Journal of Innovation & Knowledge 4 (2019) 240–247

Journal of Innovation & Knowledge

https://www.journals.elsevier.com/journal-of-innovation-and-knowledge

Empirical paper

Open innovation and the effects of Crowdsourcing in a pharma ecosystem

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ARTICLE INFO

Article history:
Received 14 March 2018
Accepted 25 March 2018
Available online 6 April 2018

JEL classification:
032

Keywords:
Crowdsourcing
Drug discovery
Pharmaceutical industry
Transaction cost theory

ABSTRACT

This study examines the emerging organizational concept of Crowdsourcing where new idea submissions from outside the firm's boundaries are obtained, selected, evaluated, coded, and integrated into the organization. This research is developed through a case study of a large European pharmaceutical company 'PharmaFX', we investigate the process of the interactions between the host company and its collaborators. The Crowdsourcing activities conducted in 2014 and 2015 are presented and acquired benefits are reported on from the perspective of transaction cost.

One of our central findings provide newly discovered evidence that the process of "*scientific Ideation Challenge*" as seen planned and implemented in PharmaFX in collaboration with InnoCentive – a reputable Crowdsourcing platform intermediary – have unique process characteristics, became less economically viable for PharmaFX than anticipated, this was partly due to the broadness of the scope of the Crowdsourcing initiatives. These findings could have a significant impact on future open innovation strategies and their economic viability in drug development.

Introduction and overview

The pharma industry has consistently been ranked as one of the most profitable industries (Debnath, Al-Mawsawi, & Neamati, 2010). The great profits obtained by the Pharma industry mostly stem from so-called "Blockbuster" drugs, which create global sales of at least $1 billion annually. In the last decade, pharma companies have optimized this blockbuster business model, in which they spend large amounts in internal research and development of new drugs, leading to a blockbuster drug (Gautam & Pan, 2016; Khanna, 2012).

Increased competition and the pressure to develop new drugs lead to great investments in drug research (DuBois, 2013). In recent years the trend has been increased declining R&D productivity, shorter exclusivity periods and increasing costs of commercialization (Au, 2014; Chesbrough & Chen, 2015). Despite significant advances, the number of drugs approved per $1 billion invested, halved about every nine years since 1950 (Scannell, Blanckley, Boldon, & Warrington, 2012). Of those drugs that reach the market, few are blockbusters.

While most research-based industries strives to frequently making modifications to their R&D processes, the pharmaceutical sector still deploys an inefficient drug development process (Kaitin, 2010). It seems like the companies are prisoners of their past successes. The 150-year-old paradigm of large companies being the dominate sources for developing pharmaceuticals is however changing (Earm & Earm, 2014; Ekins & Williams, 2010). Pharmaceutical companies are forced to achieve more value with fewer resources to ensure continuous innovation, which has resulted in a shift away from the "closed innovation" model. Ideas for new drugs are developed internally and commercialized by using vertically integrated in-house resources. This process relies heavily on secrecy, intellectual property rights, and corporate silos (Hunter & Stephens, 2010).

Novel steps towards an externalization of accessing capabilities are made in recent years through collaborations with academia, the cultivation of biotech start-ups and proactive licensing and acquisitions. However, this is still ending in the old schema of "closed" innovation. The arguments for the "closed innovation" model is for firms having full control of their ideas, which guarantees them a high return on investments. However, at a time where great ideas can emerge from any corner of the world, and information technologies have been economically viable when accessing external knowledge, it is now widely accepted that virtually no firm should base R&D on solely internal capabilities (Baldwin & Von Hippel, 2011; Pisano & Verganti, 2008).

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https://doi.org/10.1016/j.jik.2018.03.008

An increasingly acknowledged method to access outside capabilities is by using "Crowdsourcing". This entails that firms look outside their boundaries to get problems solved, by disclosing the details of the problem at hand, and inviting anyone deemed qualified to participate in solving the problem (Afuah & Tucci, 2012; Jeppesen & Lakhani, 2010; Norman, Bountra, Edwards, Yamamoto, & Friend, 2011).

Research has reported on the benefits and importance of openness and knowledge sharing amongst scientist by using crowds when scientific progress is desired (Lakhani & Boudreau, 2013). The pharmaceutical industry is already opening up as indicated by numbers of process outsourcing (Moss & Davies, 2014). Yet, only few companies exploit crowds effectively or at all (Moss & Davies, 2014). Organizations built on internal innovation processes are understandably cautious. Externalizing problem-solving in the early development stages can be dangerous, and raises the questions of how to protect intellectual property rights, how to incorporate Crowdsourcing administratively, what the associated costs might be, and how the quality of solutions can be ensured (Lakhani & Boudreau, 2013). While implementing Crowdsourcing in the pharmaceutical R&D context has been discussed for some time, it has increasingly started to gain focus on successful implementation (Hughes & Wareham, 2010; Hunter & Stephens, 2010). Consequently, the potential risks, but also potential benefits, have not yet been studied at the firm level in this industry.

Based on the findings from this study, general recommendations are proposed, as well as potential benefits and pitfalls from Crowdsourcing endeavours. Within the pharmaceutical industrial context, only one article addresses Crowdsourcing phenomena. The authors investigate how pharmaceutical companies have engaged external actors and, despite the pharmaceutical industry's increasing inclination towards Open Innovation and collaborations, their business models had not yet developed (Bentzien, Bharadwaj, & Thompson, 2015).

