISO 9000 standards in achieving a list of commonly accepted quality criteria. His findings proved that these methodologies help companies to improve their software quality, even though their deployment is expensive and consumes a lot of time.

The Capability Maturity Model (CMM) is a tool which can be used to review and control all processes in a company and has some roots TQM. The processes are tested against a set of criteria which determines the maturity of the company, which can be arranged in 5 different levels. Adhering to the CMM is complicated and very costly and thus more suitable for larger organizations. Moving up a level takes about two years, and the rules for each stage are strict but a higher level shows a higher status and certain stakeholders will only work with companies on a certain level. There is also a monetary gain as improved processes can save costs, 1 USD invested resulted in at least 5 USD saved in several companies. BOOTSTRAP and SPICE are two similar maturity models that adopt a rich profile instead of a few levels. (Van Vliet, 2007) Process oriented models are not a guarantee for high quality products. (Van Vliet, 2007)

2.4.2 Software Quality

Kitchenham and Pfleeger (1996) bring up the question of what software quality means and for whom. Five views are presented; the transcendental view, the user view, the manufacturing view, the product view and the value-based view. A transcendental perspective on quality means that there is an unreachable intrinsic quality to a product and we cannot define it, only recognize it. The user view indicates how well the user's needs are met and how usable the product is. The manufacturing view concerns how well a product comes to the outlined specifications. The product view looks at the product itself and measures the metrics and qualities of the product, which is believed to influence the quality of its use. The value-based perspective focuses on how much the customer would be willing to pay for the product.

The different views on quality are not helped by the different academic standards in models suggested as tools to ensure quality. In models such as McCall's or the ISO 9126 factors and metrics are presented as having effect on each other and on the overall quality without explaining the relationships. Furthermore these models rely on "soft" questions, where

individual judgment determines the measurements of metrics. As individual evaluations are the basis of the models there is a problem with comparing different products or models as consistency may be lacking. Two ways of bypassing this is by working to develop consistent properties in a product instead of striving for vaguely defined quality terms or by focusing on the quality of the process. (Kitchenham & Pfleeger, 1996)

If a company does not have adequate control over the software quality processes, the process of finding and fixing problems is often non-structured and less than perfect, and generally occurs at a late stage in the development. (Van Vliet, 2007)

Failures at late stages should be avoided, because, according to Kumaresh and Baskaran (2010), the later an error occurs, the longer it takes to be solved and the bigger its cost is. Kumaresh and Baskaran (2010, p. 42) define Software defect as "Imperfections in software development process that would cause software to fail to meet the desired expectations", and they state that defect prevention should be included in every software development project in order to improve its quality and reduce its cost.

In order to improve software quality, Fukushima and Yamada (2010) suggest two different ways such as process monitoring and quality evaluation activities. The former consists of monitoring every step of the software development process, whereas the latter is aimed to check the quality of the requirements through some specific standard forms. These methods showed to be helpful when improving the quality of software products. The main problem found within crowdsourcing resides in the fact that the key stages of the software development process – the ones related to programming – are out of the scope of the company. This is because these stages are transferred to the crowd, and the crowd will only return a solution fulfilling the specified requirements. The importance of this problem depends on how much of the software development process the company outsources, which could vary from just the coding phase to even the whole system design based on some given requirements.

Conradi and Fugetta (2002) talk about the limitations in formal frameworks like CMM. Software design is a creative process concerned with the end goal of providing customers with a satisfying product, and ultimately not how well formed their processes are. Larger companies may have the time and stability to invest in CMM but smaller companies work in a constantly changing environment and to start projects to ensure current processes that take several years may take too long and only cement processes that needs changing. The traditional framework is about discipline whereas software design has a large creative component that needs to be nourished as well.

2.5 Quality Assurance

According to Kitchenham (1989) the international Organization for Standardization defines quality as "[t]he totality of features and characteristics or a product of service that bears on its ability to satisfy stated or implied needs." (Kitchenham, 1989, p.373)

Quality is a complex thing with different concepts to different people. As touched upon earlier users may view quality as the fitness of purpose, whereas developers may view it as the conformance of requirements while if we look at a product itself the one with high quality is the one that serves to improve the company's economy the most (Kitchenham, 1989). Quality assurance is considered to be a consumer's risk reduction factor, which is good for competition (Gupta, 1989). Understanding the view of a company's perspective on quality will lead us to a better understanding of the quality assurance process and the reason for each quality assurance step.

2.5.1 Software Quality Assurance

Software Quality Assurance (SQA) is about constructing and following plans to review software products and its development. Reviews and suggestions must be heard by the management. The measures used are both objective and subjective. (Van Vliet, 2007). It is a process to ensure a software product can do what it is meant to do. By taking software quality assurance into account, a company can reduce the risk of producing low quality products, reduce software life cycle costs and increase customer satisfaction (Anjard, 1995). Quality assurance should be implemented in every step of the software development process, from its design until its distribution. The earlier software quality assurance is processed, the lower maintenance costs and fewer complications (Gupta, 1989).

Software quality assurance is based on two approaches: the *(i) Quality Programme* and *(ii) Independent Verification and Validation*. The Quality Programmes are approaches which identify the appropriate protocol for software development process. This approach is usually used by companies which understand quality as conformance to specification. The Independent Verification and Validation (IVV) approach uses a group of technicians which are independent from the development group to do analysis and test software. (Kitchenham, 1989)

Software quality assurance consists of five steps: *(i) establish software quality policies; (ii) establish goals for software quality; (iii) establish plans to reach the goals; (iv) establish controls for evaluation against the goals* and *(v) perform corrective action make it perform as the goals* (Breisford, 1988). The main aim of quality assurance falls upon on the process, not on the product.

There are several factors to be successful in software quality assurance including design methodologies, test criteria, specialized tools and personal quality assurance expertise. Paige (1985) also determined some factors in order to determine software: software size, automation, documentation, and testability.

One of the primary functions of quality assurance is to efficiently test and approve software before releasing it to the market. This is to avoid the failure while software reaches customers' hands. The more thorough the testing is, the higher quality the software will have (Gupta, 1989). In the case of crowdsourcing, each piece of source code will be created, tested and distributed by programmers themselves. Commonly, programmers tend to test their source code with well-behaved test data without test planning, even though their test might not be tough enough (Gupta, 1989). This leads to a scenario in which the crowdsource provider has to establish mechanisms to ensure the quality of that piece of code. This may require an inspection process and how crowdsource providers do so is what we try to explore.

2.6 Social Theory on Quality

There are more than technical aspects to quality assurance. In order to improve the quality of a product it is also important to understand how the psychology can have some influence in people's performance. This section tries to give a better understanding of this by explaining how both success and failure influence in an opposite way in a person's motivation towards future collaboration. It is also important to understand that humans are sociable beings, so their position within society can be influential as well, and this is why and the end of this section, the importance of social motivation is thoroughly explained.

2.6.1 The psychology of success and failure

Lewin (1999) stated that the rate of success and failure are deeply influenced by people's emotions, their goals as well as their social relations. A person who has succeeded doing a certain task or special activity will tend to repeat the succeeded task. This tendency is because of the feelings produced by the success of the task finished by the contributor, which lead him to try to experience something similar again. Just the opposite happens when somebody fails to accomplish a task in a satisfying way. This may lead to some sort of sad feelings, which can demotivate the person to try to solve a new problem.

This applies to the crowd in the case of crowdsourcing, as when they complete the task in a crowdsourcing competition and are rewarded for it, there is a high possibility of them participating in other competitions, whereas if they do not manage to provide a good solution, they might feel frustrated because of all the effort they put into it, and may not want to compete in any of the new competitions started by the employees. Other psychological factors affect a person's decision to participate in crowdsourcing, and since people are social beings, how they are seen by others can play a large part, which is called social motivation.

2.6.2 Social Motivation

The motivations for participating in projects where people external to a company perform the work decided by the company are varied. The most common one is financial retribution, but there are others such as the chance to display skills and to establish contact with potential employers (Boudreau & Lakhani, 2009). Social motivation is one of the factors that drives the crowd. According to Borgida and Mobilio (2000) social motivation is a driving force that derives from the real or imagined presence of others or from one's sense of the self as a social object. Social motivation can play a part in people's emotions, cognition or behavior and push people to a desirable goal as well as push away an undesirable state to prevent negative consequences.

Motivation intensity is affected by a person's need of the potential outcomes of his behavior and the expectation of that behavior achieving the outcome and fulfilling his need. The moderate levels of motivation intensity usually result with the best performance (Borgida & Mobilio, 2000).

Brehm and Self (1989) have distinguished the ways of thinking about motivation into two terms which are *(i) extrinsic source of motivation* and *(ii) intrinsic source of motivation*. Extrinsic source of motivation is promoted by some external reward or threat such as money or job promotion. On the other hand, intrinsic motivation is a behavior that is freely chosen and is initiated by interest, curiosity or other personal needs and can be something like enjoying the tasks or the sense of identity that comes from competitions or community membership. These motivations can also lead the members to work for free if they feel part of a cause, because tasks are not seen as work (Boudreau & Lakhani, 2009). An intrinsic motivation can become extrinsic motivation if a task or an activity also provides some external reward.

One of the reasons for contributing is identified by Baumeister and Leary (1995) as a need to belong, a basic need to forge as well as maintain social attachments. This is to fulfill people's own need for security and emotional connectedness, so people try to create and maintain relationships with others. Markus and Nurius (1986) stated the other source of motivation is mental representations of the self. The presence of others can cause people to turn attention to evaluate their standards or goals, no matter whether they are real or imagined. Furthermore, the memories of the past together with expectations of the future are also sources of social motivation.

The last motivation suggested by Gollwitzer and Bargh (1996) are goals. Goals are inspirational, once people have settled on an objective they will focus on that target and choose the necessary action to achieve it.

The site TopCoder is one of the most famous webs for crowdsourcing and displays both the competition and community approaches. It is a community platform that also holds various challenges and contests. More than 180 000 developers compete on TopCoder but between contestants knowledge is shared and they try to educate each other in different software areas. (Boudreau & Lakhani, 2009)

TopCoder's use of ratings gives the contributors a particular status that plays a big part in their motivation to participate and for the ones with the higher score, winning seems to be a very big motivator and something they are heavily emotionally invested in (Boudreau, Laceta & Lakhani, 2011).

2.7 Research Model

As the aim of our thesis is to explore how quality is ensured in crowdsourcing it is important to know how crowdsourcing is used in actual businesses and what quality issues they take into consideration as well as explore if there are any quality models, standards or known methodologies they use. How crowdsourcing companies control the crowd and keep people working for them is also of interest. Our thesis can be divided into two major parts which are crowdsourcing itself and quality within crowdsourcing.

According to Estellés-Arolas and Gonzáles-Ladrón-de-Guevara (2012) there are three elements that we should take into consideration for clear understanding of crowdsourcing which are the process, the initiator and the crowd. The process is how each company uses crowdsourcing and maintains control over it, whereas the initiator and the crowd are people involved in the crowdsourcing process. Thus, studying the role and relationship between these people will provide a deeper understanding of crowdsourcing.

On the quality part, we have looked into specific theories on software quality as well as quality in general such as people's motivation. Motivation is important as moderating levels of motivation will result in people's best performance (Borgida & Mobilio, 2000) leading to good quality. We are also interested in specific quality models and standards which we think can be used with crowdsourcing.

From these two parts we can determine six categories we deem as important components of an understanding of quality ensuring in crowdsourcing. We will present our findings and do analysis by using these categories, which are:

1) The use of crowdsourcing
2) Role and relationship
3) Motivation
4) Quality perspective
5) Quality assurance methods
6) Quality model

Each category is not independent, they are all related to each other. Both use of crowdsourcing and role and relationship are linked to the categories related to quality – quality perspective and quality model- through motivation. This relation is more clearly presented in the figure 2.1, which will be helpful to have a better understanding of our way of thinking:
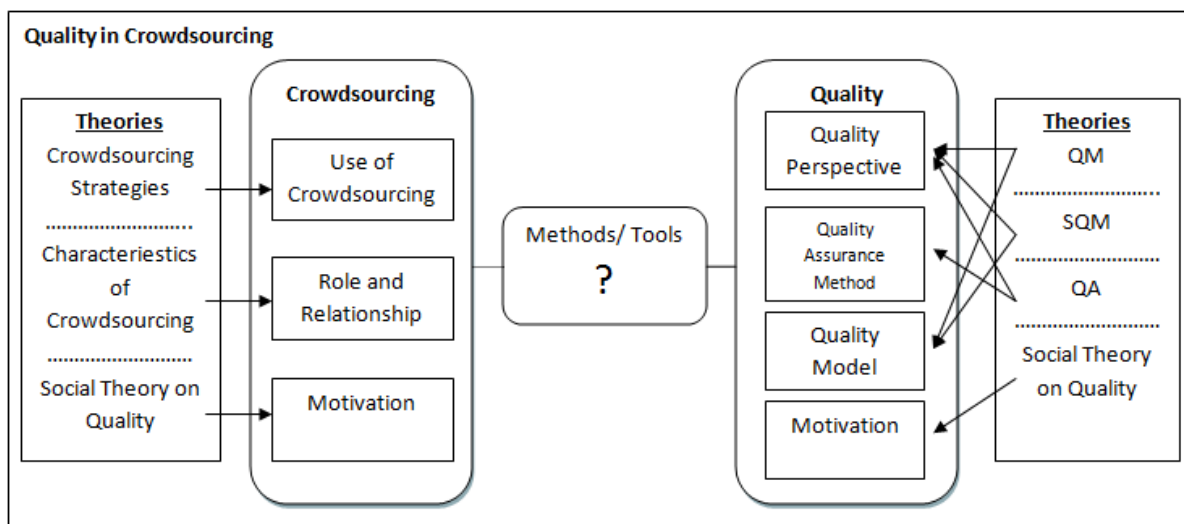
Figure 2.1 Our research model

Figure 2.1 shows how the various theories presented in this chapter point towards dimensions that need to be studied in order to understand the connection of quality and crowdsourcing. The thing that ties these two vital components of our thesis together is the use of particular methods, and finding these is the purpose of this paper. Theoretical background on crowdsourcing strategies found in chapter 2.1.2 shows that we need an understanding of a company's *Use of Crowdsourcing*. The Characteristics of Crowdsourcing in 2.1.1 shows us how the *Role and Relationship* between the actors in the process matter. Social Theories on quality from 2.6 explains *Motivation* for participating in crowdsourcing as well as for producing quality. Quality Management, Software Quality Management and Quality Assurance theories found in 2.3, 2.4 and 2.5 lead us to see the importance of which *Quality Perspective* is in use. Quality Assurance theory in 2.5 leads us to examine how quality is managed and which *Quality Assurance Methods* are used. Theories on CMM, ISO and similar standards and models from Quality Management 2.3 and Software Quality Management 2.4 are what we use to see if *Quality Models* are used. The identified categories are outlined in the next sections of the thesis. Motivation will be treated as one category in this thesis but it occurs in both crowdsourcing and quality in figure 2.1 because we want to show the different aspects of required motivation in a visual way.

1) Use of Crowdsourcing

This category provides a clearer understanding of crowdsourcing and specifically explores the process of crowdsourcing, the detail of strategies each company uses, how they run and control over the crowdsourcing process, the difference between community based and competitions based companies as well as their pros and cons. By looking into details the use of crowdsourcing we will have a better understanding of why crowdsourcing requires minimal cost and time.

