



Universiteit Utrecht

CROWDSOURCING FOR INNOVATION

*An overview of the success factors and challenges
of the broadcast search process*

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Summary

Crowdsourcing is an umbrella term for activities in which the crowd is tasked to come up with ideas or complete certain tasks. The focus of this thesis is on broadcast search, a particular form of crowdsourcing, in which an organization broadcasts an open call to an undefined crowd to find innovative ideas or solutions to problems the organization faces in the innovation process. The aim of this thesis is to identify known success factors and challenges of broadcast search in the scientific literature and to understand how these factors influence the process and outcome of broadcast search initiatives. In order to do this, a framework of the broadcast search process is devised, in which four phases are specified. Next, a systematic literature review is conducted, from which 22 empirical, peer-reviewed articles relevant to the broadcast search process are retained. The articles are then reduced to their essence and summarized in an author matrix, from which 22 unique success factors and 9 challenges are derived. These success factors and challenges are categorized according to which phase of the broadcast search process they influence, and which actors are involved. Finally, the implications and reliability of the results and the value of these results for understanding broadcast search success are then discussed.

Samenvatting

Crowdsourcing is een verzamelterm voor activiteiten waarin een grote groep mensen door een organisatie gevraagd wordt om ideeën te verzinnen of bepaalde taken uit te voeren. Deze thesis richt zich op *broadcast search*, een vorm van *crowdsourcing* waar een organisatie een bepaald probleem of vraagstuk uitschrijft aan een ongespecificeerde groep mensen, om zo innovatieve ideeën te verzamelen of oplossingen te verkrijgen voor problemen in het innovatie proces binnen de organisatie. Het doel van deze thesis is om de in de literatuur bekende succes factoren en uitdagingen van *broadcast search* te identificeren, en om te begrijpen hoe deze factoren het proces en de uitkomst van *broadcast search* projecten beïnvloeden. Om dit te doen is er een theoretisch raamwerk van het *broadcast search* proces opgesteld waarin onderscheid wordt gemaakt tussen vier fases. Vervolgens is er een systematische literatuur studie uitgevoerd, hetgeen 22 empirische, peer-reviewed artikelen heeft opgeleverd die relevant zijn voor het broadcast search proces. De essentie van deze artikelen is vervolgens samengevat in een auteurs matrix, waaruit 22 unieke succes factoren en 9 uitdagingen zijn afgeleid. Deze factoren zijn gecategoriseerd op basis op basis van welke fase in het proces ze beïnvloeden, en welke actoren er een rol bij spelen. Tot slot wordt de implicatie en betrouwbaarheid van de resultaten behandeld, en wordt het belang van de resultaten voor het begrijpen van *broadcast search* succes besproken.

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"Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!" – The red queen (Lewis Carrol)

1. Introduction

Given the importance of innovation for the realization of value, and considering the changing landscape in which innovation is achieved, organizations must evolve in resonance with their environment to stay relevant and prosperous (Cooper, 2009; Tidd & Bessant, 2009). Or, in the words of Lewis Carrol, you must run at least twice as fast if you want to get anywhere. The process of innovation, from invention to implementation, was long considered as being confined to the boundaries of the organization. However, the past decade has seen a shift towards a more open innovation paradigm (Chesbrough & Appleyard, 2007), in which organizations are opening their boundaries to leverage external knowledge and engage external expertise in order to continually innovate, create value for themselves, end-users and the broader society (Marjanovic et al., 2012; Zhao & Zhu, 2012).

An emerging phenomenon associated with this development is crowdsourcing. Briefly defined, crowdsourcing is the act of outsourcing a certain task to an undefined crowd in the form of an open call in order to mobilize the competence and expertise distributed among the crowd (Howe, 2008; Schenk & Guittard, 2009; Erickson et al., 2012). Crowdsourcing is not necessarily limited to the context of innovation; initiatives can differ significantly as organizations turn to the crowd to meet a wide variety of needs, e.g. the translation of websites, digitization of archives or the aggregation of dispersed data (Kleemann et al., 2008, Schenk & Guittard, 2009). However, the focus of this thesis is on the use of crowdsourcing to benefit innovation, often referred to as broadcast search, in which an organization turns to the crowd to generate creative ideas or solve complex problems to advance internal R&D efforts.

Multiple studies have demonstrated broadcast search to be an effective strategy to enhance the efficiency of a firm's innovation process, and many initiatives are reported to be very successful (e.g. Brabham, 2008; Boudrea & Lakhani, 2009; Poetz & Schreier, 2012; Luttgens et al., 2014). However, crowdsourcing success is not a given, and a large amount of broadcast search initiatives fail to produce the desired outcome (Jeppesen & Lakhani, 2010; Franke et al., 2013; Dahlander & Piezunka, 2013; Luttgens et al., 2014).

