

CREATING & CAPTURING VALUE THROUGH CROWDSOURCING

edited by Christopher L. Tucci,
Allan Afuah, & Gianluigi Viscusi

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CHRISTOPHER L. TUCCI, ALLAN AFUAH,
AND GIANLUIGI VISCUSI

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Foreword to Creating and capturing value through crowdsourcing

*Henry Chesbrough*¹

Innovation has come a long way in a short period of time. Just thirty years ago, thinkers like Michael Porter of Harvard were telling innovators to invest heavily in internal R&D to use as a barrier against their competitors. The idea was that this investment would differentiate the company in the market, and that only those companies who made similar levels of investment could keep up. This R&D activity was organized inside the company, and its results shared with no one until the products that resulted from innovation went to market.

The leading companies of the day were distinguished in part by the level of their internal R&D spending. Computer makers like IBM poured their dollars into new computer hardware and software. AT&T built out its Bell Laboratories research system, perhaps the most accomplished industrial lab of its day. Auto makers such as Ford, GM, and Chrysler spent billions each year in rolling out new cars and trucks. Pharmaceutical giants such as Merck created powerful research arms that reached back into the basic sciences of biology and chemistry, and filled their product pipelines with compounds they discovered and developed inside their own four walls.

Today things are very different in most industries, not only in the US but around the world. The model of industrial innovation has moved on from this inwardly focused, vertically integrated approach that I call a Closed Innovation system. Open Innovation today prevails, as organizations make extensive use (and re-use) of external ideas and technologies in their own innovation activities, while unused or under-used ideas and technologies internally are allowed to go to the outside for others to utilize. The result is a much deeper division of innovation labor, where specialist firms contribute discoveries and innovations that connect together to form a web of innovation. Startups and small to medium-sized enterprises and even individuals

¹ Chesbrough is “the father of Open Innovation”, according to Wikipedia. He is the author of the award-winning book, *Open Innovation* (Harvard Business School Press, 2003), *Open Business Models* (Harvard Business School Press, 2006), *Open Services Innovation* (Jossey-Bass, 2011), and the newest book, *New Frontiers in Open Innovation* (Oxford University Press, 2014, with Wim Vanhaverbeke and Joel West). He is the founder and executive director of the Center for Open Innovation at the Haas School of Business at UC Berkeley in California.

play a far more significant role, while the large firms seek to attract and collaborate with these small, agile, skilled participants.

Data from the National Science Foundation on R&D spending in the US over the past thirty years bears out the extent of this shift (see Figure 1).

This chart shows that large firms with more than 25,000 employees were responsible for 70% of the industrial R&D spending done in the US in 1981. But their share of R&D spending shrank by half to 35% in 2007. In contrast, small firms with less than 1,000 employees increased their share of R&D spending from 4% to 24% during that period. Note that large firms are still important in industrial R&D because their share is still very big (35%). The amount of R&D spending in large firms increased from \$21.2 billion in 1981 to \$94.8 billion in 2011, a factor of 4.

However, the increase in R&D expenditures of small firms is even more impressive. Firms with less than 1,000 employees spent \$64.7 billion on R&D in 2011 compared to \$1.3 billion in 1981—50 times as much spending! Another way to look at this is smaller firm R&D spending overall has grown 10 times as fast as large company spending over these 26 years. Clearly, the world of innovation has changed.

You can see this new, deeper division of innovation labor in practice, as well as in the statistics. IBM now makes more money from its services business (where it supports the hardware and software of many other companies,