The motivation for conducting this case study is offering the reader micro focus on PharmaFX's Crowdsourcing Challenge and promoting greater understanding of the process within this particular industry. The strength of employing a case study method is to explore the managerial challenges and identify the navigation of process design and execution. The overall research question guiding this paper is:

How is a Crowdsourcing programme conducted in the case of PharmaFX and what benefits – if any – can be identified?

The paper is organized in the following sections. The first section concerns reviewing the literature on the topic of crowdsourcing, specifically over the recent years and identifies the gaps and thereafter the aim of the paper. The second section presents the methodological considerations guiding the data collection and processing. Specifically, the case of PharmaFX – a large pharmaceutical company specialized in treatments for cosmetic diseases, will be presented. The case is concerned with experimenting with Open Innovation and Crowdsourcing, and PharmaFX initiated this process because as the R&D Platform director puts it in 2015: they needed to "*do something different" and move away from the "closed" innovation business model, since this is not contributing to the discovery of new drugs in an "optimal manner*". The third section analyses and discusses the process employing a transaction cost lens. Finally, the last sections present conclusion and discusses managerial implications.

Domain of Crowdsourcing literature

The academic literature gives several definitions of the concept of Crowdsourcing. A recent study by Estellés-Arolas and González-Ladrón-de-Guevara (2012) identified 40 various definitions, which include the use of a crowd for problem-solving (Chiu, Liang, & Turban, 2014). The most cited definition is the original definition of the concept, coined by Jeff Howe: "*The act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and large) network of people in the form of an open call.*" (Howe, 2009).

The second most cited definition is provided by Afuah and Tucci (2012): Crowdsourcing is the act of outsourcing a task to a "crowd," rather than to a designated "agent" (an organization, informal or formal team, or individual), such as a contractor, in the form of an open call" (Boons, Stam, & Barkema, 2015; Palacios, Martinez-Corral, Nisar, & Grijalvo, 2016).

The two definitions indicate a consensus; it is however challenged by Zheng, Li, and Hou (2011) who perceive Crowdsourcing as a co-creation process, where the firm outsources its internal tasks by using the internet as a platform. Poetz and Schreier (2012) support this while putting the concept into perspective of open-source software. In this paper, Crowdsourcing is an outsourcing process, where a large network of people gets the opportunity to solve a certain task for a company, communicated in the form of an open call. Chua, Roth, and Lemoine (2015) researched the impact of culture on creativity and how this affected the participation in an online Crowdsourcing work. The authors claim that individuals from tight cultures are less likely than individuals from loose cultures, to engage in and succeed at creative Ideation in foreign cultures. The result being, that: "*. . .the greater the cultural distance, the lower the likelihood of creativity engagement and success at foreign creative tasks.*" (Chua et al., 2015, p. 216).

Bauer and Gegenhuber (2015) describe how Crowdsourcing affects the roles of consumers and producers. They claim that Crowdsourcing blurs the boundaries between consumer and producer, by getting consumers to employ capacities like their time, effort and knowledge. Hence, consumers act as suppliers. Kohler (2015) analyzed Crowdsourcing platforms to identify the patterns of successful and effective Crowdsourcing-based business models, with the scope of being able to suggest guidance for managers who wish to create or adapt an open, Crowdsourcing-based business model. Feller, Finnegan, Hayes, and O'Reilly (2012) have examined "Solver Brokerages", which are the intermediaries that facilitate the process of Crowdsourcing. The "Solver Brokerages" are of scientific and practical interest because they enable organizations to access outside knowledge and innovation capacity and as such increase the innovation capacity (Feller et al., 2012). Liu, Yang, Adamic, and Chen (2014) explore how different types of incentives affect the participation and submission quality. They found that higher rewards induced not only more submissions but also submissions of higher quality.

A study of Dell's *IdeaStorm* community highlights the difficulties in maintaining a steady supply of quality ideas from a crowd over time. Specifically, the study reveals that people who submitted an idea several times are more likely to generate ideas that are valuable to the organization (Bayus, 2013). Another study on Dell's IdeaStorm found, that: "*. . .individuals tend to significantly underestimate the costs to the firm for implementing their ideas but overestimate the potential of their ideas in the initial stages of the Crowdsourcing process.*" (Huang, Singh, & Srinivasan, 2014, p. 2138). The ideation possibilities might be overcrowded with ideas, and some unlikely to be implemented. However, over time the average potential of ideas increases, while at the same time, the number of submitted ideas decreases (Huang et al., 2014).

The crowdsourcing process as described by Zhao and Zhu (2014) is powerful and everyone has the potential to participate. According to the authors, a typical Crowdsourcing process starts when the organization identifies which tasks they wish to crowdsource, and deduces them available to a crowd that is willing and capable of executing the tasks for the organization, for a fee or other

incentives. The crowd participates either as individuals, or as teams, and tries to solve the task. After completion, the work is submitted to the Crowdsourcing platform. This is followed by the organization's assessment of the quality of the submitted work and the participants can then receive compensation (Zhao & Zhu, 2014, p. 417). Crowdsourcing has been valuable and widely used in practice. In their contemplation, 55 academic articles are identified, out of which, only 9 provided a theoretical basis. The authors claim that there is a lack of research on Crowdsourcing based on organizational theoretical foundations (Zhao & Zhu, 2014, p. 418ff).