2) Role and Relationship

As mentioned earlier, crowdsourcing is driven by a group of people who come from various disciplines (Howe, 2010). Who forms the crowd, who the initiator is and what roles they have are important questions that have to be answered for a better understanding of crowdsourcing. The communication between each role is also an area of interest in these categories. By knowing how every role communicates with each other we will see more clearly how all roles are related to the others. The exploration of the relationship will make the connection between the crowd and the initiator more transparent which is the key to differentiate crowdsourcing from other terms such as open innovation and open source.

3) Motivation

Motivation will function as a bridge between the issues of crowdsourcing and quality in general. There is a study which shows that with high motivation people will have high performance which leads to a good product quality (Borgida & Mobilio, 2000). It is important to understand both the extrinsic and intrinsic sources of motivation of the crowd, as well as why the crowd wants to participate in each competition and what makes them want to keep working with the community.

4) Quality Perspective

As Van Vliet (2007) mentioned, there is no absolute way to guarantee quality in software. It depends on what element they take into consideration while they develop software, which depends on the quality perspective of each company. There are many such perspectives, some focused on the customer satisfaction and others focused on adherence to decided methods or the attributes of the finished product. As the way the decision makers view quality is important to the outcome this is important to explore.

5) Quality Assurance Methods

Companies use different methods to ensure quality. In the specific case of crowdsourcing of software development Van Vliet (2007) states that there are particular difficulties as companies do not have control over the developing process. If a company does not have adequate control over the software quality process, problems will appear in the last stage of the development process and errors discovered at a later stage usually cost more time and money to solve the problem. So, this category will focus on what quality aspects each company is taking into consideration and how they deal with them.

As Brandel (2008) argues, crowdsourcing may be a source of cheap labor which can lead to low quality of software product. Thus, getting the right type of people to form the crowd is one of the important issues to achieve high quality. This is why so the requirements to become part of the crowd are also part of the focus of this category.

6) Quality Model

We have suggested several models which we think may be useful when it comes to crowdsourcing. This category will explore the use of each model in crowdsourcing, and if there are there any models actually being used by any crowdsourcing companies.

3. Research method

After presenting the theory that is going to be used in order to conduct this study, this chapter explains the methodology used throughout the research. First we present the approach we decided to use because we think it is the one that best fits our stated goals. Later, the methodology for collecting empirical data from the companies participating in the research is explained, as well as what different kind of companies we found out there are when doing the research. Moreover, the overview of the inquiries that compose the questionnaire and the purpose of each of them is explained. The chapter ends with the ethical aspects of this study.

3.1 Research Approach

According to Creswell (2007) there are two types of research approaches; quantitative approach and qualitative approach. The former is aimed to give a deeper understanding on a human behavior, whereas the latter tries to analyze something from a statistical point of view. As the purpose of our thesis regards exploring the quality issues in crowdsourcing, in order to get accurate information we have to investigate many companies which use crowdsourcing in real life and ask for their ideas and opinions as well as the way in which they use crowdsourcing. Thus, the qualitative approach is an appropriate approach for this thesis, and it will lead us to understand how companies using crowdsourcing deal with the quality issue.

3.2 Approach for collecting empirical material.

According to our research question "How is software quality managed in crowdsourcing companies?" we aim to explore the software process quality of crowdsourcing phenomenon. We need to find out what means of process quality control companies are currently using in order to compare them against the software process quality theories. In this respect we need to collect from data crowdsourcing practitioners themselves to get the ideas of how this is done in practice, and interviews deemed a good approach.

The empirical data which we expect to obtain from the interview process can be divided in to two main focus points: how they do crowdsourcing in practice and the role of software process quality in crowdsourcing. The first aim of the interview is to obtain the information on the general ideas of crowdsourcing of each company, why they use crowdsourcing and how they do it. There are several ways of distributing a problem to the crowd. By asking the questions of why and how, we can obtain information on how they use the crowd to improve software development, the relationship between the crowd and the company, and how the company follows up and controls its contributors. Then, information on companies' quality strategies will be collected. Our focus point will move to software process quality by means of getting information on the definition of quality of each company. Further we will find out

the quality assurance process, model or protocol they use, as well as how serious their concern about process quality while using crowdsourcing is. We will also get the different perspectives of process quality from the different companies will be compared to the research on software process quality.

In our paper we have followed the Seven Stages of Interview Inquiry outlined by Kvale & Brinkman (2009) which details the steps that are needed for the proper use of a structured interview for a qualitative research. These seven stages are clearly presented in the following figure, and explained more thoroughly afterwards.
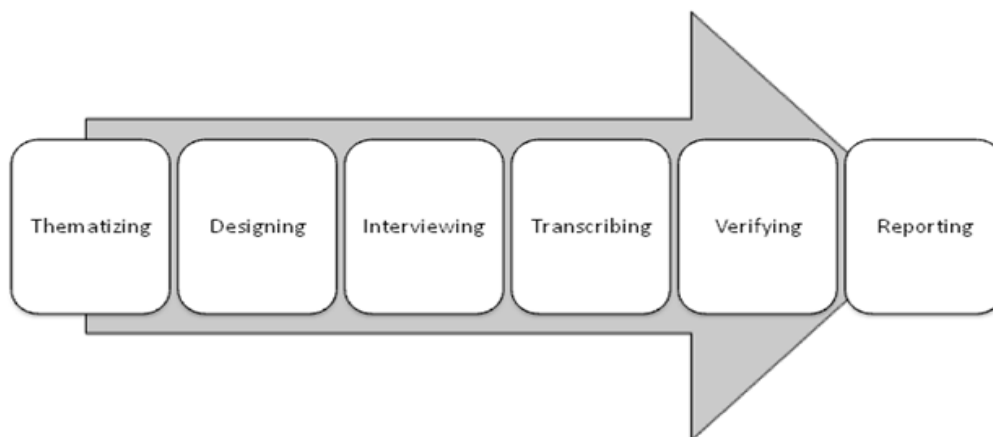
Figure 3.1: Seven Stages of Interview Inquiry

Thematizing is the first step which involves formulating a purpose for asking questions and for seeking the specific knowledge that we do (Kvale & Brinkman, 2009). In our study we focused on quality and crowdsourcing. We needed to know if quality was an issue in the products that are produced in crowdsourcing and if so how that is managed. This is important as it shows us the issues in quality that comes with this new distribution model.

Designing is the second step and requires planning out the interview and doing this in accordance with what the information will be used for in later stages of the research (Kvale & Brinkman, 2009). Our study did this by formulating an interview guide with topics that investigates the areas we are interested in, namely quality management in crowdsourcing and other functions of the crowdsourcing setup which can tell us types of embedded quality management that are not stated as such. This way of working would provide us more material to analyze. In the design of our interview guide special consideration was given in order to avoid too many questions or vaguely phrased or closed ones.

Interviewing is the third step and should be based on the interview guide and the interviewer should be aware of what they are asking and the situation in which it is being asked (Kvale & Brinkman, 2009). We conducted interviews via Skype, which enables audio-to-audio communication online. Some respondents could not be scheduled for interviews but were

willing to fill out our interview guide as a questionnaire instead. For the first Skype interview only Mikael was present in order to more easily facilitate a meeting based on the time difference. For the second Skype interview all the three of us were present but Mikael played the role of the primary interviewer following the interview guide, freeing the others up for additional note taking and new spontaneous questions. The interviews were recorded using the programs Supertintin and Evaer.

Transcribing is the fourth step and is about making the interview material ready for analysis (Kvale & Brinkman, 2009). This was done by writing down the recorded audio into text, which is discussed further under chapter 3.7 Processing the data.

Analyzing is the fifth step and requires a chosen type of analysis based on the purpose of the study (Kvale & Brinkman, 2009). Our research is focused on the methods used to ensure quality and the informants' words are our source of information. We have chosen a bricolage approach like the one described by Kvale & Brinkman (2009), where a mixture of tactics have been used. Out of the examples given by Kvale & Brinkman (2009) we have taken particular care to notice patterns and themes, cataloging, counting occurrences and contrasting them.

Verifying is the sixth step where the validity, reliability and generalizability of the findings are dealt with. Validity concerns whether or not what has been found out in the study is what was supposed to be found out. Reliability is about whether the results are trust worthy and consistent. Achieving good reliability means that an informant would give the same answers if asked again and that leading questions aren't used. Generalizability is about whether the findings can be taken to apply to more than this single instance. (Kvale & Brinkman, 2009)

To ensure validity in our work we kept the research question in mind during all the steps and each step was built upon a previous one which ultimately is based on the research question. In striving for generalizability we asked different types of crowdsource companies, which meant that we could see if methods or attributes could be found across the different enterprises. We have no reasons to doubt the informants' statements or that they wouldn't provide the same answers if asked again. In the analysis part we tried to apply implications based on our theoretical framework, which means that some of our conclusions move beyond the interview responses. While designing the interview guides we tried to avoid leading questions. Other than that some basic fact checking was done by seeing if the companies' web sites confirmed the responses.

Reporting is the last step where the findings are reported in an ethically sound and academically appropriate way. (Kvale & Brinkman, 2009) We took care to present our findings in a visually interesting way, using tables and figures, as well as following academic standards. Particular thought was given to the ethical considerations which are presented under chapter 3.7.

3.3 Informants

The informants of our study are the companies that are using or would use crowdsourcing to provide software development to companies, organizations or individuals who pay for these services. Crowdsource providers are companies which are in the business of crowdsourcing. They work as a middle-man or a broker finding jobs for the crowd as well as provide the crowd to the companies seeking solutions. The relationship between crowdsourcing providers, the employers and the crowd are of interest to us. It is essential to know how strong their relationship is, how they do business and how employers have direct channel to communicate with the crowd and control over them. Their relationship is one of the aspects to be concerned about when doing analysis to conclude how seriously they are taking care of quality in their business.

As we searched for the ones offering this service, we found that there are two kinds of companies: The simpler crowdsource provider and the more complex, often larger community based crowdsourcing provider. They may have different methods for how they use crowdsourcing, how they maintain and control quality of the crowd and their product, as well as different strategies and possible different motivations for the crowd.

One of these two, the community based crowdsourcing is a type of crowdsourcing providing company which is built on an online community. It gathers people who have common interests and provide a space to share and exchange each individual's ideas. Usually, seeking the best solution is done by launching competitions and pre-set prizes are provided for each competition which is similar to general crowdsourcing's payment options but unlike those have rich social interaction on a community based platform. The other type of crowdsourcing company is usually simpler and is focused on smaller easier and tasks and social interaction is uncommon. We are interested in both types of crowdsourcing companies to explore how crowdsourcing works in different situations as well as what quality aspects they consider. More information on the specific companies we talked to will be given in chapter 4 when we present our empirical findings.

In order to find crowdsourcing companies we looked up ones mentioned in articles and searched for keywords. We utilized the previously mentioned definition of crowdsourcer provided by Estellés-Arolas and Gonzáles-Ladrón-de-Guevara (2012) as a checklist to rule out similar but ultimately different enterprises. Information on the specific companies in the study can be found in chapter 4, where we discuss our findings.

3.4 Data collection method

Since the information we would like to obtain from the informant is their daily life experience on how they use crowdsourcing in their business and how they maintain quality when using it, we have chosen the interview approach because it is a method that allows us to have a direct conversation with the informants (Creswell, 2007; Kvale, 2009). As Kvale (2009) mentions,

there are three types of interviews: *structured interview, unstructured interview* and *semi-structure interview*. Structured interview is an interview in which only pre-defined questions are asked, it is like a script to be followed by the interviewer. On the other hand, unstructured interviews do not use pre-defined questions, which makes the interview more like an open discussion. Lastly the semi-structured interview is a method between structured interview and unstructured interview, it is an interview with predetermined questions but also open to discussion within the interviewee's comments that the interviewer finds interesting. This allows us to delve deeper into areas we may not have originally thought relevant to our research question, but which has shown potential during the interview situation.

As each company may have different perspectives on quality they may have different methods and tools to handle the quality issue and we need each informant to tell their story and express their ideas freely without restricting to predefined question but within our topic area. So, we chose to use semi-structure interview as the main approach for our data gathering.

As crowdsourcing is not embraced by many companies in Sweden this study attempts contact with companies that are located large geographical distances away, which hindered the opportunity to have qualitative interviews in person but Skype and phone interviews were asked for. Every interview was recorded and transcribed. For those who were not available for the interview, we sent out a questionnaire via an email. The questionnaire consisted of the same questions as the interview guide which, like the interview questions, focuses on the six categories established in our research model.

3.5 Interview Guide

The interview guide provided some predetermined questions which we used in our interview. They serve as the core questions which drove the interviewer to reach the purpose of the interview. We constructed an interview guide based on our research model which was divided into six categories. We aimed at avoiding having too many questions not to bore the respondents or to use leading questions as those might create biased answers. The questions asked to the representatives of the companies who use crowdsourcing are found below along with their motivations. These questions were also used as a questionnaire for those who were not available to have an actual interview.

1) Use of Crowdsourcing

There are 3 different questions regarding this category within our questionnaire. Those questions are listed below:

- *In what way do you use crowd-sourcing and why?*
- *Do you post jobs for all to see or do you use a certain crowd for certain assignments and if so why?*

- *What happens if no solution is provided before deadline?*

These questions are asked to see how the company uses the crowd in their business as well as what strategies each company embraces. These questions aim to give us a better and deeper understanding on how every company uses crowdsourcing, the aim of each company as well as what they expected to get from the crowd. The way they post jobs can lead to how they value the crowd, if all contributors are equal in every job or if they are not. We also try to see different policies in extreme cases such as when no solution is provided by the crowd.

2) Role/Relationship

In this category, we aim to get a better understanding of the crowdsourcing process, as well as getting the idea of who is involved in the process, their role and the requirements of each role. The communication between each role is also a focus of this category. By knowing the channel of communication between each role, we can get to see more clearly how they relate to each other. The kind of companies that use crowdsourcing services is also of interest to us as by knowing this we will know how open crowdsourcing is and what kinds of job can be done by using crowdsourcing. Thus, we have formulated these four questions:

- *What is it required to be a contributor?*
- *Describe your relationship with the people you provide your services to.*
- *What kind of companies or people use your services? Do you contact companies in order to check if they need your services or does it happen the other way around?*
- *Describe the communication between (your company) and the contributors. Is there any contact between contributors?*

3) Motivation

The question in this category is open ended and flexible depending on the company so there will be only one question as a starting question which can lead to follow up questions on motivation based on the answers:

- *Do the contributors get paid and if so what is the basis of payment?*

  There was a study done on the quality of the answers in crowdsourcing, where it was said that some contributors don't put much effort into the solution since the payment is low, do you have any comments or thoughts around that?

As we saw in the theoretical chapter, money is the main motivation that drives the crowd to action. This question can provide a better understanding of the motivation of the crowd and how the potential amount of the competition prize is decided. This question can also lead to

other kinds of motivational factors, as we think that different companies and communities may have different variations of motivation.

4) Quality Perspective

There are 2 questions within this category:

- *What would you define as quality? How do you measure it?*
- *Do you provide a unique solution to the company or several ones? What are the decision making aspects in order to select the solution(s)?*

The aim of the questions in this category is to obtain information on the quality perspective of each company. The quality perspective provides a deeper understanding of the methods and quality strategies that are used by each company. The quality perspective is also related to how companies select the final solution for their client, which is what the second question is intended to find out.