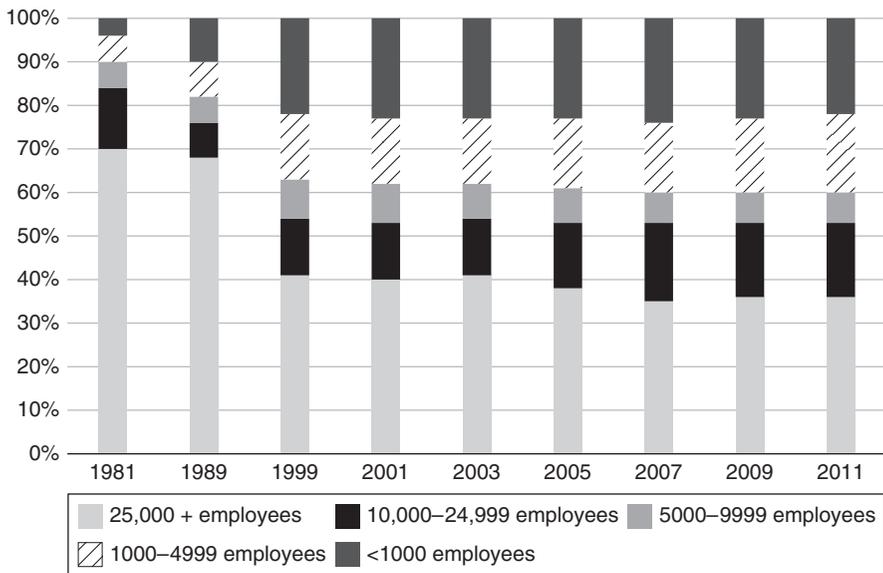


Figure 1. Percentage of R&D performed by companies of different sizes, 1981–2011

Sources: National Science Foundation, Science Resource Studies, Survey of Industrial Research Development 1999, 2001, 2003, 2006, 2008, 2011.

including its competitors) than it does from its traditional product businesses. Cell phone manufacturers strive to attract applications developers to their platforms to boost the range and quality of services that customers can install on their phones. The pharmaceutical industry now licenses in most of its compounds in its product pipeline from external sources such as universities and young biotech firms, rather than carrying projects from the laboratory bench all the way through to market. Auto makers now rely primarily upon their suppliers and their suppliers' suppliers for new innovations.

Within this overall shift toward more open innovation, crowdsourcing is also growing in importance. The fundamental insight underlying crowdsourcing—which is shared by open innovation—is that useful knowledge is widely distributed around the world. No one has a monopoly on that knowledge. Once you accept that, you must face the question of how best to access the wealth of knowledge around the globe.

Crowdsourcing is a powerful answer to that question. Done right, it taps into the knowledge, creativity, insight, and skill of the world around you. It can find solutions to previously intractable problems. It can help you predict next month's sales, or next season's fashions. It can improve the management of your supply chain. It can enhance your customers' experience of your products and services. It even frequently outperforms polling in predicting the winners of elections. And often these improved outcomes can be created with surprisingly modest investments.

You will read about many crowdsourcing examples in this book, so I will confine myself here to one, the company Innocentive. Innocentive has built an online network of more than 200,000 people around the world who go to its website to consider challenges that companies have posted prizes to have solved. These problems are usually technical in nature, and quite difficult to solve, which is why leading companies that have not found answers internally have reached out to the Innocentive community for solutions.

One intractable problem arose from the aftermath of the Exxon Valdez oil spill in Alaska. The crude oil spilled had settled on the ocean floor, hundreds of feet below the surface in very cold water. The combination of pressure and cold temperatures made it impossible to suck up the oil from the ocean floor. This was the challenge presented to the Innocentive community.

Happily, a solution was found from Innocentive's crowd of hundreds of thousands of experts. But that solution came from an unlikely place, one that suggests the value of the crowdsourcing approach. An engineer with extensive experience in the cement industry realized that cement companies employed vibration to keep cement from setting before it had been delivered and deployed in its final location. That same vibration could make the oil on the ocean floor more viscous, allowing it to be sucked off of the ocean floor. A test of the idea demonstrated that it actually worked. The prize was paid, and the technique recovered a great deal of oil that

might otherwise have lingered for decades, continuing to damage the surrounding environment.

As you will also read in this book, crowdsourcing is not a panacea for all ills, and can lead to terrible results if it is not managed properly. If, for example, the “crowd” of contributors are not independent of one another, the crowd can become a herd, charging off in a single direction, instead of balancing the different perspectives of people to provide a reliable prediction of a future event or activity.