Not surprisingly, crowdsourced problem-solving can, under certain circumstances, be more efficient than solving the problem internally, provided that (1) the characteristics of the problem, (2) knowledge required for the solution, (3) the crowd and (4) the solutions being evaluated. This is the case when Crowdsourcing transforms distant search into local search, which enables the company to benefit from distant search without carrying the associated cost. Conditions for Crowdsourcing are ideal when: "*(1) the problem is easy to delineate and broadcast to the crowd, (2) the knowledge required to solve the problem falls outside the focal agent's knowledge neighbourhood (requires distant search), (3) the crowd is large, with some members of the crowd motivated and knowledgeable enough to self-select and solve the problem, (4) the final solution is easy to evaluate and integrate into the focal agent's value chain, and (5) information technologies are inexpensive and pervasive in the environment that includes the focal agent and the crowd*" (Afuah & Tucci, 2012, p. 356). Bloodgood (2013) however questions the relevance of Crowdsourcing and its problem-solving nature. The author claims that despite its appearing enhancement of problem-solving, Crowdsourcing does not provide a substantive increase in firms' competitive performance. The author especially focusses on the focal firm, which might compromise its position by risking revealing new products to competitors during crowdsourced problem-solving. The author suggests that research on Crowdsourcing could be conducted with the perspective of awareness-motivation-capabilities (Bloodgood, 2013).

Another managerial consideration is found in Zheng et al. (2011), who suggest that firms need to improve task design and the way they motivate the people that participate in Crowdsourcing contests if they intend to optimize solutions from the process. The authors propose balancing the usage of extrinsic and intrinsic motivation when seeking to encourage participation in Crowdsourcing and that: "*Crowdsourcing contest tasks should preferably be highly autonomous, explicitly specified, and less complex, as well as require a variety of skills*." (Zheng et al., 2011, p. 57).

Recent studies have examined organizational capabilities in processing the suggestions they have solicited through a Crowdsourcing process (Piezunka & Dahlander, 2015). The authors claim, that "*. . .organizations that do not handle filtering well may fail to tap into the full potential of Crowdsourcing*." (Piezunka & Dahlander, 2015, p. 858), when organizations face a large pool of suggestions, they can only attend to a subset of the suggestions due to limited attention. Organizations are thus more likely to pay attention to those suggestions that are familiar to internal knowledge pole, which contradicts the reasoning for pursuing external knowledge (Piezunka & Dahlander, 2015).

Methodological considerations

This paper is based on an exploratory single-case study of PharmaFX (Voss, Johnson, & Godsell, 2016). The major advantage and suitability for case study method is discovering new ideas, gaining insights and summing up hypothesis. This approach is employed to explore relations that are more or less known or totally unknown (Voss et al., 2016). The exploratory research is a qualitative inductive investigation where both primary and secondary data are employed (Harden & Thomas, 2005). While some researchers agree that the detailed examination of a single case study cannot provide reliable information about the broader class, it may be useful in the preliminary stages of an investigation, because it provides hypotheses from a real life context, which may be tested systematically on a larger scale (Hill, Abercrombie, & Turner, 1984). To achieve triangulation, multiple data sources is used to create a richer picture and validate the data (Denzin & Lincoln, 1994). Furthermore, this approach is appropriate due to the relative newness of researching Crowdsourcing within a Pharma organization (Mills, Durepos, & Wiebe, 2010). Hence, the motivation for the case study method is the permission of a holistic view of contemporary real-life progression of events.

The selected case PharmaFX is a European pharmaceutical company that has operated for over a century. It produces pharmaceutical drugs for the treatment of cosmetic diseases among others; it sells its products in over 100 countries and employs more than 5000 people worldwide. According to internal documents, PharmaFX has a focus on Open Innovation as a means for "*exploring new opportunities and ways of working with external research partners*".

Data gathering was facilitated by the senior director of Open Innovation department at PharmaFX, who enabled access into the Crowdsourcing activities conducted in 2014 and 2015. The department responsible for managing the Open Innovation activities at PharmaFX carries the responsibility of collaborating with the rest of the organization. This includes setting up and executing on the Open Innovation platform, as well as managing the Crowdsourcing projects, with the goal of boosting innovation in the organization.

The unique opportunity of accessing primary and secondary data permits the researcher new insights into the problem (Farquhar, 2012). For both datasets, the same rigour and thoroughness is applied using QDAS and they are critically treated in terms of quality and their overall contribution to the paper (Farquhar, 2012, p. 77). The strategy employed for verifying the authenticity of the dataset is to apply different line of questioning in the interviews. Hence, the goal is to see if there are any divergences in the datasets, as well as in the findings.

The data coding strategy was executed using Qualitative Data Analysis Software (QDAS) for ruling out validity threats (Siccama & Penna, 2008). Specifically, NVivo 11 played a powerful role in systematically processing transcribed open-ended interviews at different levels in the organization. Furthermore, observations, participant logs and internal company documentation were collected over two years and coded. Firstly, the researchers worked disjointedly developing initial codes to mirror "categories" of data gathered and verified with the company informants. Through the review of the data, additional codes were identified that were general causes and effects of the implication of the Crowdsourcing challenge. As the project progressed, the researchers differentiated working in a constant comparison manner, where identical codes merged and others arranged in hierarchal structures. This process further strengthen validation in the data.