5) Quality Assurance Methods

This category aims to get information on the quality assurance of each company. Questions in this category will be about solution requirements and quality assurance, and they are listed below:

- *How specific is the company about the solution requirements? Can they reject the solution you provide? What happens if none of the solutions is considered good enough?*
- *Are you taking steps to ensure quality? Do you have a problem with spammers, scammers and similar non-serious contributors?*

These questions will lead us to a discussion where we will find out if any particular tools or methods are used to ensure quality in what is delivered to the employers.

6) Quality Model

There is only one question related to the use of a quality model, which is intended to let us know whether the company does or does not use any quality model or standard. The question is stated below:

- *Are you using any models such as the Capability Maturity Model (CMM) or ISO-standards to ensure quality? Why/why not? If they are used, did a formal or academic background inform your choice to do so?*

Since just knowing whether they use of not some quality model was not enough, we decided to give their reason for their decision, so that we can know what motivates the presence or lack of these models explained in chapter 2.

3.6 Conducting and Processing the Interview

Interviews were conducted through the use of Skype, in order to communicate with respondents far away. As discussed in chapter 3.2 we followed the approach outlined by Kvale & Brinkman's Seven Stages of Interview Inquiry. The interviews were recorded using recording software, with the respondents' informed consent, which will be further discussed under chapter 3.7.

The recordings were then transcribed. There are different levels of detail that can be put into transcripts, and some studies include emphasis, intonation and body language in their transcripts (Kvale & Brinkman, 2007). As we were interested in what they had to say and not explicitly how they said it, we decided not to add these details. Furthermore we deemed that there would be no risk for misinterpretation of the conversation.

Certain areas of the audio were missing or unintelligible. In these cases there was a discussion surrounding the missing information as well as its relevancy based on the context surrounding it and the memory of the interview situation. Nothing was deemed unintelligible until all had listened to it and tried to provide the correct word. Small talk not related to the questions usually occurred at the beginning and end of the interviews and was removed from the transcripts.

3.7 Ethics

Throughout the data collection thought was given to ethical questions, specifically those connected to informed consent, confidentiality, consequences and our roles.

Informed consent means that informants are aware what the study is about, what role they would play and that they are free to participate or leave the study whenever they choose (Kvale & Brinkman, 2009). Our informants were briefed on the purpose of the paper at first contact, in other words when we emailed them to ask if they were interested to participate. If a potential informant wanted more information we provided it to them before any questions were asked.

Confidentiality regards private information identifying the informants being published, which should be agreed upon with the informant ahead of time (Kvale & Brinkman, 2009). All informants were given the opportunity to remain anonymous in our paper. Some informants chose to be partially anonymous and asked that we kept their last names out of the finished product. No contract was signed but an agreement was obtained either via filled out

questionnaires or recorded audio for interviews. As we were not aware of any reasons to obscure the names of the companies or informants, we saw no reason not to disclose this information in those cases when the informants had agreed to it. We believed that presenting the names of the companies and informants would make the presentation of our findings as well as cross checking easier to both us and the reader. The informants who had asked for partial anonymity were referred to as they wished in the transcripts of the interviews. The role the informant played in the company was asked. This could act to reveal their identity to those with particular knowledge of the company but we decided that these answers were publishable as the question was heavily depending on the amount of information the respondent was willing to give out that the answers of the ones who wanted to remain unknown were vague. We did not investigate informants' roles beyond what they told us.

There could be consequences to the participants of a study and the researchers should take these in consideration (Kvale & Birkman, 2009). One aspect we considered with the data collection was that some of the information could make certain companies or individuals look bad. This was not our intention but we strived to present the data as transparently and honestly as possible. Like previously mentioned, the respondents had the opportunity to remain anonymous if they felt they spoke something their company or others would disapprove of them saying. We did not find any instance of sensitive information given, and the respondents did not behave like there had been given such information either. Had there been information of a sensitive nature of for instance proprietary knowledge or personal nature steps would have been taken to edit these out of the paper if not agreed upon otherwise with the respondent. We believe there will not be any negative consequences of this paper on either participants or the field of study.

The role of a researcher should be one who makes ethical choices, presents accurate and representative information and strives to be independent from the influence or perspectives of others (Kvale & Birkman, 2009). For us this meant that we paid attention whenever ethical questions came up as well as to not falsify any data and represent the data accurately. In effect we had to trust in what was said by the respondents instead of looking at finished products due to lack of access and scope of the research. As we only spoke with one representative from each company there is no further validation we could do of the relevant facts presented in interviews and questionnaires. Some small talk occurred in the interviews which was not transcribed as they did not touch the research subject. Beyond our questions to them, we have no relationship to any of the participants in the study.

4. Empirical findings

This chapter holds a summary of all the information given by respondents separated by research category. This information was taken from replies to the questions formulated and motivated last chapter as well as from some other follow up inquiries that came up during the interview situation.

4.1 Presentation of informants

Here follows a short introduction of the companies that participated in our study. A brief description of each company is given as well as the person we got in contact with, who was either interviewed or filled in the questionnaire.

Company A: Microworkers

Microworkers is a platform that connects employers and workers in the crowd to connect and create solutions of various difficulties. Currently, their company has 300,000 contributors in the crowd. (Nhatvi Nguyen, Microworkers).

Most of the solutions are easier tasks that can be performed in a few minutes, such as social media activities. (http://microworkers.com, 2012).

The person we spoke to at Microworkers was Nhatvi Nguyen, who described himself as the chief worker who works to promote the platform and was knowledgeable about the structure and upcoming projects.

Company B: Clickchores

Clickchores is a fairly new company, founded in November 2011 in The United States. The company works to connect people worldwide to conduct simple small tasks that are primarily within the areas of Search Engine Optimization, digital advertising and social media. (www.facebook.com, 2012).

The company currently has a few thousand members in its crowd. (Ari, Clickchores). Our respondent at Clickchores was Ari, and his last name was withheld on request.

Company C: Microtask

Microtask provides services to businesses by using their platform to get tasks such as text recognition and data entry services done accurately by individuals who are in most cases chosen from work force providers based on algorithms. (Ville Miettinen, Microtask).

The company was founded in 2009 and has offices in Finland and the United States (Vesterinen, 2010). At Microtask we spoke with Ville Miettinen, founder and CEO.

Company D: TopCoder

TopCoder sees itself as a community with over 425,000 software developers, algorithmists and digital designers where the contests with prizes are held on a platform, providing services for clients by utilizing the crowd. (www.topcoder.com, 2012). The respondent we spoke to at the company was Jim McKeown, Director of Marketing Communications.

4.2 Presenting Findings

Within this subsection, the findings discovered through both the interviews and questionnaires are shown. When analyzing the transcripts, we found certain methods that different companies use in order to measure the quality of both the contributors as well as the employers. These methods are aimed at improving the quality of the final software product. They are listed below:

- *Ranking/rating*: Employer and contributor are rated based on either how many submissions they have received satisfied/not satisfied on or how the employer confirms to payment terms. Rankings/ratings are given out by involved employers and contributors respectively.
- *Report spam*: Employers report that a contributor is constantly submitting bad solutions, and it is clear that he is just trying to earn some money without making the effort to make a solution that fulfills the requirements of the job.
- *Report unfair treatment*: contributors report being unfairly treated when they are ranked lowly by employers, when they have succeeded with their submissions.
- *Skill-filter*: employers can decide to filter their jobs, in order to make them visible only to contributors with a set of skills they decide.
- *Type of job-filter*: employers can make their jobs only visible for contributors who are interested in that type of jobs, instead of the job being accessible to all the contributors.
- *Geographic filter*: employers can decide if they want their job to be available for everybody or just contributors from some specific geographical region.
- *Task lock*: employers can decide a worker to provide a solution for their job, making him free from competing on a time basis.
- *Task pre-approvals*: crowdsource providers look at every job characteristics in order to see the instructions are clear, if the task is possible to do within the time specified and if the economic reward is fair enough.
- *Strategy - Best*: among all the available solutions provided, the employer has to decide which one is the one that fits the most with his requirements. Sometimes, more than one solution can be chosen, being all those contributors rewarded as well.
- *Strategy - First*: consists on selecting the first solution or solutions provided by contributors. It is up to the employers to decide how many of them they want.
- *Skill Barriers for registering*: employers require contributors to have some specific skills in order that they can provide solutions to the jobs that employers are going to require.
- *Open forum*: forum where both contributors and employers can discuss different topics, as well as share some of their solutions so that contributors can learn from each other, thus the knowledge of the whole community is increased.

These findings are presented in accordance with the categories developed in the theoretical framework which were explained in the second chapter and are: *The use of crowdsourcing, Role and relationship, Motivation, Quality perspective, Quality Assurance,* and *Quality model.*

1) Use of crowdsourcing

There are different uses of crowdsourcing by different companies. Table 4.1 show the information of how each company use crowdsourcing in their business and the crowdsourcing process in different companies.

Table 4.1: Findings on use of crowdsourcing.

Informants	Findings
TopCoder	A combination of community based and competition based crowdsourcing for creating digital assets is used. The idea of using crowdsourcing was born out of problems identified in traditional software business together with the growth of online world.
Microtask	Microtask uses crowdsourcing (which they called distributed workforces) for obtaining the back-end labor in their service. As text recognition in fairly standardized their strategies is "first come first serve". A job will not be posted to the public but will be assigned directly to the worker.
Clickchores	*"Clickchores focuses on getting people from all around the world to do some very simple tasks"* (Informant B, Clickchores, Appendix 2.2). An employer can post a task, and contributors work on a first come first served basis.
Microworkers	There are two different types of campaigns: time based and task lock campaigns. In the former ones contributors work on a time basis and the first ones who finish the task are accepted, whereas in the latter ones, a group of workers are hired by the employer for a special task.

Despite some slight differences existing, the way these companies use crowdsourcing is quite similar. In all four cases, the employer posts jobs or assignments which are seen by the contributors, who will try to provide a solution to it. Every job has an assigned economic compensation that will be given to the contributor who delivered the solution if his submission was accepted. Apart from this way of working, some of the sites such as Microworkers have the possibility to make a different type of contest. Instead of making every job available to every contributor, employers collaborating with Microworkers can decide who they want to work for them and hire them for a specific job. Along with type of

job filter, some tasks may be suitable for a particular country so Microworkers and Clickchores also provides a geographic filter, which is a function which will only display a job for some specific areas that are deemed suitable for each job.

The major difference among all these sites is the way they decide which submission is the one selected to go forward. In the case of Clickchores and Microworkers it is as simple as rewarding the first solution received that proves to have done what was required. In the most complicated cases like TopCoder, the employer or their representative has to decide which submission best suits the job. In some cases, not only the submission selected will get an economic reward, but also some other that the employer decides, in order to keep levels of motivation high among contributors.

2) Role/Relationship

Crowdsourcing is comprised of 3 participants: the initiator, the crowdsource provider and the crowd. Among the informants there are different words used for the crowd, some call them members, workers or employees. Each company has its own specific requirements to participate in crowdsourcing.

Table 4.2: Findings on role/relationship.

Informants	Findings
TopCoder	There are over 400,000 members worldwide of TopCoder's community who are interested in software, critical thinking and competition. TopCoder have such varied types of organizations as Facebook, Google, Paypal, UBS and NASA as clients, spanning IT, financial and governmental work. The role of TopCoder itself is to build a platform that allows the crowd to work, play and have social activities together as well as launch competitions for their clients.
Microtask	Microtask is a B2B (Business to Business) company which offers high-quality text recognition and data entry services. Their clients are companies which have to deal with a large scale of data entries and document processing such as document management house, bank, mail-room and etc. The contributors will not be aware of each other which they think is an important part of the solution.
Clickchores	Anyone can be a contributor to this site, even though they admit having a majority of contributors from developing countries. The employer can also be anyone. The role of Clickchores is the role of a supervisor, making sure that everybody is treated in a fair way, avoiding scams and so on.
Microworkers	The only requirements to be a contributor are being able to understand English and being at least 18. Employers post tasks on the website to be finished by some specific date. Microworkers tries to make sure that the task is doable within the specific time selected and that it is not a scam.

The crowds belonging to the informants are made up of individuals who work for the community or participate in each competition, and are mainly people who are looking to make some extra money even if they have a full-time job. The role of the crowd is to develop ideas and perform the revenue generating work. For the crowdsource providers that use a community, the crowd also engages in social activities.

> *"Members are our employees and bosses at the same time[…]Members develop ideas, they build the platform and they perform the revenue generating work which is done for clients."* (Informant D, TopCoder, Appendix 3.2)

The initiator and crowdsource provider are sometimes the same person but mostly not. The initiators are sometimes called "clients", which would be clients of the crowdsourcing company, and sometimes they are called "employers". The initiator is the person who comes to the community looking for solutions, offering jobs that will be compensated. The initiator can be a private individual or various types of companies including technology companies, financial services companies, bioengineering companies, pharmaceutical companies, medical companies, agribusiness companies as well as a government. The initiator will obtain access to the crowd skills, knowledge and experience and reward them in return.

Lastly the crowdsource provider is the person or organization who controls and takes care of the community. Their role is to be a middle man between the crowd and the initiator. They provide a space for initiators to post their job as well as set up a competition. The crowdsource provider reviews the campaign instructions to make sure that each task has clear and precise guidelines. The crowdsource provider has to work with both the initiator and the crowds, and all the respondents said there were no direct communication channel between those two. They have to make sure that they protect both the initiator and the crowd to ensure fairness in the community.

The crowdsource provider does not communicate directly with the crowd outside of posting jobs and for those with communities; the crowdsource provider will most likely provide a space to exchange knowledge or opinion between contributors. This can be in form of open-forum as TopCoder does or via social network such as Facebook page for Microworkers.

3) Motivation

We can see that in this category the motivation for contributors to submit a solution is the same, money, which is also the only reward available for them. This can be better observed in a more detailed way in table 4.3.

Table 4.3: Findings on motivation.

Informants	Findings
TopCoder	The standard is the winner, who sent the best submission, as well as the one who got second place get paid with a pre-set amount. The badge is also one of the reasons for members to participate in the activity in their community. Badges will show in the member profile which works as an achievement system based on their activity and results.
Microtask	Microtask have used both volunteer workforce and paid workforce. Paid workers get paid per number of characters processed.
Clickchores	Contributors see the jobs available in their area, and once they have submitted their solution they just need to wait for it to be verified within the next 72 hours in order to get paid.
Microworkers	The main motivation is the economic reward that contributors get. There is a minimum basis that has to be met by the employer.

In all the companies we have studied, the crowd comes together on a competition or a job for a variety of reasons, although money is the main one. The amount of a prize is also an important aspect that a company has to take into account and need to carefully calculate it. For instance, TopCoder uses algorithms, analytics and market based results as well as years of experience in order to do this. Informant D from TopCoder expressed the reasons why the crowd participates in the following way:

> *"Members compete in a competition for a variety of reasons, money being one of them. They must have confidence that they are being paid in a fair competition at a fair rate otherwise they will not compete."*
> (Informant D, TopCoder, Appendix 3.2)

Clickchores and Microworkers both agree that the main motivation of the crowd is a financial reward, so a minimal based rate payment is essential. By setting minimum base rate payments for different tasks the idea is to attract a wide range of people to participate in the crowd.