Crowdsourcing is thus a powerful resource for innovators. Like most powerful resources, this power can be mismanaged as well. That is why you would be well advised to read this book, drink in its insights, and then apply it to your own challenges. A world of people and organizations are available to assist you, if you have the commitment and care to engage them properly.

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Introduction to *Creating and Capturing Value Through Crowdsourcing*

Christopher L. Tucci, Allan Afuah, and Gianluigi Viscusi

Abstract

Partly fueled by the pervasiveness of information technologies that facilitate the broadcasting of problems to crowds, and by anecdotal examples of phenomenally high-value solutions from outsourcing some problems to crowds, growth in the research and practice of crowdsourcing for problem solving has been remarkable. Research streams have been emerging in different disciplines. In this introduction to the volume, we introduce twelve chapters by scholars—from different disciplines—who explore interesting topics from some of these emerging research streams. The chapters fall into different groups distinguished by whether value is created and captured via tournament-based, collaboration-based, or hybrid crowdsourcing activities. We also offer future research directions and conclusions.

INTRODUCTION

For decades, transaction cost economics, the problem-solving view, and other theoretical perspectives have been used to understand, explain, and make predictions about why and when a firm would want to solve a problem through hierarchies, hybrids, or markets (e.g., Williamson, 1985, 2002; Nickerson & Zenger, 2004). In that research, getting a problem solved through “markets” has meant that a focal firm finds someone whom it believes can solve the problem, and designates that someone—through an *ex ante* contract or other agreement/commitment specific to the problem—as the contractor to solve the problem (Afuah, 2018a). The challenge is that, for many problems, finding that someone to solve a problem can be as difficult as finding a needle in a haystack (Afuah & Tucci, 2012; Afuah, 2016). Even more challenging is

the fact that some problems require a collection of solvers that the focal firm cannot identify, *ex ante*, to collaborate with and solve the problem.

This is where *crowdsourcing*—a portmanteau of the words “crowd” and “outsourcing,” as in outsourcing to a crowd rather than a designated contractor (Howe, 2006)—comes in. Because it can be difficult for focal firms, individuals, or even nations to identify, *ex ante*, who can solve a problem, they broadcast the problem to a crowd so that potential solvers can self-select to solve it with no *ex ante* agreements/commitments to solving the problem (Afuah & Tucci, 2012).

Partly fueled by the pervasiveness of information technologies that facilitate the broadcasting of problems to crowds, and by anecdotal examples of phenomenally high-value solutions from outsourcing some problems to crowds, growth in the research and practice of crowdsourcing has been remarkable. Importantly, different crowdsourcing research streams have emerged. Some scholars see crowdsourcing as an online phenomenon (e.g., Brabham, 2008), while others see it as a governance mechanism that goes back to at least the Longitude Prize of 1714, with information technology only serving as an enabler (Afuah & Tucci, 2012). Yet others see crowdsourcing as a mechanism for selling and buying on-demand labor that has the potential to disrupt the way firms create and capture value. Symbolic of these differences are the different research silos that explore crowdsourcing and the different terms that have been used to describe the phenomenon. Authors have used terms such as *broadcast search*, *distributed innovation*, *crowdfunding*, *collective intelligence*, *innovation tournaments*, *innovation contests*, and so on to describe crowdsourcing.

Fortunately, much research has been conducted on outsourcing and crowds—research that can help us to better theorize about crowdsourcing. In particular, much has been written about using tournaments to get crowds to solve problems, how crowds collaborate in solving problems, and what motivates crowds to solve problems—that is, much has been written about using crowds to create and capture value. The chapters in this volume fall into different groups, distinguished by whether value is created and captured via tournament-based, collaboration-based, or hybrid crowdsourcing activities.

The papers in Part I introduce the reader to crowdsourcing and the crowds and communities that are foundational to the phenomenon. More specifically, Afuah (2018a) presents a crowdsourcing primer and framework with the goal of introducing scholars to some of the constructs and concepts that academics may find useful in exploring theoretically interesting research questions. Viscusi & Tucci (2018) examine some important *characteristics of crowds* such as the goal orientation and the “seriality” of interactions and activities, thus clarifying how crowds may differ from communities and other kinds of collective entities. This difference is particularly relevant for identifying which kind of collective entity would be most effective when designing crowdsourcing initiatives, especially considering the different kinds of investments that might be required by the different kinds of crowds and communities.