Scientific understanding of crowdsourcing is relevant for the successful implementation of crowdsourcing initiatives (Shao et al., 2012). However, since crowdsourcing is a relatively young subject of scientific study, dedicated crowdsourcing research is still limited (Zhao & Zhu, 2012; Pederson et al., 2012; Feller et al., 2012; Corvello et al., 2013). So far studies have focused on

identifying crowdsourcing in practice (Howe, 2006; Brabham, 2008), developing functional and integrated definitions (Schenk & Guittard, 2009; Estelles-Arolas & Guevara, 2012), characterizing the crowdsourcing process (Geiger et al., 2012; Pederson et al., 2013), and studying crowd characteristics and motivations (Leimeister et al., 2009; Acar & van den Ende 2011). While this previous research has contributed to an understanding of the mechanisms that lead to successful crowdsourcing, and factors determining successful crowdsourcing have been explicitly studied to some degree (e.g. Luttgens et al, 2014; Franke et al., 2013), the different strands of research do not seem to have converged yet and the research is fragmented (Zhao & Zhu, 2012; Franke et al., 2013; Walter & Back, 2011). This thesis aims to weave together these strands of research into an initial overview of the known factors influencing the outcome of broadcast search initiatives and the challenges involved in the process, by conducting a systematic literature review. The research question thus addressed is as follows: *which success factors and challenges of broadcast search can be identified in the literature, and how do they influence the successful outcome of the broadcast search process?*

The relevance of this question is two-fold. First, an overview of success factors and challenges and an understanding of how these influence the outcome of broadcast search initiatives adds to the growing body of literature on crowdsourcing. Creating such an overview can help identify aspects that are important to crowdsourcing success but are as of yet under-researched or controversial, and can serve as a reference point for future research. Secondly, a better understanding of crowdsourcing will facilitate its practical application. This is beneficial for organizations who are looking to improve their chances of innovation through crowdsourcing. Awareness of proven success factors can help circumvent common pitfalls and overcome challenges, and the theoretical knowledge can be used by organizations when constructing their own workflows and processes relating to crowdsourcing.

The rest of this thesis is structured as follows. First, the relevant concepts surrounding crowdsourcing are explained, and a theoretical framework is devised to guide the literature search. Next, the methods used to conduct the systematic literature review and the subsequent data analysis are explained, after which the results are presented. Finally, these results are discussed in relation to the theoretical framework, implications for practice and theory are drawn, limitations are addressed and the thesis is concluded.

2. Theoretical framework

In order to guide the literature review this section provides a categorization of the different forms of crowdsourcing and defines broadcast search according to this categorization, provides an overview of the process of broadcast search, derives a model of broadcast search success and describes the concepts success factors and challenges.

2.1. Defining crowdsourcing

The word crowdsourcing, a contraction of ‘crowd’ and ‘outsourcing’, was popularized by Jeff Howe in 2006. The word is used to describe a wide group of activities that take on different forms, ranging from the digitization of archives (ReCaptcha) and graphic design (Wilogo) to proposing innovative concepts (Atizo) and complex problem solving (InnoCentive) (Schenk & Guittard, 2011). This variety makes it difficult to define and categorize crowdsourcing (Estelles-Arolas & Guevara, 2012). In order to define broadcast search for this thesis, a description is given on the basis of what the crowd has to do and what the crowd gets in return, combining insights from Estelles-Arolas and Guevara (2012) and Schenk and Guittard (2011).

What the crowd has to do

According to Schenk and Guittard (2011) the crowdsourcing approach can be categorized in terms of the type of task that is performed and the nature of the work. The type of task that is performed by the crowd can be either simple, creative or complex. The nature of the work can be either selective or integrative. Integrative work consists of aggregating the effort of many participants resulting in increased value (such as is the case with ReCaptcha). Selective work on the other hand, uses the diversity of the crowd to find a single best option, usually in the form of a competition. In broadcast search, which is also referred to as ‘tournament-based crowdsourcing’ or ‘innovation contest’, the crowd is tasked with selective work and complex or creative tasks, such as idea generation and problem solving (Walter & Back, 2009).

What the crowd gets in return

Compensation for voluntary effort can take the form of material and non-material rewards. Non-material rewards pertain to intrinsic motivation factors such as entertainment, social recognition or the development of skills. It is not uncommon for integrative work with simple tasks to be undertaken on this basis (Aitamurto et al., 2011). Material rewards are often pecuniary in nature, and can range from micro-payments of a couple of cents per (simple) task, to prizes of a million dollars for complex problem solving tasks of a selective nature (Estelles-Arolas & Guevara, 2012).

The broadcast search approach is often associated with substantial financial rewards (Frey et al., 2011).

2.2. Broadcast search process

The broadcast search process is the set of actions undertaken by the different actors in order to achieve a desired outcome (Pederson et al., 2012). While this process can differ depending on how a broadcast search initiative is executed, it is possible to derive common actors and actions that are involved in the process. This section sets out to identify these actors and actions.

At its roots, the broadcast search approach consists of the act of taking a challenge faced by an organization, the ‘seeker’, and broadcasting it in the form of an open call to a crowd of external “solvers” (Brabham, 2008; Howe, 2006; Luttgens et al., 2014). This open call can be presented in the form of a “request for proposals” (RFP) document. The document describes the task to be solved and highlights the performance criteria that a winning solution has to meet (Luttgens et al., 2014). Furthermore, the organization specifies if the challenge is accessible to everyone, or that certain restrictions are applied regarding the group of potential contributors (Geiger et al., 2011). These restrictions can be qualification based (i.e. contributors need to have proven qualifications or skills) or context specific (e.g. only employees or customers can contribute). However, most broadcast search initiatives do not limit the contributors (Geiger et al., 2011). While crowdsourcing is often employed as a business model for companies, it can also be used by public organizations or governments as a problem solving tool (Estelles-Arolas and Guevara, 2012).