> *"I think prices are very important, and employers can set their own price, based on certain limited amounts and their task category. [...] So we try to cover those minimums to at least keep some sort of quality..."*
> (Informant B, Clickchores, Appendix 2.2)

TopCoder also uses an achievement system which gives badges to the contributors based on their activity and results. These badges will show in the member profile which TopCoder claims to be one of the most important motivations for their members.

4) Quality Perspective

When it comes to quality definitions the companies have different views based on their set up and the type of work they are focused on accomplishing. Both the product and the customer satisfaction are important.

Table 4.4: Findings on quality perspective.

Informants	Findings
TopCoder	TopCoder has two perspectives on quality. The customer perspective is based on quantitative analysis of number of bugs or defects per lines of code together with customer experience and the value they got from product. A pure software perspective with traditional software quality assurance processes is also used.
Microtask	The quality perspective of Microtask is the output accuracy of the data entry process which is measured in percent of correct characters or words.
Clickchores	*"It was either quality submission or it was not. But there are categories that are more complex such as write an article on X topic and post it to your blog, and then obviously quality becomes a big concern."* (Informant B, Clickchores, Appendix 2.2)
Microworkers	A solution has either passed or not. There are only two outcomes: *"One is satisfied with the job submission and the other is not satisfied with the job submission."* (Informant A, Microworkers, Appendix 2.1). Microworkers does claim that improvement in this assessment could be made.

There are huge differences within this category, ranging from a simple passed or not - used by Microworkers - to a more complex system measuring the percentage of correct input - used my Microtask. In between these two, we can find TopCoder with its two different perspectives and Clickchores, whose quality view depends on the type of task that has been done.

5) Quality Assurance Methods

There are some variations within the quality assurance methods that each company uses, which are linked to their quality perspective. The detail of quality assurance method of each company can be found in table 4.5.

Table 4.5: Findings on quality assurance methods.

Informants	Findings
TopCoder	TopCoder demands clear requirements including timeline and prizes for every competition. Every solution will be reviewed and scored, and also feedback will be provided to the member. *"This is a very important value within the process as it allows competitors to learn and get better."* (Informant D, TopCoder, Appendix 3.2) In case there is no solution deemed to be fulfilling the requirements, the competition will be re-launched with the modified requirements, timeline or prize amount.
Microtask	They have three ways to ensure the quality: buying a workforces from "workforce providers" which have a contract to ensure quality of workers, making the system automatically measure the quality of each contributor so it rejects the work of sub-standard contributors and increasing the accuracy of the solution by using more task replication by sending same task to multiple workers.
Clickchores	In order to demonstrate that they have fulfilled the task, contributors are required to send in some proof, which needs to be reviewed by the employer. The job is also is verified before being published in order to make sure that it is not a scam and that it clearly explains what is required in order to accomplish the task.
Microworkers	They have a rating system in which the employer can mark a submission as satisfying or not satisfying. Based on this, contributors have an overall rate. The same thing happens with employers, so that contributors are aware of scam attempts.

The ways in which the companies explicitly ensure quality varies. The simpler companies, such as Microtask and Clickchores, have a simple attitude towards the matter:

> *"The only measure to ensure quality is leaving in the employer's hands: if that employer is happy with the quality of submission and they pay the worker and if not then they mark the job as not completed, not satisfied and the worker is not going to get paid for the job."* (Informant B, Clickchores, Appendix 2.2)

TopCoder also states that their view of quality is based on traditional software quality assurance methods but that the level of rigor is adjustable based on the requirements of the employer.

Companies like TopCoder have a standard of steps of testing as well as the previously described socially motivating factors which they believe help ensure good performance. Microtask maintains quality by statistical measurements, tracking a contributor's success rate and automatically assigning fitting jobs to the individual contributor and in some cases task replication, in other words sending one microtask to several contributors.

There are different strategies presented among the companies. A task can be opened to all contributors, or be restricted to countries or those individuals calculated by programs to be most appropriate. The results can be from the first submission approved or the submission deemed best out of many. TopCoder uses competitions with price money and social acclaim in order to encourage quality submissions.

The testing of TopCoder is carried out in different stages, which separates out substandard or spam submissions. There is also the ability to ban members committing spam, something that many companies employ.

One way to only use especially skilled workers is to have barriers for registering. Such barriers were not found in the companies with the exception of Microtask, which uses a workforce provider instead of opening up tasks to a general crowd. They have however had projects where a more open registration was held.

All companies in the study have emphasized clarity and transparency and cited the terms and conditions as something that must be read through and complied with before posting jobs. The idea of protecting the workers was mentioned and thus serious employers are looked for. Before a job can be posted on Microworker's platform, Microworkers representatives look through the posting to make sure it complies with the rules and is clear about what must be done as well as what proof of task and requirements there are. In the cases where the crowdsourcing companies discover that a competition or job posting has not had any approved submissions then a repost of said task can be done after reviewing the clarity of the instructions.

Those contributors who have been rejected get different amounts of information on the reasons, ranging from none at Microtask to full reviews by TopCoder. The contributors in both companies however have the ability to appeal.

At TopCoder a so-called Copilot is used to ensure quality. A Copilot is a designated successful and skilled member of the TopCoder contributor community and acts as the go-between the employer and the community. The Copilot works out the level of requirements with the company as well as the award sum, and then is in charge of presenting and maintaining the TopCoder process and selects the winner. It is also the TopCoder who fills out the review cards of a contributor. Copilots are not always used as some companies have their own trained personnel for these purposes.

TopCoder has a forum which contains learning tools for members. One way companies try to keep a base level of quality is by setting minimum payment limits.

6) Quality Model

None of the interviewed sites uses any quality models, although TopCoder says they could be qualified as CCMI if they had any interest in being certified. The other sites work based on their own policies.

Table 4.6: Findings on quality model.

Informants	Findings
TopCoder	TopCoder has not been formally certified according to any model or standard, but they argue that they are CCMI level 5. They say their nature of their software process actually forces the diligence and rigor required to achieve level 5.
Microtask	No model used.
Clickchores	They do not use any quality model or any standards, as they say "*It's really more based on our own personal thoughts*"(Informant B, Clickchores, Appendix 2.2)
Microworkers	At the moment they do not use any quality model or similar, but are working on it as they say: *"we are building some very advanced features and we're working on those features as we speak right now and those should have a lot of test capabilities to ensure the quality"* (Informant A, Microworkers, Appendix 2.1).

4.3 Summary

Crowdsourcing is used by companies in a similar way. They provide a space for their employers to post jobs and allow their contributors - which are called "the crowd" or "contributors" - to freely choose whether they want to participate or not in a task and provide a solution to it. In some cases, employers can decide who they want to assign the job to. The contributors who complete the job will be rewarded if their submission is accepted. The way in which TopCoder works may a bit different from other companies, they may use one of the crowd's member to control the work process. This contributor is what they call "Copilot" which can be seen as a middle man between employers and the crowd.

The role of crowdsource provider is to cooperate with both the crowd and their employers. They have to maintain the community and ensure fairness in it. They have to review jobs before they are published as well as provide a place for contributors to submit their work.

In most companies there are no specific requirements in order to become a member of the crowd. Everyone can become a contributor because most crowdsourcing companies aim to

get people from all over the world, because the bigger size of the crowd is the more work can be done with higher quality, and thus it is possible to attract more employers to post jobs.

The big difference between informants is the strategies for selecting submission. Companies like Clickchores and Microworkers use simple strategies, as the earliest submitted solution is the selected one, once they receive some proof of the job being done. In the case of TopCoder, only the best, and in most cases the second, are selected and submitted to the employer.

Financial reward is the main reason that makes the crowd work for crowdsource providers. The amount of a prize has to be carefully calculated, not too much for the employer to pay and not too low so that the crowd is attracted to participate. However, money is not the only reason that keeps the crowd working for them, TopCoder also uses a badge system that makes the crowd motivate themselves and keep them within the community.

Table 4.7: Methods used by companies

Methods	Companies			
	Microworkers	Clickchores	TopCoder	Microtask
Ranking/rating	X		X	
Report spam	X	X	X	
Report unfair treatment	X	X		
Skill-filter				X
Type of job-filter				X
Geographic-filter	X	X		
Task lock	X			
Task pre-approval	X	X	X	X
Strategy – Best			X	X
Strategy – First	X			
Skill barriers for registering				X
Open forum	X	X	X	

Each company has different views of quality which lead to different methods they use to ensure quality. Table 4.7 shows the summary of the methods used to achieve a certain level of quality in each company. Each method helps the company to ensure quality in different ways. We will discuss more on what every method does in the following chapter. Lastly, it appears that there is no software quality model used in any of the crowdsourcing companies that have participated in this study.

5. Analysis and Discussion

In this chapter we analyze the collected data by categorizing the patterns into the research model's categories when possible as well as comparing our findings with existing theory in order to build upon it. Furthermore there will be a discussion of the analysis and the paper as a whole.

5.1 Analysis

Like in previous chapters the outlined research categories provide the structure for our analysis. We do analysis separately but not freely independent of each category because they are all related to each other. There are some aspects that are mentioned in more than one category but from different perspectives. This is to get an overview of each method, what the method does and how it helps maintain quality in crowdsourcing.

5.1.1 Use of Crowdsourcing

From our findings we can see that there are different uses of crowdsourcing in different companies. The way they use crowdsourcing can be distinguished into two approaches: *first come first served* and *best solution*. Companies which use the first come first serve approach are companies whose business model is based on micro payments by allowing employers to post a job on their website and make it open for the crowd which can choose freely. The crowd will get paid after they have finished and submitted a job. Mostly this kind of approach will consist of a simple task with requirements and a number of submissions for which they are willing to pay. Only a small group of the crowd who submits a job first will be paid. Companies embracing this approach aim to get a bigger crowd from all over the world to work for them (Microworkers, Clickchores). Because it is a very simple task, the quality management of this kind of approach will be on the previous stage before post a job to the crowd. A fully detailed list of requirements is important to ensure quality of the tasks submitted by contributors.

The second approach is a competition based approach. Only the best solution and possibly the second will get rewarded by the employer. The tasks/jobs on this approach will be more complex and require specific skills to be completed, so in this kind of approach the size of the crowd is not as important as the skills of the crowd. The crowd mostly shares common interests and has a place to share certain knowledge. The details of such community will be described further in the next section. As we can see, getting a lot of people being part of the crowd is also important but does not seem to be a first priority for TopCoder. They seem to aim to get people who are interested in software development to work together and provide a forum for their community to share their knowledge and improve their individual skills.

Use of crowdsourcing can solve traditional software business, which is something that Way et al. (2011) and TopCoder agree on. By gathering a diversity of people through the online world to work together, a lot of cost and time can be saved with no risk of cost expand because of the pre-determined set of prize and time. But there are some cautions which are brought up by Brandel (2008), like the fact that the crowd is hard to predict or control. Companies need to be careful not to let a narrow group of people influence their decision. TopCoder solves this problem by creating a role inside the crowd called "Copilot". A Copilot's duty is to work with their client to agree on plan and pricing, as well as to control the direction of the crowd in each contest to ensure that there will be a solution back to their client.

5.1.2 Role and Relationship

As described by Estellés-Arolas and Gonzáles-Ladrón-de-Guevara (2012) there are three important elements of crowdsourcing: the crowd, the initiator and the process. The last one has already been commented in the previous section within this chapter, so the other two are still missing. The crowd is the most important role in crowdsourcing, and it can be seen as a boss of the crowdsource provider as well as their employees, they form a developing platform and foster new ideas for community. The community cannot survive without the crowd but the success of crowdsourcing is relying in the crowdsource provider's hands. The crowdsource provider's job is to gather people for the crowd as well as to find jobs for them. But just getting people is not enough, as we can see from the theories that the way they maintain and control the crowd is more important than how to get them. They have to make sure that the crowd gets fair rewards after they've completed their task as well as the initiator getting good quality work. So, by reviewing the crowd work and making sure that the community is treated in a fair way, the quality of crowdsourcing community is maintained.

Most of our informants seem to be open to everyone becoming part of their community. Only Microtask differs a little bit by not being open to everybody, and most of the time they get their workforce from workforce provider company. Their contributors will not be aware of each other, which they claim to be an important part in order to ensure the quality. This is because they are a company that only does specific jobs so they require some specific skills to complete the task.

As mentioned before, TopCoder has created a new role in their community called "Copilot". A Copilot works as a middle man between the crowdsource provider and the crowd members. The Copilot is part of the crowd so he knows what the crowd wants, negotiates for a suitable reward in every job and runs the contest. The Copilot is an interesting role in TopCoder community, because he is the one that controls the direction of the crowd, and is also responsible to work with the client at an appropriate level of detail to make sure that the submission matches the requirements. But the Copilot does not have much influence in the overall crowd because everyone can become a Copilot once they have gained certain level of

experience. Copilots will lead every campaign in which they are involved, but not every campaign requires the collaboration of somebody playing the role of a Copilot.

As crowdsourcing is a community based platform, communication within the community is also one area of interest. But only TopCoder provides space for their community to discuss and share knowledge. It is possible that those more open communication channels are a result of the resources of TopCoder or their focus on more complicated products.

5.1.3 Quality Perspective

The words used to describe quality in the companies vary. Clickchores and Microworkers emphasize a binary view, consisting of a submission being either a submission of good quality or not. Microtask has a certain accuracy percentage they are willing to accept. TopCoder has both customer satisfaction and traditional product testing. Comparing these values and statements with the views on quality presented by Kitchenham and Pfleeger (1996) in chapter 2, we can see that there is basis for several of the five views. At first glance, the transcendental perspective seems to be in use as companies say something is either of good quality or not. However this is not an accurate description, since a list of requirements must be met. This is closer to the manufacturing view as products must come close to, or in these cases, fulfill certain specifications or requirements. In TopCoder there are several runs of testing as well as individual assessment done by so-called Copilots, which leads to finding the best product. In these circumstances a product view is utilized, as the product itself is made sure to have certain properties. The customer view of quality is very heavily used. It is up to the customer to give the final approval or dismissal of a submission in accordance to what they think of the submission and how well it meets their needs, except for Microtask who do it themselves. There is no basis for value-based perspective as prices are determined before the product is created, thereby what a customer is willing to pay is not applicable in crowdsourcing.

It is worth noting that quality of the product is not the only thing mentioned by the companies. In some cases the job postings are not serious or realistic, at which point the company will step in. It was also mentioned that a service to the crowd is provided and that fairness to both parties must be strived for. This fairness is a subjective measure and varies between companies because we see that not all complaints are taken into account by the simpler companies. The communication channels are not as developed in these companies, as communication with the crowdsource provider usually consists of a report button or a support ticket. This can be contrasted with the community of TopCoder. Fairness is a subjective concept and resources may play a part how much actual concern is given to all aspects of it.

The way TopCoder is set up means that there is a person in charge of a project, who is the middleman between the members participating in a project and the company who posted the job. This is the aforementioned Copilot. Within their job description lies to assess with the company what submissions are good enough as well as write out a scorecard of the submission. There is a greater review than just the dichotomy of approved/not approved. This

can contribute to the sense of being fairly listened to and involved which may lead to greater commitments to the crowd as well as learning.

5.1.4 Quality Assurance Methods

The first issue we pointed out referring quality within the crowd was the fact that many individuals work on the same small tasks, so the most common solution is selected as the best one, because going through all submissions would take too much time for the company. Based on this, Ipeirotis, Provost and Wang (2010) developed an algorithm in order to measure the trustability of each contributor.