West & Sims (2018) focus on the role that crowds and communities play during open innovation, especially focusing on *problem formulation* in innovation contests and the role of managerial actions in facilitating it. To this end, the authors analyze multiple case studies to inductively build a theoretical framework defining mechanisms for seeker firms' formulations of sharable problems in innovation contests. The last chapter in Part I, by Buttice et al. (2018), provides an extensive overview of crowdfunding, which is one of the most popular forms of crowdsourcing (if one conceptualizes a lack of funding as a problem to be solved). In particular, the chapter specifies the main characteristics of crowdfunding and how they relate to crowdfunding success.

The papers in Part II of the volume are about tournament-based crowdsourcing and extend the arguments discussed in Part I. In the first paper in the group, Wallin et al. (2018) remind us that *problem formulation* is so fundamental to problem solving that—for some problems—formulation can be more important than the solution. Using seven case studies, they detail rare accounts of the intra-organizational activities and implications of problem formulation for contests. Ranade & Varshney (2018) consider the other side of the spectrum of crowdsourcing contests, focusing on the *utility* generated for different types of tasks, including but not limited to idea generation. In particular, the authors identify a set of relevant factors for crowdsourcing contest design such as knowledge about the relative strengths of the participating solvers/workers and their awareness of the strength of internal competitors.

The papers in Part III are about collaboration-based crowdsourcing. Cordella et al. (2018) focus on the public sector to understand how and why co-production can be a valuable solution to delivering public services, improving both their public value *and* the administrative activities behind them. The authors propose that collaboration-based crowdsourcing in the public sector implies a change of perspective from focusing merely on the production processes of public services to first targeting public value creation. Levina & Fayard (2018) consider digital platforms enabling crowdsourcing contests and compare how consulting companies approach the translation and integration of diverse ideas and expertise to how they are addressed in innovation-focused crowdsourcing platforms. In particular, the authors analyze the role of boundary-spanning practices for knowledge collaboration, necessary due to the complexity of the task in crowdsourcing exercises where many new boundaries must be managed, in comparison with, e.g., online communities (cf. Faraj et al., 2011).

To conclude Part III, Šundić & Leitner (2018) analyze cases from A1 Telekom Austria to understand co-creation in both public and internal crowdsourcing initiatives, thus also contributing to the literature on internal crowdsourcing (cf. Zuchowski et al. 2016). The three approaches proposed comprise: (1) the open, external co-creation approach with customers and

users of the A1 Support Community; (2) the semi-open, internal tool-based co-creation approach with selected employees; and (3) the internal offline co-creation approach with employees.

The papers in Part IV are about hybrid crowdsourcing—that is, they explore questions that involve both tournament- and collaboration-based crowdsourcing. Afuah (2018b) argues that simultaneous competition to solve modules of a decomposable problem and collaboration to aggregate the module solutions produce a higher-value solution to the problem than collaboration alone. Just as important, simultaneous cooperation to reduce crowdsourcing frictions, and competition to solve a non-decomposable problem yield a higher-value solution than competition alone. Horn et al. (2018) take us into the world of prediction markets, and demonstrate how these markets can be used as a crowdsourcing mechanism to get crowds that will more effectively solve problems. More specifically, they demonstrate that when prediction markets are used in getting internal crowds to solve a problem, the crowd can outperform external crowds in solving some problems.

To round out the book, Curto-Millet & Nisar (2018) review the extent to which stakeholder theory might be applicable to understanding the ethical dimension of crowdsourcing. They discuss many of the ethical consequences of crowdsourcing and propose recommendations on how stakeholder theory can provide a response to such ethical dilemmas, and they provide one of the first attempts to debate the role of stakeholder theory for future research directions in the context of crowdsourcing.