Broadcast search is almost always facilitated by a crowdsourcing intermediary (Pederson et al., 2012; Luttgens et al., 2014). Crowdsourcing intermediaries are web platforms which function as marketplaces, they serve as a meeting point for seekers and solvers and are responsible for laying the ground rules of the crowdsourcing process (Zogaj et al., 2014; Pederson et al., 2012). On the one hand they interact with solvers and seekers regarding task definition, solution requirements, duration and rewards. On the other hand they are responsible for managing the crowd itself and all the activities within the crowd (Zogaj et al., 2014). Intermediaries work in different ways regarding the solver community, the way the open call is broadcast, the intellectual property model (IP) and the influence a seeker organization can have during the project (Diener & Piller, 2013).

After the challenge as formulated by the organization has been broadcast to the crowd, potential participants can be motivated to attempt to solve the challenge by submitting an idea or solution proposal (Luttgens et al., 2014). Participants self-select the challenges in which to invest their time and effort, and this decision can be influenced by the crowdsourcing intermediary which can attempt to attract, incent and sustain the crowd by offering personalized recommendation and

customization options (Stewart et al., 2009; Zhao & Zhu, 2012). After a participant has contributed an idea or potential solution, these responses need to be evaluated (Zhao & Zhu, 2012). This is undertaken either by the general crowd, in a form of crowdsourcing known as crowd-voting, or, more commonly, by the organization itself (Pederson et al., 2012). The form of evaluation that is employed can depend on the level of control an organization desires over the outcome and is subject to whether the platform provides the community and means for crowd-voting (Geiger et al., 2011; Pederson et al., 2012). Subsequently, the winning solver or a selection of a certain number of solvers, depending on the remuneration structure, is rewarded (Blohm et al., 2011; Geiger et al., 2011; Luttgens et al., 2014). According to some, these are the last steps in the crowdsourcing process (e.g. Roman 2009; Stewart et al., 2009; Yang et al., 2008). However, others claim that the organization still has to process this input, and decide if and how the acquired solution can be implemented into the organization, before a crowdsourcing initiative can be considered fulfilled (West & Bogers, 2011).

To conclude, the three main types of actors involved in the broadcast search process are the organization, the platform, and the crowd. These actors undertake different actions in the broadcast search process. The organization broadcasts the open call to the intermediary platform, (usually) evaluates the contributions, rewards the winners and has to decide if and how to implement the acquired response. The intermediary platform lays down the ground rules, communicates with the seekers regarding the task design and can provide tools and a community for solvers. The crowd selects challenges in which to participate and can attempt to contribute potentially useful ideas or solutions.

2.3 Successful outcome of broadcast search

Crowdsourcing success can take on many different forms (Marjanovic et al., 2012), as the notion of success is subject to the perspective and expectations of the actor for who success is defined. In this thesis the notion of broadcast search success is confined to the factual outcome of the process from an organizational perspective. Thus, a broadcast search initiative is deemed successful if the aforementioned process results in an idea or a solution to a certain problem which the organization can utilize to achieve innovation (Pederson et al., 2012). To understand how certain success factors or challenges can influence this outcome it is necessary to look at how they influence the process. To do this, a distinction of four phases is devised based on the broadcast search process described above, each involving a certain set of actors and actions. The successful outcome of a broadcast search initiative can then be understood as the result of success in (one or more of) these different phases.

Activation

The first phase of the broadcast search process is the activation phase. It starts when an organization broadcasts a challenge accompanied by information regarding the requirements of contributions, task duration and reward structure, and which reaches the crowd through an intermediary platform. When the crowd becomes aware of the existence of this challenge, certain individuals in that crowd may be motivated to participate in the challenge (Zhao & Zhu, 2012). In order for any crowdsourcing initiative to be successful, it is essential to activate individuals to participate, as a lack of participants deprives the process of its inputs (Pederson et al., 2012; Aitamurto et al., 2011). Success in the activation phase can thus be seen as successfully motivating participants to invest time and effort in a certain challenge.

Contribution

While there might be mass activation in a crowdsourcing project, it can be expected that not all of these participants work out a solution or come up with an idea, or decide to submit it for competition (Zhao & Zhu, 2012). The contribution phase concerns the ideas or solutions that are actually submitted by the participants. The success of this phase is determined on the basis of contribution performance (Sharma, 2010; Poetz & Schreier, 2009). Contribution performance can be divided into two dimensions, namely quantity and quality of the response (Schenk & Guittard 2009; Acar & Van den Ende, 2011; Poetz & Schreier, 2009). Quantity represents the number of responses submitted by the crowd. Quality of response is harder to define, but is generally determined in terms of novelty, variety, workability, relevance and specificity of the response (Dean et al, 2006; Erickson et al., 2012). Success of the contribution phase is considered both in terms of the quantity of response and in terms of the different constructs of quality of the response.

Evaluation

The contributions that are submitted by participants need to be evaluated in order to determine their worth to the organization (Zhao & Zhu, 2012). This evaluation of responses is undertaken either during the duration of the initiative, or after the initiative has elapsed and all contributions have been gathered (Pederson et al., 2012). The evaluation of contributions is usually undertaken by the organization itself, but can also be crowdsourced, as is the case with crowd-voting (Pederson et al., 2012). Successful evaluation entails that each contribution can be judged accurately, and that a winner or winners can be identified.

Implementation

The final phase consists of aggregating the acquired ideas or solutions, deciding if and how to implement them into the organization, and, if so chosen, subsequently implementing and capturing value from them. This phase is considered an important one in the overall innovation process (Tidd & Bessant, 2013; West & Bogers, 2011), but its importance for broadcast search success in particular is not clear. This phase is included in order to categorize success factors and challenges pertaining to implementation identified in the literature, in order to determine its place in the overall process.

Visual representation

Figure 1 gives a schematic overview of the actors, actions and phases of the broadcast search process.