This is what Microtask does with its system, in which they send out the same task to many contributors and select the most common solution submitted as the best one. Afterwards they calculate each contributor's performance level in order to get some kind of ranking, so that solutions belonging to contributors who are ranked as sub-standard contributors are rejected. This system mimics the algorithm defined by Ipeirotis et al. (2010), in which wrong solutions belong to spammers or contributors either making little effort or with a recurring bias. The mechanism used by Microtask is similar to the one that was used when Quality Management was created (Yong and Wilkilson, 2001), in which statistical and mathematical tools were used in order to improve quality.

TopCoder's way of improving quality goes along with what Fukushima and Yamada (2010) came up with: process monitoring and quality evaluation activities. Despite being in a bit different way from the model they defined, TopCoder does both things. Fukushima and Yamada state that the process monitoring should be carried out in every step of the software development, but TopCoder cannot control all the contributors while they are on the software development process, so they have some checkpoints in which contributors are informed of whether their solution is good enough to be continued or not. The quality evaluation activities that TopCoder performs consist on some software test as well as review cards for contributors, in which an overall evaluation of their work is done.

This quality evaluation activity is also embraced by Microworkers and Clickchores. In the first case, employers are able to indicate whether they are satisfied or not with the contributor's provided solution, so that they have an overall rate. In the latter case, contributors need to send in some proof that shows they have done the task.

One of the problems related to TQM that Yong and Wilkinson (1999) describe is the fact that companies adopt it in a partial way, due to the lack of middle-management commitment and infrastructure. This is what a Copilot is for. He is designated to make sure the crowdsourcing process takes places as it should, and both the employer and the contributors are satisfied once the task has been finished.

Furthermore, the different methods used by the interviewed companies also help to improve the quality of the final product, thus they can be considered quality assurance methods. The

first method we are going to talk about now is task pre-approval. This is the only method used by all the companies participating in this study. It is both very simple and helpful for contributors, since it will avoid any undoable task being published. This ensures the contributors that every job that is posted on the website is doable and has a fair reward, which should motivate them enough to try to participate.

The second one we defined was ranking/rating, which was embraced by all companies but Microtask. This method helps people collaborating with the company to see who the good contributors and employers are. Highly rated contributors will be more likely to provide a satisfying solution, whereas high ranked employers will be expected to treat contributors in a fair way and reward them as stated.

The two following methods – report spam and report unfair treatment - are connected to the previous one, and used by the same companies except for TopCoder, which only uses the first of these two. Report spam helps employers to point out which contributors are not competing in a proper way, but just providing low quality solutions in order to the prize, so that employers can block those contributors or just ignore their solutions. Report unfair treatment is the same, but the other way round: it is contributors who point out which employers are not being fair. Employers that are marked as being unfair with contributors are more likely to receive low quality solutions because they underestimate the work of contributors, who do not want to spend their time doing something for which they are not going to receive the reward they were expecting to.

Microtask uses two specific methods based on contributors' abilities: skill-filtered jobs and skill barriers for registering. We can argue that it is the same method applied in different stages of the crowdsourcing process. Barriers for registering help the company to only have qualified members, avoiding anyone who does not fit in the company's profile. This leads to a scenario in which all contributors are able to do any of the tasks posted, and in case that any special job needs to be done, there is the possibility of still making the filtering even more accurate for some specific skilled contributors, so that only the suitable ones are able to take that special task.

Finally, the last method is task lock, and it is only used by Microworkers. This tool helps contributors to have more time to do a job, so that they do not have to worry to be one of the first ones submitting a solution. Having more time to complete a job gives contributor more chances to develop a high quality solution because it is the only thing they have to focus on.

5.1.5 Motivation

What motivates the crowd is really important because crowdsourcing depends on individuals with certain skills wanting to participate as well as them feeling motivated to generate quality work. Money is a clear motivational factor for most of the crowd. The companies set minimum rewards, often based on the types of jobs. TopCoder has used algorithms to determine the limits. The level of the payment is a result of paying contributors enough to be

motivated to do the work and low enough to attract paying customers and provide a profit. Clickchores enables customers to specify which countries people can contribute from, and are aware that price differences exist in different parts of the world, but they advise international openness.

Borgida and Mobilio (2000) speak about how the need for social worth can act as a strong motivator. This is something that the companies acknowledge in different ways, TopCoder most of all. In their paper, Borgida and Mobilio (2000) further state that different people will react differently depending on their need for the outcome of their behavior and how strong the belief is that a behavior will result in that outcome. This could explain some people being more motivated by social camaraderie than others who have a general need for monetary compensation. It could also go into the concept of fairness, as how much one expects to be treated well for their actions can depend on the company. Open communication channels and minimum levels of payment would seem to appeal to those who look for fairness.

The fact that even second best submissions can get awards in TopCoder goes along with what Lewin (1999) says in that further participation is encouraged and an individual is more likely to come back when a person feel they have reached some success, thus providing TopCoder with a return of this very skilled and motivated worker. Baumeister and Leary (1995) say that willingness to contribute can strengthen if participants feel like they belong and have an opportunity to create social relationships.

The motivational factors we observed were of the two kinds described by Brehm and Self (1989), the extrinsic and the intrinsic motivation. Extrinsic motivations include prices, rewards and opportunity to look good for future employers, whereas intrinsic motivations include people participating because they enjoy doing the particular tasks as a hobby as well as the sense of identity participation or community membership that can be provided. TopCoder even have t-shirts, which would encourage individuals to partially base their identity on such a membership.

There have already been studies saying that the reward system inherent in TopCoder is motivating further participation (Boudreau, Laceta & Lakhani, 2011). We could see these in the prices, rankings and achievement medals which act as a status symbol. We could also find similar status symbols even in the simpler companies. Both Microworkers and Clickchores utilize these, even if they do not have any community wherein an individual could receive adulation for these statuses. It is possible the self of self-worth alone is motivational.

5.1.6 Quality Models

We asked if any quality models were used by the companies, which they responded with a negative answer. TopCoder stated that they would be the equivalent of Level 5 of CMM. This points to academic models not being in used in practice when it comes to crowdsourcing. This might be because crowdsourcing as a concept is relatively new so not much literature of best

practices exists, and companies finding and following other quality models, especially in the more informal and simples companies, might be unrealistic.

5.2 Discussion

The way to find the best solution was discussed by many of the authors (Way, et al.,2011; Breul, 2010; Brandel, 2008) but we found that in practice a lot of the time the first solution provided by the crowd would be the one that received monetary compensation. This strategy was often used by the simpler companies that perhaps do not have the resources to spend time on finding the best solutions or that do not require much overview of the solution due to the simpler nature of the task. These kinds of tasks do not require high skills and do not take much time to complete so these jobs are open to everyone. The first one who does a job and sends in a submission will get paid. The quality of these kinds of tasks is not of much concern and there is generally no testing step. Quality is mostly dependent on the employers' quality perspective and their satisfaction. Awarding the first rather than the best might bring up quality issues such as the crowd racing to submit their solution without going beyond the bare minimums of the requirements. It is possible that encouraging this instead of well thought out responses will make quality suffer.

How companies deal with quality during the process of crowdsourcing could also be important in order to make the crowd – and everybody involved in the process – trustful. This means that if the company somehow checks for the quality of the solutions provided by the contributors, they will know that they cannot provide substandard solutions to the organization's request, since it will not be accepted and they will not get any kind of reward.

But this works in both directions, as trust must be had both by the contributors who provide solutions to the companies and by the organizations themselves. The firm has to satisfy the contributors with the promised reward, so that if contributors know that the company asking for help through this technique is trustful and its prizes are really inviting, they will try to give their best in order to provide a satisfying solution. So, making both sides of the community trust each other is expected to help the quality of the final results to be higher than if there was no trust among the participants at all.

Surprisingly, none of the companies but TopCoder allows any sort of communication among contributors, which can lead to lower quality solutions due to the lack of knowledge sharing in order to improve everyone's individual skills. There is no communication between contributors and employers either, only the job posts that are published on the web page of the crowdsourcing provider. This lack of possible communication may lead to misunderstandings and thus may have a big impact on the final solution quality because contributors end up doing something that is slightly different from employers' desires.

The study found that the companies did not base their work on any established quality model. There are a few possible reasons for this. Informants' background can have an effect on what they consider when building their platform in accordance to their business idea. As

crowdsourcing is a relatively new concept and there has not been much research done into it at this point, there are not models or best practices for the specific area of crowdsourcing yet. While there exists a wealth of other quality models, it is possible these are not applicable to crowdsourcing or are presented in a way that the crowdsource providers do not think of them as such. Decisions appear to be based on experience and the companies' own studies into algorithms and statistical measures. It is unknown if this affects quality.

The success of crowdsourcing could not have happened without the growth of the online world. The spread of Internet accessibility and use all over the world enabled a crowd to exist, be reached and participate. In developing countries, online jobs seem to get more people interested because of their currency rate, something which might interest some employers in more developed countries. When they work online they will be paid in US dollar or other currencies that often have a higher rate than local currency so this money is more valuable in a developing country. As we've seen that some companies use the option of geographic filters, thereby deciding which country the people performing the task are from. So it can be said that crowdsourcing mimics traditional outsourcing trends in that developing countries might be exploited. When there is more crowd participation in crowdsourcing, there will be more and varied submissions so a company will have more chances to get better solution. We can say that crowdsourcing is a good alternative for a company that wants to outsource their task.

The differences in the use of crowdsourcing and the methods built into the structure of the crowdsource platform might depend on a few different factors. The size and available resources of the company seem like a logical reason, but strategic choices regarding focus would seem to contribute as well. The less complex platforms are, the most they make of their business on minuscule microtasks which require for instance social media activities or proof-reading, whereas the more complex companies are, the more complicated program components they focus on. This difference in focus, along with the view of quality would seem to explain the big differences between crowdsource providers.

We believe that the significance of this study lies in the fact that it delves into a largely unexplored area. Crowdsourcing is becoming more prevalent and as disintegrated companies face more issues when it comes to quality, we believe this will provide a growing concern. We hope that this paper will give some insights into what quality measures are already taken and which aspects of those methods that companies would do well to learn from and in some manner possibly emulate.

Out of the four informants, only one, TopCoder, deals specifically with software development at the moment. As there are fewer crowdsource platforms focused on software than general crowdsource platforms, we decided that the information gained about the general workings of these other companies mattered to our study in order to determine the common ways quality is managed on crowdsourcing platforms. The findings showed that there were many common elements between TopCoder and the other companies which can be seen as to support our decision.

The exact relationships between the methods found and software quality is difficult to say. This study doesn't look at the finished product which means that effectiveness can't be measured. Furthermore the focus on contact with the crowdsource provider and not on the participating crowd members mean we have the crowdsource provider's view and our own conclusions based on the literature review as the basis for our results on the crowd. The literature review does point towards a relationship where using methods involving social ways of encouragement would seem to lead to a higher degree of participation and performance than just monetary compensation, but as there are many other factors involved this will be considered a potential aspect and not the only determining factor. It is also unclear if methods such as ranking or filters lead to a higher degree of software quality. In certain cases we can say that ranking and filters let the initiator and the crowdsource initiator know which members are the best to use in the future and which are a waste of time because of the quality of the submitted work. As we see in the interview the quality of the submitted work is judged both on a customer satisfaction basis and a product quality basis. This means that what counts for quality in one case might not be considered quality in another. Attributes such as time to complete the task and the level of payment a worker is content with could perhaps influence the initiators view of a contributor when they set the ranking. These attributes may not have anything to do with the quality of the software product. We still believe the methods identified in this paper can serve a purpose as they go to show some interesting relationships, if not necessarily all relationships that exist. These relationships seem to be more complex than we initially thought.

6. Conclusions and Further Studies

In this chapter we present our findings from the analysis chapter to answer our research question. We discuss how crowdsourcing work in general, what methods are used and what each method does to ensure quality. In last section of this chapter we give some suggestions on possible topic for further studies within crowdsourcing area.

6.1 Conclusions

In conclusion, there are three important roles in the crowdsourcing process*: the crowd, the crowdsource provider* and the *clients*. The crowd gets a job through a crowdsource provider which is given by their clients. The process is started by a client who passes a job to the crowdsource provider and the crowdsource provider has to review it and make sure that it has clear requirements before they publish it for the crowd. After the crowd finds a solution and submits it back to the crowdsource provider, the role of crowdsource provider will be different depending on their strategies.

Strategies

We found that these strategies used in crowdsourcing can be of two different types, which can be called *contest* and *first come first served.* For the contest strategy, it is the crowdsource provider's role to run a contest and get the best solution back to their clients, as seen in figure 6.1. Within this approach, it is the provider who decides which submission is the best and will be sent to the employer. Sometimes, not only the best solution gets rewarded but the top ones. How many solutions get rewarded is decided by the employer, and depending on that, the provider will need to choose more or less submissions.
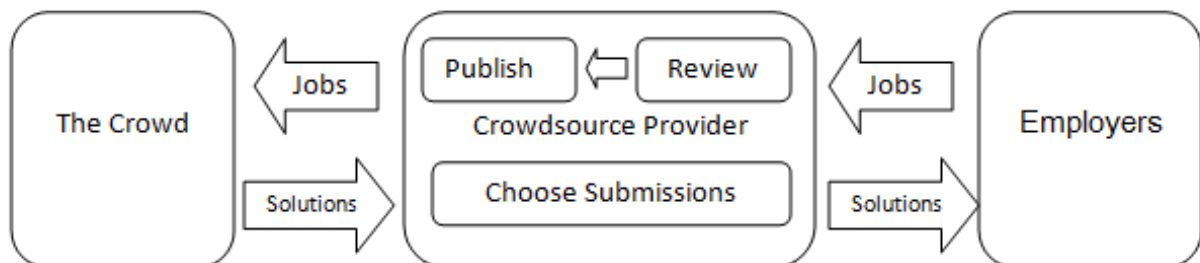

Figure 6.1: Contest strategy.

In first come first served strategies, as can be appreciated in figure 6.2, the crowdsource provider just has to provide a space or channel for the crowd to send their submission to their clients. In case the number of maximum submissions decided by the employer has not been reached and the requirements have been fulfilled, the solution provided by the contributor will be accepted.
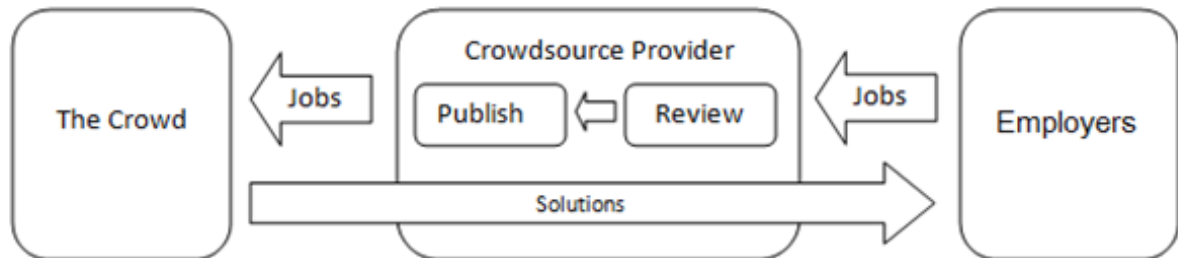

Figure 6.2: First Come First Served strategy.