Data findings

In the case of PharmaFX, the Challenge category is a Premium Challenge as classified by the crowdsourcing platform provider InnoCentive, here the problem is solved within 45–90 days. InnoCentive handles confidentiality matters and transfer of Intellectual Property Rights (IPR). When the Challenge has a scientific or technical scope, the company only pays rewards for solutions that meet specific criteria. The Challenge has to be "*. . .a well-formed problem, whose solution has high value to an organization. It is specific, detailed, actionable, and delivers a measurable outcome*" (InnoCentive, 2016). The Challenge can be idea generation, obtaining new ideas, or a

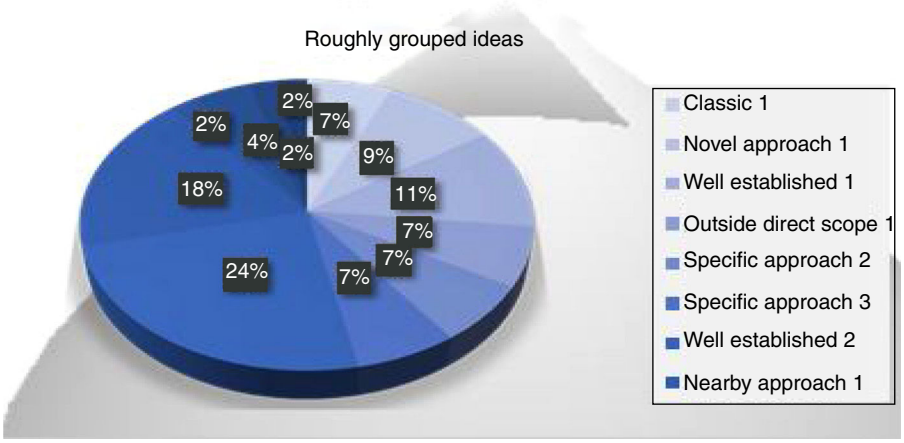

Fig. 1. Roughly grouped ideas.

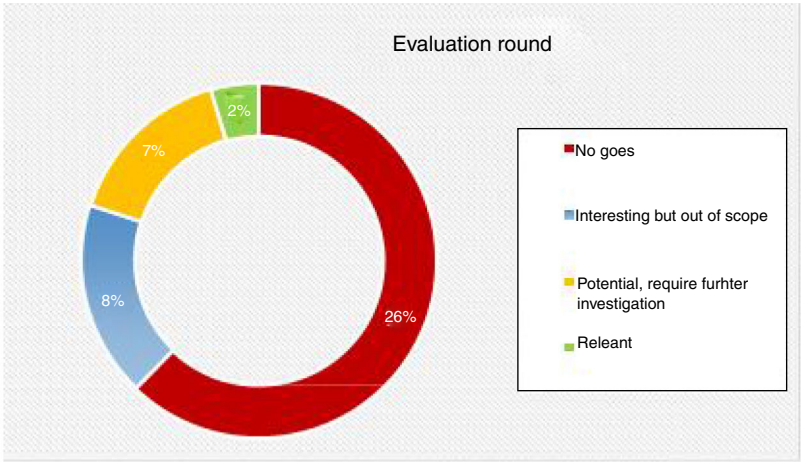

Fig. 2. Final evaluation.

complex technical or scientific problem solving. InnoCentive provides an expert that is suited for the specific Challenge, which helps PharmaFX formulate and articulate the Challenge, and the specific criteria for solutions suitability. The InnoCentive expert will throughout the period of online posting of the Challenge be of service to 'solvers', the external crowd member, who have questions or requests regarding the Challenge. When the Challenge deadline is reached the expert ranks the incoming submissions, to help the company with identifying the solution(s) that best meet the specific criteria and needs. When the winner(s) are found, InnoCentive verifies the solvers identity, obtains a Solver Agreement contract and any necessary employer waiver, transfer the award to the solver and finally handles the transfer of IP (InnoCentive, 2016).

Other sources of data are project description, facts about submissions in the Crowdsourcing Challenges and internal evaluation processes at PharmaFX. This data permits us some deeper insights into submissions, evaluation processes, methodologies for identification of the winners of the Crowdsourcing project and finally the reward allocations. In the following a short overview of the data is presented. In total, 58 submissions were sent to PharmaFX's specific Challenge, out of which, 13 were filtered and 45 were forwarded for the first evaluation round.

These 45 submissions were then grouped into different categories based on similar scientific concepts. The number of ideas in each category is presented in percentage in Fig. 1. Noticeable here is that many submissions are well established or had a nearby approach, whereas a small percentage is outside the direct scope of the Challenge.

The first initial rough evaluation is conducted by four persons in the evaluation team. They colour-coded each of the 45 submissions: red indicated a "*bad*" solution, yellow a "*maybe good*" solution and green "*good*" solution. Internally, both the problem owner and the scientific specialists did not find any of the submitted solutions as being a 'good' solution at this stage.

Further in the process, the information about the final evaluation of the submitted ideas is now grouped into the following four categories: "*No goes*", "*Interesting but out of scope*", "*Potential, require further investigation*" and "*Relevant*". These categories are presented in absolute numbers in Fig. 2. It is noteworthy that the colours presented in Fig. 2 are representing the "*Final conclusion traffic light*" developed by the evaluation team during the evaluation phase. Of all submitted solutions, approximately 20% are of value to PharmaFX whereas around 80% cannot be utilized.

The evaluation guidelines describe the process of gathering two different kinds of Challenge winners, without communicating this separation to the community. The first type of winner is the one who submitted a solution for a specific need for PharmaFX. Accordingly, the idea must fulfil distinct success criteria. Further, the idea could have existed internally and if so, there is an extra value. Therefore, the idea will most likely be transferred to the problem owner.