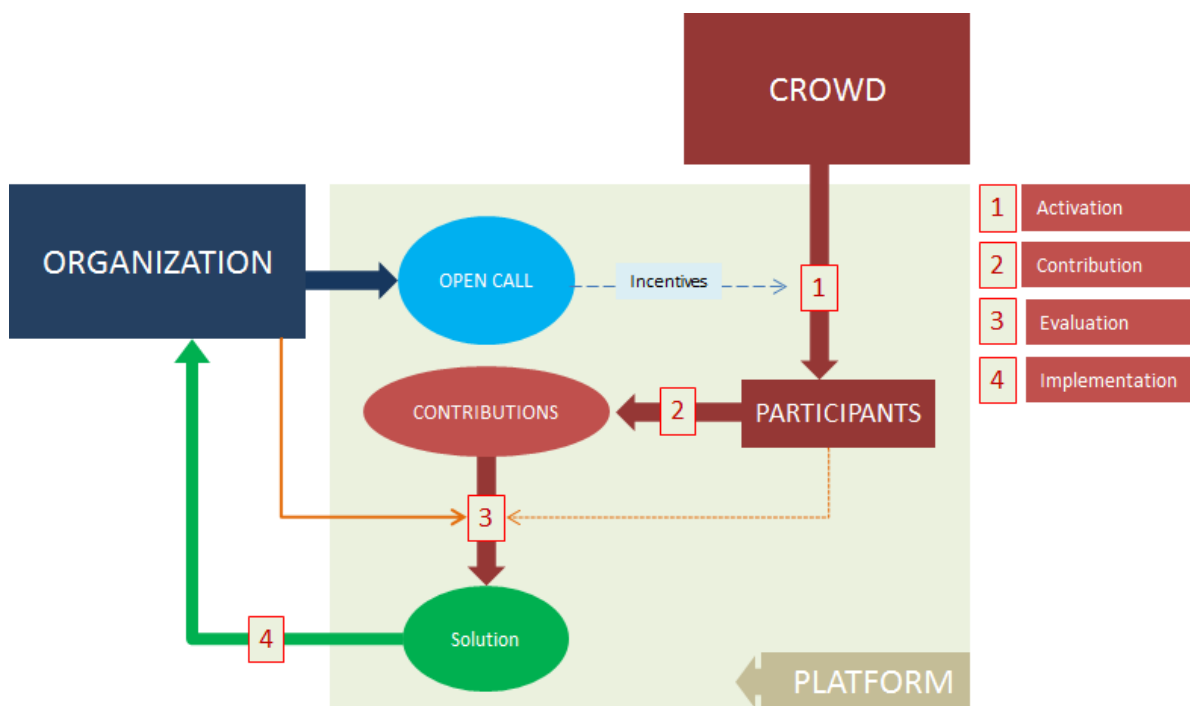


Figure 1. Visual representation

2.4. Success factors and challenges

Utilizing broadcast search for innovation can be a complex process (Marjanovic et al., 2012). As has been shown in the previous paragraph, the broadcast search process can be divided into four phases, and there are three main types of actors involved. The literature review aims to aggregate insights on known success factors and challenges, and to determine how these influence the successful outcome of the broadcast search process. Success factors and challenges are defined as follows:

A [*success factor / challenge*] is taken to be any action, feature or condition in the broadcast search process that in any way [*positively influences / complicates or obstructs*] the outcome of one or more of the aforementioned phases of the process. These phases being: activation, contribution, evaluation and implementation.

3. Methods

This section gives an overview of the methods used to answer the research question.

3.1. Research design

The goal of this thesis is to identify success factors and challenges of broadcast search and to understand how they influence the process and outcome of broadcast search. In order to do this, a systematic state-of-the-art literature review was conducted, as this is considered an appropriate means of reviewing the main ideas and research relating to a certain field (Bryman, 2008). A systematic approach has been chosen in order to ensure thoroughness and generate unbiased and comprehensive results. Furthermore, a routinization of the search process helps reduce chance effects, limit bias, enhance legitimacy and provide transparency (Bryman, 2008).

3.2. Data collection & selection

In order to retain relevant literature for the literature review a search and select strategy was devised and inclusion criteria were set.

Search and select strategy

The primary mode of data collection employed was a systematic search for published articles in the online database of Google Scholar. The backbone to the search query set the boundaries for the rest of the search, and limited the results to articles concerning crowdsourcing related practices using one of the following terms:

Crowdsourc , broadcast search, innovation contest, ideation contest,
tournament-based innovation, innovation competition, idea competition*

This basic query was included in each search. Next, the following variations were added to further limit the search results to potentially relevant research on success factors and challenges.

Success , factor, key, essential, challenge, barrier, fail* , process, activat* , participat* ,
contribut* , evaluat* , implement**

The results, usually more than 4000 per search, were sorted by relevance, which is determined by an opaque Google algorithm that takes into account the number of times the article has been cited by other authors, among other factors. Per search, the articles on the first 15 pages of search results (after 15 pages the average number of relevant articles had decreased to 1 in 4 pages), containing 10 articles per page, were reviewed based on the title. If the article was potentially relevant, it was opened in a separate tab. This first phase of selection reduced the number of articles from 150 to an average of 20 per search. Next, the abstracts of the article were read, and, if the article was still considered potentially relevant, it was bookmarked into the online research management program

Mendeley, including a short description of the potential relevance. This process was repeated multiple times with slight variations in the search terms as indicated above, eventually yielding a total of 74 articles in Mendeley. The next step was reviewing the entire article, ensuring that the selection criteria as formulated below were met. 3 potentially relevant articles were not publicly available (contacting the authors did not result in a response), leaving a final list of 17 relevant articles.