As shown in Table 1.1, we have identified seven key cross-cutting topics from the chapters in this book that represent potential research themes and challenges for disciplines such as Innovation Management and Strategy, but also Organization Science, Political Science, and Information Systems. The first theme draws out some of the distinctions and similarities between crowds and communities, what they have in common, and how to take advantage of some of the differences for firms' innovation processes. The second theme is about the relation between open innovation and crowdsourcing, how companies might think about crowdsourcing as part of their open innovation portfolio, and when crowdsourcing might be different from open innovation. The third theme has to do with the differences and commonalities between internal and external crowds and many of the nuances of using external and internal agents in different contexts.

The fourth cross-cutting theme is concerned with an exploration of the co-production and co-creation processes enabled by crowdsourcing and how they might differ from more traditional problem-solving approaches. The fifth theme is about capturing value from crowdsourcing: who are the stakeholders, how is the contest governed, how is the contest designed to increase overall value, and how is the value shared? If crowdsourcing is about problem solving, the sixth theme revolves around “non-traditional” problems

Table 1.1. Cross-cutting themes developed in this book.

Cross-cutting topic	Chapters	Disciplinary areas
1. The relation and difference between crowds and communities	<ul style="list-style-type: none"> • Chapter 3 (Viscusi & Tucci) • Chapter 4 (West & Sims) 	<ul style="list-style-type: none"> • Innovation Management • Organization Science • Information Systems
2. The relation and difference between open innovation and crowdsourcing	<ul style="list-style-type: none"> • Chapter 2 (Afuah) • Chapter 4 (West & Sims) • Chapter 9 (Levina & Fayard) • Chapter 13 (Curto-Millet & Nisar) 	<ul style="list-style-type: none"> • Innovation Management • Organization Science • Strategy
3. The advantages and disadvantages of internal versus external crowds; inter- and intra-organizational processes to facilitate crowdsourcing	<ul style="list-style-type: none"> • Chapter 2 (Afuah) • Chapter 9 (Levina & Fayard) • Chapter 6 (Wallin et al.) • Chapter 10 (Šundić & Leitner) • Chapter 12 (Horn et al.) 	<ul style="list-style-type: none"> • Innovation Management • Organization Science • Information Systems • Strategy
4. The different ways to organize crowds from the common sense understanding of crowdsourcing as an input into the problem-solving process to co-production and co-creation	<ul style="list-style-type: none"> • Chapter 3 (Viscusi & Tucci) • Chapter 8 (Cordella et al.) • Chapter 10 (Šundić & Leitner) 	<ul style="list-style-type: none"> • Innovation Management • Organization Science • Political Science
5. Governance of and value capture from crowdsourcing	<ul style="list-style-type: none"> • Chapter 11 (Afuah) • Chapter 13 (Curto-Millet & Nisar) 	<ul style="list-style-type: none"> • Strategy • Organization Science • Ethics
6. “Non-traditional problems” solved by crowdsourcing, from monetary value in crowdfunding to public value in the public sector	<ul style="list-style-type: none"> • Chapter 5 (Butticè et al.) • Chapter 8 (Cordella et al.) 	<ul style="list-style-type: none"> • Innovation Management • Strategy • Political Science • Entrepreneurship
7. The role of information and information systems capacity in designing and managing crowdsourcing	<ul style="list-style-type: none"> • Chapter 3 (Viscusi & Tucci) • Chapter 7 (Ranade & Varshney) • Chapter 11 (Afuah) 	<ul style="list-style-type: none"> • Innovation Management • Information Systems

to be solved and expands our repertoire of what constitutes effective contexts of crowdsourcing. Finally, the seventh cross-cutting theme is about the role of information and how information systems can be used in designing crowdsourcing exercises. Table 1.1 links each of these themes to multiple chapters as a convenient cross-reference and suggests different disciplines to which the themes might be relevant.