The second type of winner is a creative submission, where the idea is not exactly what PharmaFX identified as a solution, but is

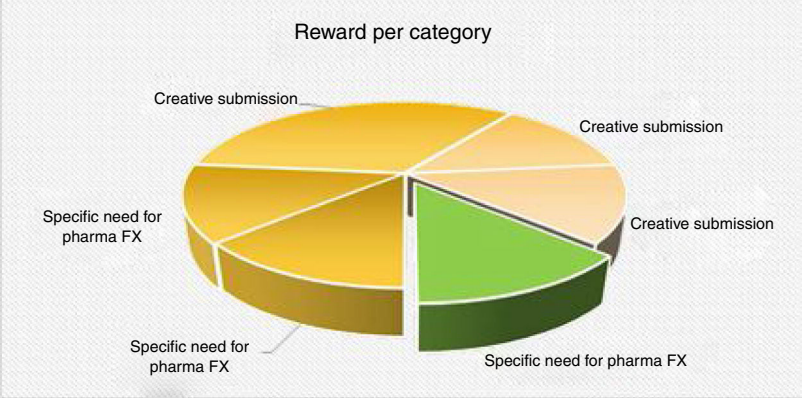

Fig. 3. Rewards per category.

creative, interesting or holds otherwise possible value, but not necessarily and exactly for this Challenge. This kind of idea should not exist internally.

Next in the process, the focus is on the rewards; how much it is, which type of category and what type of winner is rewarded. Building on the before introduced colour scheme, only ideas with "potential" (Yellow) and ideas which are "relevant" (Green) are awarded. Among the six Challenge winners, half were creative submissions and the other half had a specific value for PharmaFX. Only one of the "a relevant solution (total of two, as seen in Fig. 3) was rewarded and one submission with "potential" received $5000 instead of $2000 as the rest.

In the case of PharmaFX and the crowdsourced Challenge underlying this study, the management team decided not to reveal the sponsor of this Ideation Challenge. The Director of Open Innovation Department (DoOID) elaborated: "*First of all there is an incentive not to say it is us because that will not bias the answers so you get more open answers, and secondly it might not be relevant for them to know it is us*". This means that none of the participants knew the identity of the sponsor, nor the identity of the successful submission rewarded at the end of the challenge.

Case analysis

From a firm's perspective, there is costs of conducting a Crowdsourcing Challenge linked to the process of building the Challenge. These costs are related to the resources spent on briefing the crowd (the solvers) on the problem. Solvers need to have an adequate understanding of the problem they are invited to solve: It is the focal organisation's responsibility to analyze cost reductions internally, codify properly and transfer needed knowledge to solvers. These costs can be viewed in the light of Transaction Cost Theory (TCT) in which they negatively affect the profitability.

Data from PharmaFX's Crowdsourcing Challenge were examined by considering the costs associated with three steps of the process: internal cost reduction, codification and evaluation. These costs could be divided into two separate categories: intermediary and internal costs. The goal was to be able to illustrate how they affected PharmaFX's Crowdsourcing Challenge.

Internal cost reduction rational

Several researchers have pointed out that using Crowdsourcing to solve tasks can be cheaper than solving them internally. This is also a key argument in TCT, which proposes that firms need to reduce costs to raise their profitability while maintaining their competitive advantage. Hence, it is interesting to see what role cost reduction plays in PharmaFX.

Intermediary costs

Two categories of costs emerge when looking at PharmaFX's scientific Ideation Challenge. One category is the costs related to the intermediary. PharmaFX collaborated with InnoCentive as an intermediary for their Crowdsourcing Challenge. Two types of costs are associated with InnoCentive as the intermediary: (1) the cost of service provided by InnoCentive and accessing their online platform and (2) the monetary rewards given to the six people that are rewarded for their submissions.

Internal costs

The other category of costs is the one related to the internal resources deployed at PharmaFX. While the costs stemming from the collaboration with InnoCentive are evident from the contractual agreements, the costs arising from the deployment of internal resources at PharmaFX are less so, and no specific accounting for the internal resources at PharmaFX is evident in the data. Nevertheless, the organizational practices and consequences stemming from organizing and handling the Crowdsourcing must be addressed.

Codification costs

Intermediary costs

PharmaFX collaborated with InnoCentive to codify the Challenge accurately with associated costs. Through workshops and extensive communication, the Challenge formulation was concretized in a close collaboration between InnoCentive PharmaFX.

Internal costs illustration

PharmaFX deployed internal resources to codify and transfer knowledge to the participating solvers. Employees worked together with the person that had the problem that is going to be crowdsourced. From the perspective of internal cost savings, the deployment of internal resources is significant and the organization estimates a high financial burden, due to unviable costs related to the codification efforts.

Evaluation costs

The costs of evaluating the submitted proposals and picking the winners puts a high demand on internal resources. The evaluation process started as soon as the Crowdsourcing Challenge ended on InnoCentive's platform. The open innovation team allocated one month to evaluate all the submitted solutions and give senior management feedback. Several evaluation rounds were conducted because the project members required further investigation

in discovering the value of some ideas deemed dubious at the early stages. Another reason for the lengthy process was that evaluations of submitted ideas were done according to sets of different criteria. This resulted in some ideas getting a reward, even though the idea would not be implemented at PharmaFX (Fig. 3). As such, these costs could be a direct loss for PharmaFX.

Discussion

Among the key arguments of transaction cost theory is the need to reduce costs to improve profitability and maintain competitiveness (Coase, 1937). In using opening innovation processes and permitting for co-development, it has been suggested, that firms can reduce their costs when using Crowdsourcing to solve a task (Howe, 2009, 2016). PharmaFX conducted Crowdsourcing to get scientific inputs. The question is whether PharmaFX's Crowdsourcing Challenge was economically viable compared to internal alternatives.