A second mode of data collection was the use of backward and forward citation analysis (Webster & Watson, 2002). Papers concerned with an overarching view of crowdsourcing (e.g., Zhao & Zhu, 2012; Pederson et al., 2012) were used as hubs from which to gather more data. This resulted in 2 additional relevant studies.

Finally, additional research papers were collected from the archives of Dr. Chappin. A total of 30 scientific papers were retrieved. From these, 6 were deemed relevant, including 3 papers which had already been retained by means of the systematic review. This resulted in a total of 22 relevant articles.

Inclusion criteria

The selection of useful data was done on the basis of the following inclusion factors.

1. *The article must deal with success factors or challenges of relevance to the process of broadcast search (i.e. pertaining to certain actors, actions or features also found in the broadcast search process).*
2. *The article must preferably be published in a peer-reviewed journal. However, peer-reviewed conference proceedings are also included, due to the fact that research on broadcast search is limited.*
3. *The article has to include an empirical study, using either quantitative or qualitative data. Purely theoretical and conceptual articles are not retained.*

3.3. Data Analysis

In order to analyze the 22 articles a research matrix was constructed. This matrix is included in the appendix and contains the following information:

Author(s), Year, Journal, Discipline, Subject, Nature of research, Methods, Sample, Type of crowdsourcing, Relevant dimension of success, Identified factors, stated influence, Identified challenges, stated influence and Notes.

The full text of each article was reviewed. During this review, the following questions were asked: which challenges or success factors are identified by the authors? Are these relevant to the process of broadcast search? And to which phase as identified in the theoretical framework are the success factors and challenges applicable? The matrix was subsequently filled in for each article.

From this, a separate spreadsheet was constructed which sorts the success factors and challenges based on where they originate and which phase of the process they influence. The success factors and challenges were then compared on the basis of phase, the origin of the factor, and which aspect of the process they influenced, in order to identify overlapping factors, which were subsequently combined. If success factors within one phase were found to be conflicting or controversial, they were noted as challenge. The results are presented in the next section.

3.4. Research quality

The research quality can be determined on the basis of reliability, replicability and validity of the research (Bryman 2012). The reliability concerns whether the findings represent an accurate reflection of the total population (in this case, of all the relevant literature), and if the same results can be reproduced under a similar methodology. The routinization of the search process in the systematic literature review helps to reduce chance effects and limit bias, ensuring reliability of the research. The replicability of the research — whether the methods are sufficiently explained to make replication possible — is ensured by stipulating in detail which steps were undertaken to search and select the literature, providing transparency into the process. Next, the internal validity — whether the cause (success factors and challenges) entail the effects (outcome of broadcast search) — is dependent on the quality of the research included in the systematic literature review. Only including peer-reviewed research helps ensure internal validity. Finally, the external validity concerns the issue of the generalization of the findings. Because the success factors and challenges relate to a certain feature, action or actor of relevance to the broadcast search process, the findings are applicable to the context of broadcast search. However, since success factors and challenges are aggregated in this thesis, not all of them may be of relevance to a particular initiative, meaning that the generalization of the findings should be undertaken with care.

4. Results

For this research 22 articles were analyzed. Table 1 summarizes the general characteristics of these articles. As emphasized before, crowdsourcing is a relatively young subject of research, and the immaturity of the field is reflected by the publication dates of the reviewed articles. From these 22 articles, three were published in 2009; three in 2010; six in 2011; three in 2012; four in 2013; and three in 2014. Furthermore, crowdsourcing has attracted attention from a wide range of scientific disciplines (Zhao & Zhu, 2012). This too is reflected by the articles in the literature review. Eight articles are rooted in information systems or science; six in management science; four in innovation science; and four in economics. The articles that directly concern the specific form of crowdsourcing referred to as broadcast search or innovation contest make up the majority, with 13 articles. Three articles focus primarily on community-based innovation, another three on open innovation, and the last three on either user innovation, software, or content production. The articles not directly concerning broadcast search were included conform the first inclusion criterion, as they pertain to certain actors, actions or features also found in the broadcast search process and offer valuable insight into this process.

Year of publication	Number	Percentage	Reference
2009	3	14 %	5; 9; 10
2010	3	14 %	17; 18; 21
2011	6	26 %	1; 2; 6; 10; 19; 22
2012	3	14 %	4; 8; 14
2013	4	18 %	3; 12; 13; 15
2014	3	14 %	7; 16; 20

Discipline	Number	Percentage	Reference
Information systems	8	37 %	2; 4; 6; 8; 9; 11; 18; 20
Management science	6	27 %	1; 5; 13; 17; 19; 22
Innovation science	4	18 %	3; 12; 15; 21
Economics	4	18 %	7; 10; 14; 16

Crowdsourcing type	Number	Percentage	Reference
Broadcast search	13	58 %	1; 6; 7; 8; 10; 11; 12; 14; 15; 16; 17; 18; 21
Open innovation	3	14 %	2; 3; 4
Community-based innovation	3	14 %	13; 21; 22
Other (User innovation; software; content production)	3	14 %	5; 9; 19

Table 1. General characteristics of the literature

In the 22 articles that were analyzed a total of 35 success factors and 14 challenges were identified. These success factors and challenges were compared on the basis of phase, the origin of the factor, and which aspect of the process they influenced, in order to identify overlapping factors, which were subsequently combined. If certain success factors within one phase were found to be conflicting or controversial, they were noted as challenge. This resulted in a total of 22 unique success factors and 9 unique challenges. Table 2 gives a summary of this process of identifying unique success factors and challenges.