Copilot

Besides the three roles previously stated, we also found another interesting role called "Copilot". The role of TopCoder's Copilot turns out to be really interesting. It can be considered as a project leader, even though it is not present in all different projects, since its participation has to be explicitly chosen by employers. The participation of a Copilot within a task makes everything easier for the employers, since they do not need to care about that task anymore and will be able to focus on their own business, leaving all responsibilities to the chosen person. This chosen Copilot knows the crowd and is experienced within the business, so his decisions will have a good basis for achieving what the employers are aiming to get. Because of all this, the role of the Copilot might seem like something really helpful for crowdsourcing companies that try to submit high quality solutions to the employers.

Methods

Besides the two different strategies used by companies embracing crowdsourcing, there are 10 diverse methods to ensure a certain level of quality in the product that is produced. The first of these methods is ranking/rating, in which employers give a review of the solution provided by contributors. These reviews will give an overall idea of how good contributors are, so that employers can focus on best ranked ones avoiding the poorly rated, which can also act as a motivational factor. There are two similar methods to this one: report spam and report unfair treatment. The former consists of employers pointing out contributors who are just submitting vague solutions in order to get the reward, whereas the latter let the contributors complain when an employer does not behave in a proper way when it comes to giving the reward or rating in a fair way. Both these methods aim to improve both contributors' and employers' attitude towards the use of crowdsourcing.

One of the most important methods used is task pre-approval. With it, crowdsource providers make sure that every job published to the crowd is doable before the deadline, has clear instructions and a fair reward. The first method mentioned, ranking/rating, can be quite useful when combined with another one named task lock. Companies using this method decide which contributors they want to be working on their task, making them not worry about the time issue so that the solution they develop has a higher quality. Because of the lack of rush they can focus on the quality of the product. An open forum is another helpful method, which allows contributors to share their knowledge, improving everybody's abilities, and thus raise the average skillset and value of the crowd.

Finally, the remaining methods use some sort of filter. The most basic filters are based on the geographic position of the contributor and on the type of job. This allows employer to decide more precisely what kind of contributors they want to make their task available for. The last two methods are based on contributors' skills, and consist on restricting tasks to people with specific abilities. The difference between these two methods is when they are applied: when registering on the website – called skill barriers for registering – and when posting a job – called skill filter.

Motivations for quality

Besides monetary compensation, the social aspects in crowdsourcing appear to be something that would seem to lead to better grounds for quality. The sharing of information continuously heightens the contributors' skills and the prizes and rankings appeal to individuals' self-worth as well as motivates participation and is a way to combat non-serious entries. The belonging to a community helps keep motivation as well as may lead to individuals performing extra well for the benefit of the community. The most successful company we talked to was the one that devoted most resources to creating social interaction although other companies thought keeping the crowd happy was necessary and considered a fair treatment an important part of the business. The crowd is the most important part of crowdsourcing and the main thing for all the companies is to keep the crowd interested and to get them to produce quality submissions.

Summary

In conclusion, the quality is maintained in a variety of ways in crowdsourcing ventures. There are methods that seem to be common no matter if the products are software products or something completely different. Even companies with similar business models apply different methods that in the end ensure a certain level of quality. These methods are applied in several stages of the crowdsourcing process, from the very first step when the task is defined and its doability is checked to the last phase, once the final product is created and its quality is checked against a set of requirements, tested and determined by the initiator or their representative. This thesis has identified 10 methods used to manage quality in

crowdsourcing. The relationships between these and software quality is not entirely apparent but there seems to be a belief among the companies that there is a connection, which there seem to be some support for in the literature review. Taking these methods into account can hopefully be of use when working towards higher software quality when crowdsourcing is chosen as a development approach, which is currently being used as an alternative to more traditional ones.

6.2 Suggestion for further Studies

As this study has looked at the measures employed to ensure quality in crowdsourcing, it could be of interest to conduct a study that measures the product quality itself in regards to these quality assurance methods. Such a continued study could add the dimension of effectiveness to the methods we've outlined. The methods used could be measured against the quality of the submitted solutions. A study like this would require greater access to the crowdsource provider than this paper has had. Results might have the potential to point toward which methods identified in our thesis are helpful or unnecessary, and thus a waste of resources, in order to achieve software quality through the use of crowdsourcing. Our study could also be replicated with a focus on, and contact with, the crowd where their perspective on quality and motivation could add new insights to the findings of this paper. This could verify or falsify our findings on motivational factors for participation and quality submissions.

Appendix

Appendix 1 Question Guide

Questions on Quality in Crowdsourcing

Name:

Position/Occupation:

Company/Organization:

If you wish to remain anonymous when we present our thesis please say so here and we will keep your name out of the final product. Do you wish to remain anonymous?

Answer:

Question 1: *In what way do you use crowd-sourcing and why?*

Answer 1:

Question 2: *Describe your relationship with the people you provide your services to.*

Answer 2:

Question 3: *What kind of companies or people use your services?*

Do you contact companies in order to check if they need your services or does it happen the other way around?

Answer 3:

Question 4: *How specific is the company about the solution requirements? Can they reject the solution you provide? What happens if none of the solutions is considered good enough?*
Answer 4:

Question 5: *What happens if no solution is provided before deadline?*

Answer 5:

Question 6: *What would you define as quality? How do you measure it?*

Answer 6:

Question 7: *Do the contributors get paid and if so what is the basis of payment? There was a study[1] done by Ipeirotis, Provost & Wang (2010) on the quality of the answers in crowdsourcing, where it was said that some contributors don't put much effort into the solution since the payment is low, do you have any comments or thoughts around that?*

Answer 7:

Question 8: *Are you taking steps to insure quality? Do you have a problem with spammers, scammers and similar non-serious contributors?*

Answer 8:

Question 9: *Are you using any models such as the CapabilityMaturity Model (CMM) or ISO-standards to insure quality? Why/why not? If they are used, did a formal or academic background inform your choice to do so?*

Answer 9:

Question 10: *What is it required to be a contributor?*

Answer 10:

Question 11: *Do you provide a unique solution to the company or several ones? What are the decision making aspects in order to select the solution(s)?*

Answer 11:

Question 12: *Do you post jobs for all to see or do you use a certain crowd for certain assignments and if so why?*

Answer 12:

Question 13: *Describe the communication between (your company) and the contributors. Is there any contact between contributors?*

Answer 13:

Thank you for your cooperation!

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[1] Panagiotis G. Ipeirotis, Foster Provost, Jing Wang. (2010) Quality Management on Amazon Mechanical Turk. Proceedings of the ACM SIGKDD Workshop on Human Computation (HCOMP)

Appendix 2 Interview Transcripts

2.1 Informant A : Microworkers

M : Mikael Sevandersson

N: Nhatvi Nguyen

Date of recording : 2012-04-10

M: Let's see. Ok there we go. So we're writing about crowdsourcing and sort of what that means and if there is any sort of quality control being taking place, stuff like that.

N: I see, ok. My work, we work very hard. We work very hard to insure the most quality we can for the employer as well as protecting the workers'… work. Because I think at the end of the day my work is a platform that enables collaboration between employers and the workers. And if there is a… issues where you know, you would run into spam issues then we want to make sure we remove all the spam as quickly as we can and then also we review as much of the jobs that in that we can to make sure it is doable for the worker, because in some cases you can see some in some the jobs that we sometimes have to decline because it's not possible for the workers to complete in a certain amount of time. Right now, the current platform we have is all about who can finish as fast as they can. And so if a job takes so long to finish, then it might put a worker in a tough position, say for example, there are 30 opening positions for the basic campaigns it…. Might not… you know… when we have 1000 of workers competing for it so… if the first 30 people able to submit the task then that is accepted and whereas the rest that finish the task don't get to submit it because the worker wants it that way basically. The one that finishes first will get to be able to submit the task. That is for basic campaigns. For hire group campaigns we have task lock capability that we will assign a certain amount of time for that worker to complete the task so that they don't have to compete on a timer basis like in the base campaigns. We also implemented the time lock in basic campaigns but the workers didn't like that feature, the task lock for the basic campaign, so we ended up removing that features.

M: Is that sort of like you can only do one task at a time or what would that be?

N: Right, you can only do one task so there are… you know, when they say it's a 1000 workers competing for 30 or 100 tasks, they want the person who finishes faster to submit the task, so basically that's the two different scenarios for the basic vs the hire group campaigns and some of the issues that might arise because of the differences in setup in the campaigns themselves.

M: Ok yeah. Interesting. I actually have some questions as well, some pre-written questions. If we can run through them perhaps?

N: Ok sure.

M: Ok, how would you describe your business? In what way?

N: Uhm… Microworkers is really a platform to enable the collaboration between employers and workers. And you know in a way, we, my worker will review the campaign to make sure that the worker can complete the task within the expected amount of time, and we allow the employer to rate the task and at times if we see there are not a fairness in terms of the rating of the task we have to get involved and insure that the task gets rated fairly. There are scenarios with certain tasks where you cannot decide… (MISSING RECORDING)

N: …the CD can take advantage of that, they can maintain 1000 of contacts that they can ask… the participants to work with, I think is a very valuable platform in most situation. So for those scenarios I think it works out well. That's what we're envisioning, trying to work with different entities that have more interest in the geo-

target of the CD's and then bring the worker onboard by the CDs. Yes, because people tend to be able to work closely in a geo-target location moreso than, in many cases, a worldwide location, yes.

M: yeah ok. Right. Let's see… uhm. How specific is the company or the people that hire you about the solution requirements? Can they reject the solutions you provide and what happens if none of the solutions provided are accepted?

N: The employer is allowed to reject the solution the worker provide, however if there are none accepted then we would definitely try to review what is the basis of that rejection and if the basis of the rejection makes sense then we would either require the employer if he or she want to continue their campaign, to update the instructions so that the worker or the user is able to complete the task. Otherwise if we realize the task is not possible to complete then we have to remove it completely. Yes, because there's no point to have you know 0 success rate on microplatforms if everyone got rejected, so we try to maintain 50-60 success rate, so that is also very important.

M: Ok. Is that sort of the same thing with if a solution is not sort of delivered before the deadline, is that sort of the same thing that you check if it's… a solution that can be made or does it get reposted or what happens?

N: Yes, if… we recognize that is an established employer with strong credentials then we ask the employer to repost the instructions just to make sure it's clear enough to the users to participate and we also review the rejection's explanation very carefully as well. There are again scenarios where we cannot review it, then we would have to remove the campaign altogether.

M: Alright, ehm… What would you define as quality and how would you measure it? In the work provided.

N: Uhm, my worker platform right now is in a sense very simple for the employer to rate a worker and to consider its quality so we have basically two levels. One is satisfied with the job submission and the other is not satisfied with the job submission. Obviously there is improvement in that area, we can mark certain tasks as… not satisfied but sometimes we can mark as an added feature spam, so that way it doesn't impact the rating of the campaign because when the spam comes in and the employer have to rate that task as not satisfied then the overall rating of the campaign is impacted, but ideally it shouldn't impact the campaign as it's a spam submission, so one of our goals is to allow the employer to mark certain tasks as spam so that it doesn't impact the overall rating of the campaign.

M: Ok. Is it… can… can sort of the employers be marked as spam as well, that they're not serious?

N: Absolutely. For that we have a way for the worker to report. Yes, I mean that is part of our job as well to review the employer campaigns as well. Yes.

M: Ok, good. Let's see… Do the contributors get paid and if so what is the basis of payment? They do get paid, I know that, on your site but do you set the payments or the employers…?

N: We set the minimum. For certain campaign types we set the minimum because what we found now is that that there is always a sense of trying to lower the rate all the time and… when we do that, the lower the rate… A site can only attract a certain type of users and to be able to attract a worldwide audience we have to have certain minimum base rate so that it entices users from all over the world to participate. So we work very hard to make sure the minimum is met and if the employer decide to pay more then that's up to his discretion. We don't dictate on the higher scale, but on the lower end we do set the minimum. Because I think that's very important, to ensure certain participation from everyone worldwide.

M: It's like you said, it's a way to get the workers to actually be there, you're doing a service to your workers as well.

N: That's right, yes. I noticed a number of other platforms don't do that and… that is very important [unintelligible] for my workers that we maintain that. So… uhm I think that is one of the key successes of Microworkers.

M: I've also read a study that said that when it comes to crowdsourcing, the smaller the payments are, you cannot always be sure that the people that are contributing are serious contributors, they might be more interested in just taking many tasks for low amounts of money in order to get money and then they're not really doing a good job at it.

N: Exactly. You hit it right on the point there. That is very important. At the same time the rate cannot be set too high that you don't get any participation but there also has to be a minimum setting as well. We work very hard to find the minimum setting and maintain that.

M: Let's see here, you've already answered some of the questions already… Right. Are you using any formal models or something in order to quality? Are there any for instance checklists or anything that you take into account when you looked into these ways of ratings systems and the quality checks or is it something you've come up with completely on your own?

N: I'm sorry, can you run by your question again?

M: Yes, the question, as it stands on the paper is, are you using any models or checklists such as the Capability Maturity Model or ISO-standards to insure quality? Why/why not? And if so is there a formal or academic background to inform to use that choice?

N: Uhm…

M: Did you decide the quality strategy on your own or have you used something written as a basis for it?

N: I see. I see. At the beginning I would have to say no but we are building some very advanced features and we're working on those features as we speak right now and those should have a lot of test capabilities to insure the quality of the job submits and I think that is a very important feature that we hope to launch very shortly. And that's… hopefully by that time you know when you see that platform you can come back and take a look at it, but clearly we depend on the employers to provide the feedback on how the workers perform. But in the future campaigns that we are rolling out that is a key feature to insure quality and we will empower the…It's because with anything, if there's no quality control then you don't get the best results. And the worst part is that if the results are not trusted, it's not usable, period. So, in a part of the release that we are working on for the next 6 months that is the main feature that we are working on right now.

M: Ok. May I ask, what is your background? Do you have any former academic or business background on crowdsourcing or quality?

N: No. I would say crowdsourcing is a new space for the last 3-4 years, so to say anybody has a lot of background in crowdsourcing is not an honest answer. For me, I didn't come from that segment, studied at Texas A&M University with my master degree from electrical engineer back in 1996. And I worked in a telecom business and I also worked in an electric [unintelligible] business for the last 8 years. And then, I was able to partner up with the founder for mircroworkers. And he basically designed the platform from ground up and he still pretty much participated in the current feature development of the platform, and I, you know, based on my previous experience, I was able to guide the feature set development and evolve the platform for the last 2 years to what it is today. But saying in a crowdsourcing space, definitely I don't have that much experience, but I'm hoping I'm learning as we come along. And also defining the segment by self, because I think Microworkers are different from other crowdsourcing platforms [unintelligible] freelancers where they are more one on one type of platform. And there are other sort of like contest design platform such as 99designs. I don't know if you are familiar with those kind of platforms, where you have many designers submitting their tasks, but then only one is selected. With Microworkers, basically you have multiple position opening for every campaign. So, in that space that is a little bit different from what a contest design would be or for a one on one type of campaigns or

freelancers. So, it's a very exciting space, and I hope, you know there is going to be a lot of growth in this segment as well. I think definitely tremendous work in the crowdsourcing segment that we are focusing in and I'm very excited about that as well, so... Yes

M: It's actually sort of interesting to see also from the academic part that the term crowdsourcing it's been around for, I think, since 2006 but not much has been written about it, but it's getting more and more attention. If the area is growing, that's interesting.