PharmaFX decided to crowdsource based on an assumption that it would be financially viable. Retrospectively PharmaFX gained great scientific inputs at an inexpensive price, while only awarding six individuals a total sum of $15,000.

Even supposing PharmaFX would try to proof that their Crowdsourcing Challenge leads to cost reduction compared to internal alternatives, the reality is far from the truth. The data coding and analysis show that the overall costs of the Challenge have not been kept track of, although costs were central in the overall reasoning for initiating the project. The participation of internal resources associated with the Challenge which was unaccounted for prior to the Crowdsourcing Challenge. The management had no estimation of man-hours, and the director was personally involved to initiate the Challenge. Furthermore, several employees were involved during various processes, which included several managers and other specialists at PharmaFX. Management found it quite difficult to assess how the Crowdsourcing Challenge led to internal value creation while also having to reward idle submissions. As such, the costs associated with rewarding unused ideas must be considered a direct loss of the Crowdsourcing project.

The management's perception of the financial aspect was not critical towards the decision to crowdsource. This is illustrated by the sequence of events leading to the crowdsource. It is further demonstrated by the Open Innovation department getting the Crowdsourcing Challenge started, sine the problem ownership lays at another department. This clearly indicates that it was a strategic decision to crowdsource and that costs were not unimportant, but weren't the primary reason for crowdsourcing.

Codification costs emerge because of the need to provide potential solvers with adequate knowledge and background information about the Challenge. However, complex and specific knowledge is still required (Soukhoroukova, Spann, & Skiera, 2012), which leads to tremendous codification costs (Williamson, 1981). This results in costs for the firm that will negatively affect the firm's overall costs in Crowdsourcing activities (Kankanhalli, Tan, & Wei, 2005). PharmaFX's Crowdsourcing Challenge was a scientific Ideation Challenge. The exact phrasing of the Challenge was considered of significant complexity and difficulty, since no one at PharmaFX could provide solutions internally. Hence, it is interesting to take into perspective the codification costs, and the research regarding how these costs affect firms' Crowdsourcing activities. The question might then be if PharmaFX's Crowdsourcing Challenge required an immense degree of codification.

This is necessary for different reasons: the phrasing of the Challenge needed to attract the right people, and the Challenge should sound exciting. The intermediary InnoCentive mainly did the phrasing. However, despite the collaborative efforts PharmaFX received from InnoCentive, there was still a great pool of internal resources associated with the codification process. This is illustrated by several employees and managers at PharmaFX being significantly involved in the process.

Examining the complexity of PharmaFX's Crowdsourcing Challenge, the solvers needed a specific scientific background and specific knowledge, to be able to contribute to the Challenge. PharmaFX collaborated with InnoCentive to gain access to a specialized crowd with a life science background.

PharmaFX's as a pharmaceutical company might also have higher codification costs for the specific type of Challenge. It was necessary to maintain the anonymity of PharmaFX's business strategy when Challenge was initiated. This was primarily vital to secure unbiased answers from solvers, but also to minimize exposure of the initiative to other competitors. Hence, this resulted in extra codification efforts. The danger of disclosing any potentially confidential information could reveal pharmaceutical firms 'innovation models shifting from open to closed, thus PharmaFX was still concerned about the extent of the openness. Arguably, this apprehension was concluded compulsory because confidentiality is a principal characteristic in the pharmaceutical industry.

Theoretical generalization

It is arguably a paradoxical outline for a pharmaceutical company such as PharmaFX to crowdsource, while at the same time trying to maintain a certain level of confidentiality. There is a trade-off between Crowdsourcing and keeping the status quo. Evaluating the submissions provided by solvers in a Crowdsourcing Challenge can be time-consuming (Baldwin & Von Hippel, 2011; Pisano & Verganti, 2008), and as such, costly for the host organization. This is especially the case when there is a high degree of uncertainty related to the evaluation (Ye & Kankanhalli, 2015), and this can, in turn, lead to an increase in the overall Crowdsourcing cost for the firm. The question regarding the degree of uncertainty might lead to a lengthy evaluation process and as seen in the analysis, the evaluation process was a large effort. PharmaFX was extensively engaged in the assessment, which arguably resulted in a high expense. At the intermediary partner, the number of submissions was not extraordinary for similar Crowdsourcing Challenges; in fact, it was within the expected range.

The submissions' high degree of uncertainty was arguably also challenging. The submissions were theoretical ideas, which put extra demand on the evaluating team members because they investigated the submissions. Requesting ideas in a Crowdsourcing Challenge entails a higher level of uncertainty, relative to Crowdsourcing of a specific product.

The evaluation process might have been more complex and time-consuming because each submission was thoroughly evaluated, in addition to carefully investigate the viability of integrating the submission into the organization. During the evaluation, it became clear that the submissions needed to be evaluated from two different perspectives. First, solvers needed to be rewarded for submissions that fulfilled the officially illustrated success criteria of the Crowdsourcing Challenge. Secondly, the organization required additional competences to exploit the ideas. Interestingly, it was a surprise for the organization that the two perspectives did not necessarily correlate. As such, ideas that already existed internally, or ideas that were regarded unsuitable in the company, could still fulfil the deduced success criteria for the Crowdsourcing Challenge. Surely, each submission needed to be evaluated critically and thoroughly, however, the unawareness about the discrepancy, related to evaluating the submissions from two non-correlating perspectives resulted in lengthy evaluations process. It can be argued, that the high degree of uncertainty represents the root cause. As such,

this argues for an increase in the overall transaction costs for the Crowdsourcing Challenge.