Dimension	Initial success factors/ (unique)	Initial challenges / (unique)
Activation	14 (8)	3 (2)
Contribution	14 (10)	6 (2)
Evaluation	4 (2)	2 (2)
Implementation	3 (2)	3 (3)
Total	35 (22)	14 (9)

Table 2. Categorization into phases

4.1. Findings

A complete overview of the articles and the success factors and challenges can be found in the data matrix included in the appendix. In this section, a table summarizing these results is presented. In this table, the first column represents the phase; the second column indicates whether it concerns a challenge (C) or success factor (SF) (hereafter simply referred to as factors); the third column displays where the factors originate, the fourth column names these factors; the fifth column indicates how they influence the broadcast search process; and the sixth and final column presents the reference to the literature in which these factors were identified (numbers correspond with articles listed in the literature section). It is clarifying to note that while the table might suggest each factor to be of similar nature and importance, it is in fact common for some factors to be overarching observations for an entire phase, while others are more detailed explanations or interpretations of these overarching factors. The paragraphs accompanying this table take care to make this distinction.

	Origin	Success Factor (SF) / Challenge (C)	Influence	Ref's	
Activation	C	Crowd	Activation of external participants	Most initiatives fail due to lack of activation of participants	3; 17
			Too much competition	Decreases individual incentives to participate, especially in challenges with a low level of uncertainty	14; 19
	S F	Org.	Creating incentives that pertain to intrinsic motivation	Intrinsic motivations are found to be more important than extrinsic motivation to activate participants	3; 11; 20; 10
			Autonomy of the task	Autonomy has a positive effect on intrinsic motivation to participate	10
			Variety of the work	Variety has a positive effect on intrinsic motivation to participate	10
			Clear problem description and definition; lack of tacitness of the task	Activates participants to partake in the challenge	10, 17
			Feedback from the organization	Increases willingness to participate in the future; leads to sustained activation	3, 11, 9
	Platf.		Using an intermediary platform in crowdsourcing initiatives	Assures the connection between the crowdsourcing organizations and the crowd by providing a platform where these parties are able to interact.	16
			Recognition mechanisms; attention and appreciation of participants	Constitutes a source of intrinsic motivation. Activating driver for participation.	3, 11, 20, 9
			Presence of an online community for participants	Attracts (creative) participants and provides the opportunity to learn from each other which drives intrinsic motivation.	11, 22
Contribution	C	Org.	Using monetary incentives to attract quality contributions	Monetary incentives cause an increase in the quantity of response, but also a decrease in the quality of the response	1, 6
			Difficulty level of task	While an easy task leads to a higher quantity of contributions, a difficult task leads to a higher quality of contributions	14
	S F	Org.	Attracting a large amount of contributions	A higher quantity of contributions increases the chance of finding the right or best solution/idea. (Originality of ideas is random, rule of large numbers [12].	8, 12, 19, 14
			Free entry of participants		19
			Higher awards (controversial)	Leads to a higher number of contributions	14
			Longer duration	14	
			Low competition intensity	14, 19	
	Crowd	Diverse crowd with diverse knowledge base	Diversity is instrumental to novel solutions or ideas, leads to higher number of substantial contributions	1, 8	

		Platf.	Technical and social marginality of contributors	Leads to higher problem-solving success, relevant perspectives and heuristics	17
			Intrinsically motivated participants	Leads to a higher number of substantial contributions	1
			Very high or very low degree of cooperative orientations	Results in a higher quality of contributions	21
			Attracting serial ideators	more likely than participants with only one idea to generate an idea the organization finds valuable enough to implement	13
Evaluation	C	Crowd	Large amount of contributions	Organizations have limited resources and evaluating contributions can be a big task; too many contributions can lead to a failure in correct judging due to information overload	2; 6
		Org. / Platf.	Using the crowd for collective judgment of contributions	On the one hand, helps organizations overcome their limited absorptive capacity. On the other hand, the organization loses control over the process, and IP loss can be an issue	2; 8; 18
	S F	Org.	Using an effective and accurate idea management system	Increases the effectiveness of idea assessment and overall effectiveness of the innovation process	2; 4
			Multi-attribute and criteria rating scales	Leads to better rating reliability and user satisfaction	2; 18
Implementation	C	Organization	Not-invented-here' syndrome	The organization may not want to internalize the proposed solution / idea due to pride issues. Forms a barrier to successful implementation	7
			Communication barriers in an organization	Limit the possibilities of successfully implementing a solution or new idea	7
			Reducing the complexity of an external idea	Requires sufficient absorptive capacity, else the idea can not be used	2; 5
	S F	Organization	Iterative process of communication between winning participant and organization	Helps create absorptive capacity to implement problems	5
			Key individuals that function as promoters	Can help overcome the barriers, facilitate a positive outcome in the particular projects and create a positive climate for the sustainable implementation of the method within their organizations.	7

Table 3. Summary of findings

Activation

It is found that most crowdsourcing initiatives fail because of a lack of participation. Therefore, the main challenge in the activation phase is motivating the crowd to participate in the initiative [3; 17]. The crowd can be motivated by certain perceived incentives, which activate corresponding motives