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

Together, these chapters provide critical elements for pursuing research in crowdsourcing, and constitute an excellent starting point for crowdsourcing scholarship. Because the research opportunities in crowdsourcing are inherently large, and there are only twelve further chapters in this volume, there are still many research gaps and therefore many opportunities for future research. These gaps fall within four generic domains. First, although the volume is entitled *Creating and Capturing Value through Crowdsourcing*, there is still a bigger emphasis in the volume on value creation relative to value capture. This asymmetrical attention to value creation at the expense of value capture in crowdsourcing literature has been recognized for a while, but to date little has been accomplished towards addressing it (Afuah & Tucci, 2013; Bloodgood, 2013). Future research could more explicitly focus on value capture questions, especially the roles of complementary assets and business models (Teece, 1986; Massa et al., 2017).

Second, little attention has been given to date to how seekers could organize to better formulate, delineate, and broadcast problems, so as to evaluate and assimilate the solutions from crowds. We know very little about the types of organizational structures, systems, culture, and strategies that seeker organizations may want to pursue to increase their chances of creating and capturing superior value via crowdsourcing. Third, although internal crowdsourcing research has recently attracted some interest (including at least two of the chapters in this volume), much of the attention has been focused on external crowdsourcing. Future research could tease apart many of the nuances that distinguish internal from external crowds. Fourth, these chapters, like most crowdsourcing research so far, have focused largely on the advantages of the phenomenon, with less of an emphasis on its pitfalls. Future research could look into the disadvantages of crowdsourcing and how they might be mitigated, or the contingencies that might distinguish success from failure.

Fifth and most important, good research explains and predicts. However, as mentioned previously, most of the chapters in this book are conceptual, qualitative, or descriptive, focusing on the “pre-theorizing” that is natural at this stage of evolution of the field. The emphasis in this book was not on clearly defining constructs, developing and testing hypothesized relationships, or on linking constructs with causal logic. The full potential—both scientific and practical—of crowdsourcing is likely to be attained when researchers take the field to the next level and explore explanation and prediction. Luckily, as the identified research gaps suggest, there are plenty of opportunities to write papers that make meaningful contributions to advancing knowledge in crowdsourcing.

We hope this volume stimulates even more interest in the topic so that our research community can grow into a large, open crowd, teeming with excitement about crowdsourcing’s potential!

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Part I

Crowdsourcing: Fundamentals and the Role of Crowds and Communities

Crowdsourcing: A Primer and Research Framework

Allan Afuah

Abstract

Managers are regularly confronted with unsolved problems. If managers know who can solve a problem, they can assign the problem to the correct person to have it solved under an *ex ante* contract or other form of agreement/commitment, inside or outside the organization. If they do not know who can solve it, they can crowdsource it, broadcasting the problem to an undefined set of people (the crowd) to self-select and solve it with no *ex ante* contract or other commitment. Although the practice of crowdsourcing goes back to at least the Longitude Prize of 1714, research on the phenomenon has only recently flourished, thanks, in part, to advances in information technology, globalization, and other macro-environmental factors. Herein I present a crowdsourcing primer and framework with the goal of providing management scholars with some of the fundamentals needed to pursue their research interests in this compelling phenomenon.

INTRODUCTION

At a very general and intuitive level, crowdsourcing is the act of having an *undefined* set of people self-select and perform a task with no *ex ante* contracts or other commitments to get the task performed (Howe, 2006; Malone et al., 2010; Afuah & Tucci, 2012; Afuah, 2016). Solving the problem is not restricted to one person in particular—it is *open* to anyone. Beyond this intuitive level, definitions of the phenomenon can vary considerably (for a summary of definitions, see: Estellés-Arolas & González-Ladrón-De-Guevara, 2012; Majchrzak &

Malhotra, 2013). Importantly, many of these definitions are derived from the first definition of crowdsourcing offered by Howe, who coined the term and defined it as:

The act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call. (2006: 1)

Three popular examples illustrate the meaning of the phenomenon. First, in 1714, rather than select some of its employees to solve the longitude problem or contract the task to those it believed were talented enough to perform the task, the UK government crowdsourced the problem—it outsourced the task in the form of an open call to anyone anywhere in the kingdom who could solve it (Sobel, 2007). George Harrison, a clock maker, solved the problem, delivering a solution that, for decades, gave the British a competitive advantage at sea.