There were conflicting explanations on how the evaluation round was executed. The director illustrated that the evaluation round was not formalized, and there were not any fixed guidelines provided to the evaluation team members. This is conflicting with a description of the methods employed by InnoCentive in their collaboration efforts with focal companies in their Crowdsourcing Challenge initiatives. The former CEO of InnoCentive predominantly claims that companies are helped with formulating the evaluation success criteria (Allio, 2004). However, he also asserts that the organization might have employed certain criteria at the end of the evaluation. This indicates that the evaluation round ought to be well planned and organized, to avoid a prolonged evaluation process with high evaluation costs.

Synthesis and conclusion

This study aimed to explore the benefits of Crowdsourcing gained by PharmaFX and has identified the specific benefits which can be obtained, based on the case. Particularly the study is considering the benefits of reduced costs, increased brand visibility and access to specialized skills and their applicability to the pharmaceutical industry. The general academic literature of Crowdsourcing, specifically in the pharmaceutical context, is found to be not conclusive on more than a few vital questions concerning these benefits.

Synthesizing the findings, PharmaFX could gain access to specialized skills and solution diversity. The broadness of the Ideation Challenge allowed greater overall participation, which resulted in comparable greater access solution diversity. The increased access to specialized skills and solution diversity became evident in the amount and difference of the submissions. Concerning cost reduction, we found that Ideation Challenges are subject to relatively high costs in evaluation and codification, which negatively affects the overall cost reduction. However, the Ideation Challenge did not necessarily aim to reduce costs, but rather to produce new and different knowledge.

Using Crowdsourcing for a specific scientific problem would arguably always entail the need for solvers with a very specific background. Furthermore, given that the crowdsourcing might only be a small piece of the puzzle of a larger pharmaceutical R&D process. One can probably also assume, that it may be necessary to provide solvers with a larger amount of information for them to be able to provide suitable solutions.

Managers can constrain the number of generated ideas by casting a smaller net. This could be achieved by selecting a smaller group of external contributors, where a viable scenario could be identifying contributors most likely to provide distant knowledge. It is also suggested that organizations, before pursuing Crowdsourcing, establish procedures to facilitate the processing of large quantities of suggestions, define a goal ratio for how many ideas to implement, and establish criteria for how to prioritize suggestions.

In the context of Ideation Challenge, it is the sponsor looking for a greater amount of diversity, not only in the crowd but also in the solutions. The broadness of the Challenge is necessary, though it comes with greater difficulty in phrasing, resulting in greater codification costs. Furthermore, while this broadness of Ideation Challenges might increase the access to specialized skills and diverse solutions, it also increases the number of overall submissions, leading to increased evaluation costs. This can potentially result in Crowdsourcing not being as cost efficient as expected, and even have no cost reductions.

Pharma companies can benefit from opening the innovation processes, since this enables leveraging externalized knowledge, while managing the risk of competitors exploiting the same openness. Great potentials can be gained for pharma, if the fear of openness is managed.

Limitation and further research

As with all research, it is important to recognize limitations of this study. The single case, albeit explorative, of necessity limits the generalizability of the findings. Yet this unique case offers insights about the phenomena and invites to new research territory (Patton, 2002). Further restrictions of this study are regarding the potential long-term effects of the Crowdsourcing initiative.

Further research can consider the potential of cost reduction from scientific Ideation Crowdsourcing Challenge compared to internal scientific Ideation generation. Other external search alternatives, which have the same benefits as scientific Ideation Challenges, to a comparable price. Finally, longitudinally study assessments of the value creation from scientific Crowdsourced problem solving.

References

Afuah, A., & Tucci, C. L. (2012). Crowdsourcing as a solution to distant search. *Academy of Management Review*, *3*(3), 355–375.

Allio, R. J. C. I. (2004). CEO interview: The InnoCentive model of innovation. *Strategy and Leadership*, *32*(4), 4.

Au, R. (2014). The paradigm shift to an "open" model in drug development. *Applied & Translational Genomics*, *3*, 86–89.

Baldwin, C., & Von Hippel, E. (2011). Modeling a paradigm shift: From producer innovation to user and open collaborative innovation. *Organization Science*, *22*(6), 1399–1417.

Bauer, R. M., & Gegenhuber, T. (2015). Crowdsourcing: Global search and the twisted roles of consumers and producers. *Organization*, *22*(5), 1.

Bayus, B. L. (2013). Crowdsourcing new product ideas over time: An analysis of the Dell IdeaStorm community. *Management Science*, *59*(1), 1.

Bentzien, J. J., Bharadwaj, R., & Thompson, D. C. (2015). Crowdsourcing in Pharma: A strategic framework. *Drug Discovery Today*, *20*, 7.

Bloodgood, J. (2013). Crowdsourcing: Useful for problem solving, but what about value capture? *Academy of Management Review*, *38*(3), 455–457.

Boons, M., Stam, D., & Barkema, H. G. (2015). Feelings of pride and respect as drivers of ongoing member activity on Crowdsourcing platforms: Feelings of pride and respect as drivers of ongoing member activity. *Journal of Management Studies*, *52*(6), 717–741.

Chesbrough, H., & Chen, E. L. (2015). Using inside-out open innovation to recover abandoned pharmaceutical compounds. *Journal of Innovation Management*, *3*(2), 21–32.

Chiu, C.-M., Liang, T.-P., & Turban, E. (2014). What can crowdsourcing do for decision support? *Decision Support Systems*, *65*, 40–49.