[1; 8]. It is found that especially intrinsic motivation is a key driver to activate participants [3; 10; 11; 20]. Intrinsic motivation concerns such intangible returns as passion, fun, satisfaction, personal development, and social interaction [1]. In the broadcast search setting, intrinsic motivation is found to be positively influenced by a number of factors. Regarding the nature of the challenge these are autonomy of the task [10], variety of the work [10], lack of tacitness of the task [10], and a clear problem description and definition [17]. Regarding the setting of the competition, these are the use of an intermediary platform, the presence of an online community and the existence of recognition mechanisms. An intermediary platform assures the connection between the crowdsourcing organizations and the crowd by providing a platform where these parties are able to interact [16]. An online community allows participants to interact and learn from each other, drives intrinsic motivation and is found to attract creative participants [11, 22]. Recognition mechanisms allow participants to receive attention and appreciation from peers or from the organization, a form of extrinsic motivation, and is found to be an activating driver for participation [3, 11, 20]. Furthermore, feedback from the organization can increase the willingness of the crowd to participate in the future, and can lead to sustained activation [3, 11]. Finally, individual incentives to participate may be diminished if the challenge is perceived as having too high a level of competition, especially in challenges with a low level of uncertainty [19].

Contribution

One of the main success factors of the contribution phase is found to be the attraction of a large amount of contributions, as this increases the chances of finding the right or best solution or idea [8; 12; 19; 14]. The factors that are stated to positively influence the amount of contributions are the free entry of participants [19], a low difficulty level of tasks [14], long duration of initiatives, low competition level and high rewards [14]. However, although using monetary incentives to attract contributions may lead to a higher quantity of response, it is also found to reduce the quality of the response [1; 6]. Furthermore, while a low difficulty level of tasks increases the quantity of contributions, a higher difficulty level of tasks results in a higher quality of contributions [14]. One study [21] found that the crowdsourcing intermediary can facilitate a higher level quality of response by enabling either a very high or very low degree of cooperation during the initiative [14]. Another possible way to increase quality of response is by attracting serial ideators, as these are found more likely than participants with only one idea to generate an idea the organization finds valuable enough to implement [13]. In general however, the quality of the response is found to be dependent on certain characteristics of the crowd, over which the organization or platform has no direct control, such as crowd diversity, marginality and motivation of the participants in the crowd [1; 8; 17]. A diverse crowd with a diverse knowledge base is stated to be instrumental to finding

novel solutions or ideas, as it leads to a higher number of qualitative contributions [1; 8]. Additionally, technical and social marginality of the individuals in the crowd are found to be statistically related to solution quality and problem-solving success in a broadcast search setting, as these individuals bring relevant novel perspectives and heuristics to the problem [17]. Finally, it is found that intrinsically motivated participants contribute higher quality solutions to innovation contests [1].

Evaluation

In the evaluation phase, a main challenge is dealing with large amounts of contributions, as organizations have limited resources and absorptive capacity to successfully evaluate these contributions [2; 6]. Too many contributions can result in an information overload, leading to a failure in correct judging of contributions [2; 6]. Using an effective and accurate idea management system might provide the means to overcome this challenge, as it is found to increase the effectiveness of idea assessment and the overall effectiveness of the innovation process [2; 4]. Another possibility to overcome this challenge is to use the crowd for collective judgment of contributions, also known as crowd-voting, as it allows the organization to use the crowd as an extra resource [2; 18]. While using crowd-voting may be a possibility for the evaluation of creative ideas, it is unlikely to benefit broadcast search for complex problem solving, as the assessment of problem quality is subject to the specific conditions within the organization, and it is therefore important for the organization to keep control of the evaluation process [8].

Implementation

The main challenges in the implementation phase relate to the functioning and culture of the organization. Communication barriers and the 'Not-invented-here' syndrome can prevent a solution or idea generated through crowdsourcing from being successfully implemented [7]. Having key individuals in the organization that function as promoters has been shown to help overcome these barriers and facilitate a positive outcome [7]. Furthermore, organizations may need to reduce the complexity of an external idea before it can be implemented [2; 5]. It has been found that communication between the participants and the organization can increase the absorptive capacity necessary for reducing the complexity, but this relates primarily to user generated ideas, and might not be relevant to the context of broadcast search, as participants are no longer involved in the later stages [2; 5].

5. Discussion & Conclusion

In this section, the importance of the results for the broadcast search process are discussed in regards to the main actors of the process, the different phases of the process, and the nature of the success factors and challenges. Additionally, practical and theoretical implications are drawn and limitations are discussed.

Taken together, the success factors and challenges that have been identified in the literature can be categorized in different ways. First, on the basis of which phase in the broadcast search process they influence — activation, contribution, evaluation or implementation; second, which main type of actor is involved — the organization, platform or the crowd or individuals in that crowd; and third, what the nature of the success factor or challenge is — task feature, organizational action or decision, platform feature, platform action or decision, crowd characteristic or individual characteristic. A successful outcome of a broadcast search process can be understood as being dependent on a certain combination of these actions, decisions, features and characteristics of different actors in the different phases.

The results of the activation and contribution phase clearly indicate that organizations using broadcast search for innovation need to create the right incentives to motivate and activate individuals to participate in and contribute to the challenge. Especially intrinsic motivations are found to be important [11; 20; 10], and an organization can utilize certain task features (autonomy and variety of the work, clear problem description) to appeal to these incentives [10; 17]. The results indicate that the quantity and quality of contributions is mostly dependent on the characteristics of the crowd that is attracted (diversity, marginality, motivation)[1; 8; 17], which can to some degree be influenced by the organization by adjusting features of the task design (duration, competition intensity, level of rewards)[14].