Second, about three centuries after the Longitude Prize, in 2009, Facebook decided to translate its website from English to other languages to open up its social network to non-English-speakers. Rather than assigning the task to specific employees, or contracting the job to designated translation houses, Facebook crowdsourced the problem in the form of an open call to anyone anywhere in the world interested in performing the task. The site was translated from English to French in twenty-four hours and to Spanish in two weeks. By the end of 2011, the site had been translated into more than seventy languages, launching Facebook on its way to having more than one billion visitors to its site. Third, in 2005, rather than asking its forecasting group to predict sales of its gift cards, Best Buy sent emails—together with readily available straightforward data—to hundreds of its employees asking those who were interested to voluntarily perform the task (Dye, 2008). A straight average of the forecasts from those who self-selected to perform the task was 99.5 percent accurate, compared to a forecast of 94.5 percent from the company's internal expert forecasters (Dye, 2008).

In each of the three examples, a problem was broadcast to an *undefined* set of people. With no *ex ante* commitments about solving the specific problem, solvers self-selected and solved it, delivering high-value solutions. The issuer of the task did not specifically identify a person and assign the task to him or her to perform under a contract or other agreement/commitment specific to the task. The call to solve the problem was open.

One way to conceptualize crowdsourcing is to consider an organization that has a problem that it would like to solve. Such a problem could be to develop an app for a smartphone platform, design a new product, create a new algorithm for recommending videos or apps, provide hotel accommodation for someone in a strange city, catch a criminal, diagnose a rare disease, forecast sales of a new product, fund a new venture, identify people in a museum's photo archives, and so on (Afuah, 2016). That is, these "problems" can be just about any task that contributes to value creation and capture (Allen, 1966; Nickerson et al., 2012).

If a manager knows who can solve such a problem, s/he can assign the problem to the designated solver—inside or outside the organization—to solve it under some form of authority or *ex ante* contract/commitment (Malone, et al., 2010). If a manager does not know who can solve the problem, s/he can *crowdsource* it—outsource it in the form of an *open call* to an *undefined* group of solvers to self-select and solve the problem, *without* the manager specifically assigning the task to someone that they believe can solve the particular problem (Howe, 2006; Afuah & Tucci, 2012).

Types of Crowdsourcing

Crowdsourcing can be tournament based, collaboration based, or a hybrid of both. In tournament-based crowdsourcing, each actor that self-selects to solve a problem generates a solution to the problem (Che & Gale, 2003; Scotchmer, 2004; Afuah & Tucci, 2012). Thus, if there are a hundred solvers that self-select to solve the problem, about one hundred solutions are likely to be generated. These solutions are evaluated for winners. The Longitude Prize example falls in this category. Much of the crowdsourcing research conducted to date has been tournament based (e.g., Terwiesch & Xu, 2008; Boudreau et al., 2011; Lampel et al., 2012). Some of that research has yielded some rather interesting results (Poetz & Schreier, 2012; Lang et al., 2016). For example, Poetz & Schreier (2012) found that product innovation ideas from a crowd of external non-experts outperformed those from internal experts in some key performance measures. Tournament-based crowdsourcing research has drawn on neoclassical economic theory, tournament theory, and all-pay auction theory to explore theoretically interesting questions (e.g., Connelly et al., 2014; Liu et al., 2014; Ranade & Varshney, 2018).

In collaboration-based crowdsourcing, each solver provides only a component of the solution, and the different components are aggregated to obtain the solution to the problem (e.g., Afuah & Tucci, 2012; Levine & Prietula, 2013; Franzoni & Sauermann, 2014; Bauer & Gegenhuber, 2015). For example, in the crowdsourcing of the translation of a document from one language to another, different translators translate different passages and their contributions are aggregated to produce the translated document. Crowdfunding and open source projects are largely collaboration-based crowdsourcing (Mollick, 2014; Buttici et al., 2018).

Crowdsourcing can also be a hybrid of tournament-based and collaboration-based activities. Witness Wikipedia, where people can compete to write each entry and the “winning” entries are aggregated to produce the encyclopedia. The use of prediction markets to solve problems often involves both types of crowdsourcing (Christiansen, 2007; Borison & Hamm, 2010; Horn et al., 2018).