N: That's right, yes. And there is also a lot of unknown in the segment as well. Because now you are involving you know, workers from worldwide there could be regulation that come in to this segment that would be evolving as well.

M: Next question is: what is required to be a contributor?

N: Contributors, right now, as long as you can sign up to Microworkers site and understand English language, and able to work at microjobs, then basically you can pretty much become a contributor at this time. And a little bit difficult in some cases [MISSING RECORDING]

N: Receive a post office mail so that we can send the pin to verify at least the entrance verification and then you know, you can receive payment for it. Ok, I think that's the only requirement, and we require users to be at least 18 years old and above.

M: Is there some sort of division between workers later on? Besides the geographical ones, something like ratings. Do they have any other attributes? Are they grouped according to skills or anything that sorts?

N: Oh yes. That's part of the future sets where we will have created different tasks for workers and if a worker is able to pass and test and we are able to create different groups and assign those workers so that the employers can assign jobs specifically for those workers with specifically those skills. And that's part of the goal to create that type of campaign.

M: Like you stated before, you provide several solutions and not just one, it's not a contest. What are the decision-making aspects in order to select or reject spammers or others that don't get accepted?

N: For the spammers, that's the decision of the employers as well as when our administrator review those submitted jobs and they can determine that is spam proof. The job that is not successfully submitted sometimes it's a two part question, and the user only able to you answer only one part right, and for some reason he or she miss the second part completely, then that wouldn't be considered spam. If we recognize that the user is trying to make an answer but wasn't able to do it, then we wouldn't consider that spam. But at the same time, we would consider a user if trying to ask for question a, but then the submission is about go to the lane so on and so on you can recognize that as spam.

M: Is the administrator one person or is it several people? Are they in charge of the whole website or do they just rank jobs? What do the admins do?

N: Oh, the admin is very busy. First of all the admin has to review the campaign instruction, having very clear and precise campaign instruction is very important for workers to complete as quickly as they can. So if the instructions come in not very clear and not very precise, then we have to work with the employers to make sure we can recommend the correct verbiage for the campaign so that when the user works on a campaign he or she can understand it very fast. So reviewing all the campaign instructions would take lots of time, and then when a campaign goes life and active we also have to monitor how the workers are working those campaigns, because sometimes the campaign is not workable because the campaign line might be down or so and so for. We have to review that. And then the final stage is to review how the employers are rating the workers to ensure fair rating because as you said, there are also scenario where the employer. We have to make sure we protect both the employers as well as the workers.

M: Do you post jobs for all to see or do you use a certain crowd for certain assignments and if so, why? I suppose we have the geo-thing that you mentioned earlier and the thing that you said about the skills, has that been set up yet or is that to come in the future?

N: Some part of it is already set up, and some part is going to be added on in the future. The geo-part, many of that part is already set up, and also the group part, many of that is also set up, so you can find top USA workers, top UK workers, so on and so forth. The part that needs to be set up in the future is to create tests so that a worker can take those test and be assigned to a group that they can work on and be assigned the task. The (21:43, 1'08'')geo-target ** are not set up yet. I think that's also a future feature. So there are parts that are already done and there are features that need to be done in the future.

M: Describe the communication between your company and the contributors. Is there any contact between the contributors themselves?

N: Communications between us… We have a, you know, support tickets, so If there are issues, so workers or employers can open tickets, and we will review that and work on a case by case basis. And we, in many cases, you have a lot of queries, and we have created FAQ where workers and employers can look at, and hopefully read the FAQ and understand how to proceed. As far as communication among contributors, right now, we don't have a platform to allow that, at this point. Hopefully we can design a feature that would allow communication between contributors in the future.

M: Do you have any reason why you would want that?

N: Communication is a very important to mitigate misunderstandings, you know, between the campaign owners and contributors. But at the same time, we work on a world with lots of spams… So if we implement such a feature then we have to find a way to mitigate the spams issues that we are dealing with. So, we have to find a solution that will work way out basically. Yes, that's the biggest hurdle. It's what you are looking at.

M: I'm actually done with my questions. I would like to ask you, what is your position in the company?

N: I would say you can think of me as the chief workers of Microworkers. So I guess I try to work hard every day, trying to promote the platform in any way I can. So we have close to 300,000 Microworkers on our platform right now. So it's a growing platform and, you know, that's what I consider myself a chiefworkers.

M: Also, in the final product of our thesis we can either mention both your company name and you, or we can anonymize these, I was just wondering what you would prefer there.

N: I'm ok… it's definitely, you know, I'm ok with that.

M: And your name as well perhaps.

N: My name is Nhatvi Nguyen

M: Thanks. Thank you for that. That actually concludes all I wanted to ask you. I wanted to thank you a lot for your participation.

M: Thank you very much. Have a nice week! Bye!

N: Same to you. Thank you. Bye bye!

2.2 Informant B : Clickchores

M: Mikael Sevandersson

A: Ari

Date of recording: 2012-04-22

M: Right, first question. In what way do you use crowdsourcing and why?

A: So I'll answer this from the perspective of Clickchores and again with the caveat that clickchores is only about five months old by this point. But basically Clickchores focuses on getting people from all around the world to do some very simple tasks which could be conducting a search on google, clicking an add, you know liking a page on facebook. So that's kind of the goal of Clickchores, so really we have two kinds of sets of people on Clickchores and they don't overlap very much but obviously there's the employers and the workers. And a lot of our workers are focused in kind of developing nations that you know 25 cents ends up being a lot of money to them and it's been a lot harder to get workers from first world nations like Sweden, like the UK, like the US, etc. So that's just kind of a quick background on Clickchores.

M: Ok. Second question. How would you describe your relationship with the people you provide your services to?

A: So it's… it's a very virtual relationship. As we've seen with our competitors, that are just huge by this point, it's hard to provide good customer service in something like this, because there's just so many requests, even with just the few thousand members we have currently, we get a lot of support requests, we get a lot of questions, we get a lot people flagging jobs and you know particularly since this isn't our full-time endeavor, it's just something we do on the side in addition to other side-projects and a full-time job, it's really hard to keep up with things, but we try to do the best we can to answer a workers questions and complaints and to also help employers understand Clickchores, understand how to post a job, and if they have a issue or are not satisfied we do our best to refund their money and that kind of thing. Is that kind of what you're getting at from that question or…?

M: Yes. But also like… how do you communicate with them? Is it like you say support tickets, is there email contact at times or..?

A: Yes, there's basically two ways of contacting us. One is just [unintelligible] Clickchores.com and if you have a Clickchores account you can also open a support ticket.

M: Alright. Next question is what kind of people or companies use your services? Do you contact them or do they contact you?

A: It's hard to tell about kind of the demographics of our users, because on sign up we ask very limited questions but from what we can tell and from the limited amount of research we've done into who's using our services… on the worker side, I think, it's mainly people who may have a full-time job in these developing nations but are just looking on the weekend for a bit of extra money. And on the employer it kind of runs the gamut, I think that most of them are just private individuals who are in internet marketing, either as their full-time job or as kind of a side job. We've had… our most popular task is to like something on facebook or to stumble upon something on Stumbleupon. So they are very very simple tasks. Maybe boost your organic search ranking or make your site look a little bit more popular on some of these social media channels.

M: Ok, yeah. How specific is the people or company about the solution requirements and can they reject the solutions? What happens if none of the solutions are good enough?

A: So basically the way Clickchores kind of works is an employer posts a job and then that job goes into the approval process so we then look at the job, make sure it's not trying to scam anybody, that it meets our terms and conditions, and that it also is formatted in a way that would be easy for the worker group to understand and also kind of be written in a way so that somebody who does not have English as their first language would be able to at least easily understand what the job is asking for. So once that job is approved it gets opened up to the community and can be seen by anybody with a Clickchores account. Then you can filter by jobs available in your area, so someone can post a job and only ask for people in Sweden to do it and if you don't live in Sweden you're not gonna be able to do the job. And basically after a job is submitted, let's just say the job is to like my page on facebook, you have to submit a piece of proof so the employer can tell that the job is actually done. So if the job is to like my page on facebook, you say "tell me your facebook user name" and then the employer has to go through and say "Ok this job was done to my satisfaction" and once they've clicked approve on that job, the worker is actually paid and the money is withdrawn from the employer's account and put into the worker's account.

M: You say that you can filter by countries and such… do they still show up for people or can they not view the things that are for other countries?

A: They do still show up. I think the default actually is that they don't show up but there is kind of a toggle so that workers can get an idea of the kinds of jobs that are being posted but there's a toggle available to workers that say "Only view jobs that are available in my area".

M: Ok. What happens if none of the solutions are good enough? That the workers provide.

A: So… an employer can reject a worker submission, which basically just means that the worker doesn't get paid. And on the worker side, if they feel like they did a good job and did exactly what the employer wanted they can file a complaint against that employer and if the complaints against the employer becomes more than just one unhappy worker then we usually look into it and make sure that the employer is being fair in their ratings to people.

M: Ok. Is this sort of… Say that perhaps one solutions… It didn't get any responses so people didn't do that one, do the task get submitted again or..? Is there a deadline? What happens? Is there some sort of automatic thing or..?

A: If the employer doesn't take a look into a certain submission for 72 hours after that worker submitted and marked that job complete, then that worker is automatically paid. So it's important for the employer to log in, check on their job, make sure that the workers are doing their jobs correctly and approve jobs or reject jobs or else the system will automatically pay that worker.

M: Ok. We would also ask you what would you define as quality in the works submitted and how would you measure it?

A: I guess that kind of depends on the job and since many of the jobs are. It was either quality submission or it wasn't. But there are categories that are more complex such as write an article on X topic and post it to your blog, and then obviously quality becomes a big concern. What we are trying to do with Clickchore, right now we have a worker base that really is focused on the very simple tasks. But ideally, our long term vision is to develop a more skilled worker based that is able to handle jobs like write in strong English, 200 words about tablet computers and post it to your blog with a link to my website. I think that both from a profitability standpoint and from a user based value, that's really where we want to go, because those are the more high value tasks and high value workers.

M: What is the basis of payment for the workers?

A: On the deposit side, you can make a deposit through Paypal or another service called Alertpay. And after somebody makes a deposit, basically, the deposit leaves our account and then they are credited in Clickchore dollars on their account on ClickChore. So if you deposit 50 dollars, those 50 dollars immediately become

available for you to spend within the Clickchore community. And then, whenever you want, as long as it is over 3 dollars, you can submit a request to withdraw that money, and you will get paid out by Paypal.

M: There was a study that said that the pricing in crowdsourcing affects the quality. If there are, for instance, a lot of tasks that pay little money, then you may get people that are not that interested in doing the best sort of job and are not interested in doing the best they can do at this small job. They might try to finish each job as quickly as possible, to get as many as possible and get more money. Do you think that this is true? Does this affect your company in some way?

A: Yeah, I would definitely, even with the limited sample size that we've seen so far, agree with that, and I think that there is also a lot more price sensitivity depending on where the job is posted. It obviously takes a lot of more money for somebody in the US to spend their 30 seconds doing a job than it takes for somebody in Malaysia to spend 30 seconds doing a job. So I think prices are very important, and employers can set their own price, based on certain limited amounts and their task category. For a Facebook Like, the minimum is 25 cents, but if it is adding a link to your blog, for example, I think the minimum is 75 cents that the employer has to pay for each job. So we try to cover those minimums to at least keep some sort of quality, but definitely we recommend that employers try to keep people in first world countries where the jobs actually pay more than they would, but it's open up internationally.

M: Are you taking any steps to ensure quality of the jobs that are done?

A: It's very hard to insure quality of work being done as it's being done. The only measure to ensure quality is leaving in the employer's hands: if that employer is happy with the quality of submission and they pay the worker and if not then they mark the job as not completed, not satisfied and the worker is not going to get paid for the job. A secondary measure... We've had workers do this before, they'll just go through and mark every job that's available to the community as completed without actually completing the job at all, hoping that the employer is not going to take the time to actually verify their submission or that the employer waits that 72 hours. It's kind of a safety mechanism, if a worker submits four different jobs and their job is marked four times as not satisfied, those workers are banned from the Clickchores community, and are not able to submit more jobs, because they are obviously not submitting quality work, they are just trying to get paid.

M: When jobs are posted, do you look into them to see if it complies with your current terms of services and that there are clear instructions?

A: We read through every job posted before we approve it. So that job is not going to get live until we have read it, edited and then put it live.

M: Are you using any sort of academic quality models or checklists?

A: Can you give me an example?

M: We thought about CMM or ISO 9000 standards, but those are not always applicable to each company. Is there anything you are going through, a checklist, or things that you should do. Or is there something you came up with on your own?

A: We are definitely not using any ISO 9000 standards or anything like that. It's really more based on our own personal thoughts about different jobs, and there are obviously limited terms and conditions, but if we see that a job being posted is trying to download something that potentially harms somebody's computer or trying to crowdsource something to damage a brand or putting down a website or that kind of thing, we'll deny the job, and depending on what it is, if it something that's out to harms others we'll probably ban the user account as well. But we haven't really had any issues yet with that. I think we very rarely limit jobs that are posted, we often edit them, but we've only got in a couple of job submissions that are really just outside Clickchore's terms and conditions, and usually those jobs are downloaded and installed which could potentially be a virus, so we really try we get these jobs, unless it is a really trusted employer.

M: Ah… Let's see here, what is required to be contributor in your site?

A: All you got to do is sign up and verify your email address and then you can either start doing jobs immediately or you can pass money and then post job to community so there really nothing further out people to sign up.

M: OK, you provide a unique solution to company or several one? What are the decisions making aspects to select solution? Is there such a…. selection or …. I think I saw on your site that you give more than one person could do a job. Is it just that they do the job and they show the proof that they've done it or is there some sort of selection of what?

A: The way it work is, when employers post a job, they kind of fill out the title of the job, description of the job, a step by step of how to complete it, they say what they want as a proof that the job was successfully completed so for StumbleUpon it's your StumbleUpon username that was used to stumble upon that page. You can also select the countries that the job is available in, or I can click "international" which means anybody can complete the job. Then I also put in a price that I would like to pay per position, so let's say I'm willing to pay 25 cents to each person that stumbles upon my page and I want 30 people to complete it. So the number of positions is pretty critical and if you want 30 facebook likes or if you want people stumble upon your page, you put 30 peoples each and those peoples get 25 cent when they successfully complete that job and you can also set a kind of schedule on which that job would be submitted. Clickchores is still new and growing, scheduling is not as important as it might otherwise be because of the [unintelligible] amount of time between each completion of the job. But if you want something to look natural, it can happen over a week of time. You can specify that only one worker can complete the job or two workers every five hours can complete the job. That's kind of the fields that you have to fill out, before you even post the job. After you get through you can change that schedule pause the job completely if you're not satisfied with the results. Some of our competitors actually charge you up front, as soon as the job is submitted or as soon as the job as soon as the job as the job is submitted and my job is going to be costing 30 dollars, I'd tab all the people who completed and withdraw [Unintelligible]. We don't really agree with that approach. There no guarantee that a certain job will get done, so we don't think it's fair to transfer a job that they may not be satisfied with the results with so that why we only charge as it is completed.

M: Ok, It seem like our connection is getting a bit weird but we almost done here. Umm… right, is it... the job they posted, the task are free for everyone to see, if I understood correctly. There is no division, everyone can see every job.