An interesting conflict exists surrounding the use of higher rewards to attract the desired participants, as increasing rewards can lead to a higher number of submissions [14], but also to lower quality of submissions [1; 6]. This difference illustrates the importance of attracting intrinsically motivated participants, as intrinsic motivation concerns such intangible returns as passion, fun, satisfaction, personal development, and social interaction, it can be expected to lead to more effort, and better results [1]. Extrinsic motivations such as money shift the considerations to an economic perspective, in which the participant makes a trade-off between invested time and expected returns. Higher rewards can thus lead to more contributions of little effort, as participants search for the optimal balance between time invested and potential returns [1]. Usually both extrinsic and intrinsic motivation play a role in determining participant activation and contribution

[14; 6], and interaction effects between these different motivational factors have been found to exist (however, these fall outside the scope of this thesis), showing that the relationship between motivation, participation and contribution performance can be very complex [1]. Overall, the creative process of trying to contribute a solution can be understood to be a source of positive feelings of self-expression, competence and autonomy for participants[1], and it therefore makes sense that an organization should design the open call in such a way as to appeal to these motivations. Furthermore, the intermediary platform can play an important part in creating the right setting and conditions to attract intrinsically motivated participants by providing the means for communication [11], cooperation [21], recognition [3], and guidance of the task design [16].

Remarkably, what is considered a success factor in the contribution phase — obtaining a large number of contributions, which increases the likelihood of a good idea or solution — is found to be a challenge in the evaluation phase, where a high number of contributions in combination with limited resources can lead to information overload and a failure to accurately assess the contributions [2; 6]. The issues regarding the trade-off between quality and quantity and successful evaluation show that an organization must make the decisions regarding desired response, task design and platform choice in accordance with their organizational goals and capacity. This trade-off can be difficult to make when the organization has no knowledge of the effect of these different parameters. One study suggests [14] that in order to support the decision-making of organizations, and facilitate in the setting of the right task attributes, the intermediary platform should make competition information about past projects – including award amount, duration, difficulty level, number of solvers and ability level of final winners – more accessible and clearer to the seekers on the platform. In this way, an organization can make a better informed decision and can learn from past projects.

Overall, organizations looking to use broadcast to benefit their chances of innovation should realize that success is not guaranteed, and that care should be taken to choose an intermediary platform, formulate the open call and design the task in accordance to their organizational goals and capacity, as these choices can influence the type of participants and the quality of submissions that are attracted. Crowdsourcing platforms looking to attract seekers and solvers should focus on facilitating the relationship between organization and crowd. They can provide the organization with information on past projects to guide their decisions, and can attract motivated solvers by fostering an online community with tools for social recognition.

The results reveal that certain aspects of broadcast search success are not well understood or considered controversial, such as the influence of extrinsic motivation on participant behavior and contribution performance, and more research on these subjects, taking care to incorporate possible interaction effects, can help provide a more detailed understanding. Additionally, it was found that not much literature has focused on the final phase of implementation. As stated by West and Bogers (2011), only a scarcity of research addresses this topic, and not much is known about “what happens to [external] innovations once they come into the firm”. However, some challenges were identified that hinder the successful implementation of an idea or solution after the initiative, and it can be interesting to know more about this phase, as these challenges might prevent the overall innovation process from being completed satisfactory [7].

In this thesis the notion of broadcast search success is confined to the factual outcome of the process from an organizational perspective (i.e. concrete idea or solution of benefit to the organization). However, each phase of the process can potentially provide added value in different ways for the different actors. For a participant this can mean learning from the initiative, meeting new people or simply enjoying the act of participation [6]. For an organization, added value can relate to generating goodwill among the crowd (making crowdsourcing an effective PR-strategy), learning from the crowd, and perhaps finding valuable idea’s unrelated to the initial goal of the project. Taken together, these intermittent opportunities for added value arising in the broadcast search process indicate that broadcast search success can be viewed in more ways than simply achieving a certain outcome. Future research can focus on these forms of added value, to see when and under which circumstances they arise, in order to more accurately understand the benefits of broadcast search for organizations and participants.

Limitations

From the 22 articles that were reviewed, 5 were not published in a peer-reviewed journal, but were peer-reviewed conference proceedings. These were included due to the scarcity of crowdsourcing research, but it should be noted that because of the lower level of thoroughness of the peer-review that can be expected from a conference proceeding, the validity of these papers might not be assured, and more research is warranted to affirm the effects found in these studies. Furthermore, the nature of the Google Scholar algorithm is such that non-transparent factors such as geographical location influence the ranking of the search results. While care was taken to browse as many results as possible, it might still be possible that relevant studies have been wrongfully excluded. Finally, since success factors and challenges are aggregated in this thesis, not all of them may be of relevance to a particular initiative, meaning that the generalization of the findings should be done

with care, a consideration echoed by three of the empirical studies included in the literature review [10; 14; 17], who state that context specific factors might have influenced the results in unforeseen ways. Nevertheless, the results provide a valuable overview of the broadcast search process, and can be used for future research as well as an initial guide for organizations looking to realize innovation through broadcast search.

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Appendix A.

The author matrix was constructed in a separate spreadsheet, but its proportions unfortunately limit it from accurately being displayed within the confinements of an A4 page. Therefore, the author matrix has been uploaded to a public location online, allowing for remote access from any geographical location.

The matrix can be found at: <http://tinyurl.com/oph5jcc>