A: Right. They can see every job if they want or they limit what they see, job available for their country. [Unintelligible]

M: we sort of touched a bit on it earlier but …ummm.. actually you cover one of the aspects earlier um.. but do the contributors have any contact with each other? Cause we know that email ticket and email support ticket how you apparently have contact with them that way but do they have any contact with each other or something?

A: Not directly through Clickchores, we don't open up communication channel between users of the site from be able to submit prove and that prove and submission is gonna be deny and employer have to say why it was denied. Thus, if I'm an employer and I have a job to like a page on facebook and I'm not satisfied with that task, I have to say why I'm not satisfied before I reject their submission that I don't want to pay for.

M: Umm.

A: And then it kind of you know obviously there's a lot here on social aspects we have a facebook page where we found that workers will go on facebook page and use that page to communicate with each other and if they not happy about something, they'll voice their on facebook as well. So kind of our bigger competitor will see that people go on facebook and start talking about why there's not so many jobs today or more using it as a platform for complaining and trying to seek change in the community.

M: Thank you very much.

Appendix 3 Answered Questionnaires

3.1 Informant C: Microtask

Questions on Quality in Crowdsourcing

Name: Ville Miettinen

Position/Occupation: Founder & CEO

Company/Organization: Microtask

If you wish to remain anonymous when we present our thesis please say so here and we will keep your name out of the final product. Do you wish to remain anonymous?

Answer: No

Question 1: *In what way do you use crowd-sourcing and why?*

Answer 1: We use crowdsourcing (distributed workforces) for obtaining the back-end labor in our service (microtask.com)

Question 2: *Describe your relationship with the people you provide your services to.*

Answer 2: We are a B2B company, offering high-quality text recognition & data entry services.

Question 3: *What kind of companies or people use your services? Do you contact companies in order to check if they need your services or does it happen the other way around?*

Answer 3: We primarily deal with document management houses, mail-room automation companies, insurance companies, banks, as well as institutions in the public sector (archives, military) that have large-scale data entry and document processing needs. We have a direct salesforce of 5 people in the US doing outbound sales work.

Question 4: *How specific is the company about the solution requirements? Can they reject the solution you provide? What happens if none of the solutions is considered good enough?*

Answer 4: Text recognition is fairly standardized, the main things to consider (for a solution) is the cost (per # of characters processed), quality (recognition accuracy %), languages supported.

Question 5: *What happens if no solution is provided before deadline?*

Answer 5: We have a standardized solution; if the customer case cannot be mapped onto it, we will just reject that customer.

Question 6: *What would you define as quality? How do you measure it?*

Answer 6: For us quality is largely the output accuracy of the data entry process (measured in % of correct characters/words/fields). We can measure this with statistical sampling (taking N% of the data set and verify it independently, then cross-compare the results).

Question 7: *Do the contributors get paid and if so what is the basis of payment? There was a study[2] done by Ipeirotis, Provost & Wang (2010) on the quality of the answers in crowdsourcing, where it was said that some contributors don't put much effort into the solution since the payment is low, do you have any comments or thoughts around that?*

Answer 7: We have experiences about both paid and unpaid (volunteer) workers. The bulk of our customer cases are done using a paid workforce, mainly in Pakistan, India, China & Philippines. With the National Library of Finland we've also used a volunteer workforce (of more than 100,000 people).

Question 8: *Are you taking steps to insure quality? Do you have a problem with spammers, scammers and similar non-serious contributors?*

Answer 8: We deal with this in a couple of separate ways: a) We buy our work from "workforce providers" (BPOs & distributed workforces) - so there is a contract (and NDAs) between us and them b) the system automatically measures the quality of each contributor (so we can reject the work of sub-standard contributors) and c) We can increase the accuracy of the solution by using more task replication (=send same microtask to multiple workers).

Question 9: *Are you using any models such as the CapabilityMaturity Model (CMM) or ISO-standards to insure quality? Why/why not? If they are used, did a formal or academic background inform your choice to do so?*

Answer 9: No. The quality assurance is based on statistical measurement, task replication and tracking of the history of individual contributors.

Question 10: *What is it required to be a contributor?*

Answer 10: For most of our cases, they have to be employed by one of our workforce providers (they do their own screening). For the National Library case, there were no requirements whatsoever.

Question 11: *Do you provide a unique solution to the company or several ones? What are the decision making aspects in order to select the solution(s)?*

Answer 11: Our approach is unique but similar services have been provided by the Business Process Outsourcing industry for ages.

Question 12: *Do you post jobs for all to see or do you use a certain crowd for certain assignments and if so why?*

Answer 12: Jobs aren't "posted" per se but assigned directly to the workers. The system figures out on its own which worker should receive which assignment.

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[2] Panagiotis G. Ipeirotis, Foster Provost, Jing Wang. (2010) Quality Management on Amazon Mechanical Turk. Proceedings of the ACM SIGKDD Workshop on Human Computation (HCOMP)

Question 13*: Describe the communication between (your company) and the contributors.*
Is there any contact between contributors?

Answer 13: No. The contributors are not aware of each other (this is an important part of the solution).

Thank you for your cooperation!

3.2 Informant D: TopCoder

Questions on Quality in Crowdsourcing

Name: Jim McKeown

Position/Occupation: Director of Marketing Communications

Company/Organization: TopCoder, Inc.

If you wish to remain anonymous when we present our thesis please say so here and we will keep your name out of the final product. Do you wish to remain anonymous?

Answer: No, please feel free to share as necessary.

Question 1: *In what way do you use crowd-sourcing and why?*

Answer 1: The TopCoder company acts as an administrator for a global Community of over 400,000 software developers and digital asset creatives. We exist to serve the Community and to make it successful, whether in business/commerce, intellectual curiosity or just plain fun. We've built (through the Community) a platform that allows access to work, play and social activity for people around the world who are interested in software, critical thinking and competition.

The idea was born out of problems identified in traditional software business. The timing of the growth of the online world (and maturity of real output capability via virtual workforces) was critical as well.

Question 2: *Describe your relationship with the people you provide your services to.*

Answer 2: The Community is comprised of individuals we call members. Members are our employees and bosses at the same time. As previously noted, they are the reason TopCoder exists. Members develop ideas, they build the platform and they perform the revenue generating work which is done for clients.

Question 3: *What kind of companies or people use your services? Do you contact companies in order to check if they need your services or does it happen the other way around?*

Answer 3: TopCoder past and present clients include technology companies such as Facebook, Google, Yahoo, Microsoft, PayPal, AOL etc. clients in the financial services sector including UBS, Ameriprise, ING and other fields like bioengineering, pharmaceutical, medical and agribusiness. US Government partners include NASA, NSA and DARPA.

Question 4: *How specific is the company about the solution requirements? Can they reject the solution you provide? What happens if none of the solutions is considered good enough?*

Answer 4: The TopCoder process is extremely rigorous yet transparent. Clear requirements are set including timelines and prize amounts for every competition. Through a combination of peer review and automation, solutions are strictly assessed. Reviewers use a detaled scorecard which is used not only to create a score for the solution, bit to also provide feedback to the member who has competed. This is a very important value within the process as it allows competitors to learn and get better.

In rare cases where an entire set of submissions is deemed to be sub standard to the requirements, the competition can be relaunched with modified requirements, timelines or prize amounts.

Question 5: *What happens if no solution is provided before deadline?*

Answer 5: Although TopCoder has deeply studied the process of attracting the optimal number of submissions (our partners at Harvard Business School have produced papers on this – see work of Prof Karim Lakhani) for every kind of our 30 or so different forms of competition, again, in the extremely rare case of no submissions being made, the competition can be relaunched with modified requirements, timelines or prize amounts.

Question 6: *What would you define as quality? How do you measure it?*

Answer 6: Quality is looked at in many ways, but 2 that we focus on are:

1.   Quality from the customer perspective.

> This is arguably the most important. The quality of the experience that the customer has supersedes any quantitative analysis of the # of bugs or defects per lines of code. Customer experience and the value they get out of your product is key.

2.   Quality from a pure software perspective.

> This is your traditional software quality assurance process. This is important and should always be done. The level of rigor can be adjusted based on the need, or lack thereof, of the particular application. Doing a good job at this will help you succeed at #1, but cannot stand on its own without #1 when you're having a conversation about quality.

Question 7: *Do the contributors get paid and if so what is the basis of payment? There was a study[3] done by Ipeirotis, Provost & Wang (2010) on the quality of the answers in crowdsourcing, where it was said that some contributors don't put much effort into the solution since the payment is low, do you have any comments or thoughts around that?*

Answer 7: Yes, the contributors get paid. A pre set prize amount for the winner (best submission) and second place is the standard (although other prize configurations are often used). The prize structure is competitive with other commercial outsourcing models. The TopCoder formula for arriving at a prize amount has been extensively researched through the use of algorithms, analytics, market based results and ten years of experience.

Members compete on a competition for a variety of reasons, money being one of them. They must have confidence that they are being paid in a fair competition at a fair rate otherwise they will not compete. They are also self-selected, no one is coercing them into participation.

Question 8: *Are you taking steps to insure quality? Do you have a problem with spammers, scammers and similar non-serious contributors?*

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[3] Panagiotis G. Ipeirotis, Foster Provost, Jing Wang. (2010) Quality Management on Amazon Mechanical Turk. Proceedings of the ACM SIGKDD Workshop on Human Computation (HCOMP)

Answer 8: For the most part the Community is self policing – inappropriate forum conduct or activity results most often in peer censorship. In cases where TopCoder must intervene, the discipline is often in the form of a ban from participation. Trivial and non-constructive competition submissions do not pass the early systems test.

Question 9: *Are you using any models such as the CapabilityMaturity Model (CMM) or ISO-standards to insure quality? Why/why not? If they are used, did a formal or academic background inform your choice to do so?*

Answer 9: We have not been formally certified in either, but one could easily argue that we are CCMI level 5. The nature of our software process actually forces the diligence and rigor required to achieve level 5 – it's not an option like it typically is in most models.

Question 10: *What is it required to be a contributor?*

Answer 10: Signing up to compete (no cost) adherence to competition rules and Community good conduct. Desire to bring your very best effort to the competition arena.

Question 11: *Do you provide a unique solution to the company or several ones? What are the decision making aspects in order to select the solution(s)?*

Answer 11: Solutions can take the form of pretty much any kind of digital 'asset' or artifact imaginable– a piece of software for a mobile app or enterprise system (application, algorithm) a graphic design or even a creative concept. In a typical competition a winner and second place prize is awarded –this redundancy is rarely used but desirable. Depending on other competition types a client might select many submissions with appropriate, pre set prize awards.

Question 12: *Do you post jobs for all to see or do you use a certain crowd for certain assignments and if so why?*

Answer 12: All competitions (the term we use for 'work' or 'jobs') is posted in an open and transparent call to participation, which is freely accessible to all Community members across disciplines.

Openess at each stage of the process is a key component to Community participation.

Question 13: *Describe the communication between (your company) and the contributors. Is there any contact between contributors?*

Answer 13: Contact is constant and transparent, and achieved/facilitated through clear and open communications of process such as competition rules and regulations, monitored forums, general community forums, etc.

Thank you for your cooperation!

Follow-up Questions TopCoder

Question 1: *Are customers always external to TopCoder or do members of the community also post jobs and contests? Is it done in the same way?*

Answer: Anyone can run competitions as long as they adhere to the general guidelines and service agreements which are clearly stated on the website and meet legal requirements.

Question 2: *Are competitors and members scored or reviewed in some way and if so, how?*

Answer: Both. Depending on the competition format, submissions can be scored against one another and for accuracy by being run through an automated systems testing environment. There is also a transparent online peer review process which allows highly rated members of the community to check submissions against a rigorous scorecard　　　　　　　　　　　　　　　　(example　　　　　　　　　　　　　　　　here: https://software.topcoder.com/review/actions/ViewScorecard.do?method=viewScorecard&scid=30000661 　　) which also allows for a an appeals phase. * (If links in my answers do not work you will need to register on TopCoder to get access – it's free!)

Question 3: *Are there any restrictions for how many competitions a member can compete in at a time?*

Answer: No

Question 4a: *Could you describe the role of copilots?*

Answer: A Copilot is a TopCoder Member who manages the TopCoder process for a customer in order to deliver a requested asset. For example, a customer may ask to build a website. A Copilot will work with that customer to agree on a plan and pricing to build that website and then they would manage the process using the TopCoder Platform to deliver the website back to the customer. It is important to note that the Copilot is responsible for running contests, but more importantly they are responsible for delivering the "product" to the customer. Many customers will not want to know the details of what contests the Copilot is running. In fact, the concept of a contest will not be important to them. They just want their product completed. So, it is the Copilot's responsibility to work with the customer at an appropriate level of detail.

Question 4b: *Are copilots always used?*

Answer: No, sometimes a client will use their own TopCoder-trained internal resources.

Question 4c: *How does someone become a copilot?*

Answer: Sign up, compete. Repeat ;)

Question 5: *What happens if members call a rejection or review unfair?*

Answer: The submitter is allowed to enter into an appeals phase with the review board in which specifics in the scorecard (which is publicly available) can be further explained (again publicly available).

Question 6: *How does a tournament work?*

Answer: Our tournaments such as the TopCoder Open are annual events which start with several online elimination rounds which culminate at an onsite location (San Fran, Las Vegas, Orlando Fl etc.) several months later. Thousands of competitors are pared down to approximately 80 finalists across 6 or more tracks. While substantial prize money is at stake (up to $500K in past competitions, currently $150K) the purpose is primarily for fun and the thrill of competition and recognition on a world stage.

Question 7: *TopCoder uses achievements such as badges based on activity and results in tournaments. These badges are shown on a members profile sites, thereby signifying a status for themselves or other community members. Do you believe this has an effect on members' performance?*

Answer: The member profile page which chronicles achievements, skills and success is absolutley one of the most important motivators for TopCoder members. (Example here: http://community.topcoder.com/tc?module=MemberProfile&cr=287614) The rating and accompanying color classification of a member 'handle' (in this case 'argolite') is an indication of that member's status in the Community - similar to a martial arts system of belts – and has more than a little resemblance in terms of the respect from other members.

Thank you for your cooperation, Jim!

Appendix 4 Definition of the terms used

In order to avoid possible misunderstanding due to blurry definitions or distinctions between different terms used, this part presents a list of definitions of the terms that are used throughout the paper. These terms may vary for the four companies that took part in the study, and the ones defined and presented within this section are the ones used during the paper.

- *Contributor*: one of the persons who voluntarily decides to take part in the crowdsourcing process by means of providing different solutions to employers' needs.
- *Employer*: company that takes part in the crowdsourcing process requiring contributors to do some specific job.
- *Job*: task specified by an employer and to be solved by a contributor. It usually has a deadline and the contributor who provides the solution for it gets some economic rewards.
- *Middle-man*: person who makes the communication of employers and contributors possible. It is made through a web page, in which employers can post jobs, and contributors have to submit their solutions.
- *Submission*: when a contributor presents a solution to one of an employer's job.
- *Submission acceptance*: occurs when the employer considers a contributor's submission good enough to be accepted, because it fulfills all the requirements needed.
- *Submission rejection*: occurs when the employers considers a contributor's submission not good enough
- *Spam*: when contributors are just trying to make money, submitting bad solutions repeatedly.

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