Chua, R. Y. J., Roth, Y., & Lemoine, J.-F. (2015). The impact of culture on creativity. *Administrative Science Quarterly*, *60*(2), 189–227.

Coase, R. H. (1937). The nature of the firm. *Economica*, *4*(16), 386–405.

Debnath, N., Al-Mawsawi, L. Q., & Neamati, N. (2010). Are we living in the end of the blockbuster drug era? *Drug News & Perspectives*, *23*(10), 670.

Denzin, N. K., & Lincoln, Y. S. (1994). *Handbook of qualitative research*. Sage Publications, Inc.

DuBois, S. (2013). Novartis CEO: We need to re-think the blockbuster – Fortune management. *Fortune*.

Earm, K., & Earm, Y. E. (2014). Integrative approach in the era of failing drug discovery and development. *Integrative Medicine Research*, *3*(4), 211–216.

Ekins, S., & Williams, A. J. (2010). Reaching out to collaborators: Crowdsourcing for pharmaceutical research. *Pharmaceutical Research*, *27*(3), 393–395.

Estellés-Arolas, E., & González-Ladrón-de-Guevara, F. (2012). Towards an integrated crowdsourcing definition. *Journal of Information Science*, *38*(2), 189–200.

Farquhar, J. D. (2012). *Case study research for business*. London [England]; Thousand Oaks, CA: SAGE.

Feller, J., Finnegan, P., Hayes, J., & O'Reilly, P. (2012). Orchestrating sustainable Crowdsourcing: A characterisation of solver brokerages. *The Journal of Strategic Information Systems*, *21*, 3.

Gautam, A., & Pan, X. (2016). The changing model of big pharma: Impact of key trends. *Drug Discovery Today*, *21*(3).

Harden, A., & Thomas, J. (2005). Methodological issues in combining diverse study types in systematic reviews. *International Journal of Social Research Methodology*, *8*(3), 257–271.

Hill, S., Abercrombie, N., & Turner, B. (1984). *The Penguin dictionary of sociology*. Penguin Publisher.

Howe, J. (2009). *Crowdsourcing: Why the power of the crowd is driving the future of business*. New York: Three Rivers Press.

Howe, J. (2016). *The rise of Crowdsourcing | WIRED*. Accessed January, 12.

Huang, Y., Singh, P. V., & Srinivasan, K. (2014). Crowdsourcing new product ideas under consumer learning. *Management Science*, *60*, 9.

Hughes, B., & Wareham, J. (2010). Knowledge arbitrage in global pharma: A synthetic view of absorptive capacity and open innovation: Knowledge arbitrage in global pharma. *R&D Management*, *40*(3), 3.
Hunter, J., & Stephens, S. (2010). Is open innovation the way forward for big pharma? *Nature Reviews Drug Discovery*, *9*(2), 2.
InnoCentive, A. (2016). *InnoCentive office locations | follow us socially*. Accessed February, 16.
Jeppesen, L. B., & Lakhani, K. R. (2010). Marginality and problem-solving effectiveness in broadcast search. *Organization Science*, *21*(5), 1016–1033.
Kaitin, K. I. (2010). Deconstructing the drug development process: The new face of innovation. *Clinical Pharmacology*, *87*(3), 3.
Kankanhalli, A., Tan, B., & Wei, K.-K. (2005). Contributing knowledge to electronic repositories: An empirical investigation. *Management Information Systems Quarterly*, *29*(1), 1.
Khanna, I. (2012). Drug discovery in pharmaceutical industry: Productivity challenges and trends. *Drug Discovery Today*, *17*(19–20), 1088–1102.
Kohler, T. (2015). Crowdsourcing-based business models: How to create and capture value. *California Management Review*, *57*(4), 1.
Lakhani, K., & Boudreau, K. (2013). Using the crowd as an innovation partner. *Harvard Business Review*, *91*, 4.
Liu, T. X., Yang, J., Adamic, L. A., & Chen, Y. (2014). Crowdsourcing with all-pay auctions: A field experiment on taskcn. *Management Science*, *60*(8), 2020–2037.
Mills, A., Durepos, G., & Wiebe, E. (2010). A. Mills, G. Durepos, & E. Wiebe (Eds.), *Encyclopedia of case study research* (Vol. 1). Thousand Oaks, CA: SAGE Publications, Inc.
Moss, K., & Davies, N. (2014). *R&D outsourcing in hi-tech industries: A research study – PWC* outsourcing-in-hi-tech-industries.pdf.
Norman, T. C., Bountra, C., Edwards, A. M., Yamamoto, K. R., & Friend, S. H. (2011). Leveraging Crowdsourcing to facilitate the discovery of new medicines. *Science Translational Medicine*.
Palacios, M., Martinez-Corral, A., Nisar, A., & Grijalvo, M. (2016). Crowdsourcing and organizational forms: Emerging trends and research implications. *Journal of Business Research*, *69*(5), 1834–1839.
Patton, M. Q. (2002). Two decades of developments in qualitative inquiry: A personal, experiential perspective. *Qualitative Social Work*, *1*(3), 261–283.
Piezunka, H., & Dahlander, L. (2015). Distant search, narrow attention: How crowding alters organizations' filtering of suggestions in Crowdsourcing. *Academy of Management Journal*, *58*(3), 1.
Pisano, G. P., & Verganti, R. (2008). Which kind of collaboration is right for you? *Harvard Business Review*, *1*.
Poetz, M. K., & Schreier, M. (2012). The value of Crowdsourcing: Can users really compete with professionals in generating new product ideas? *Journal of Product Innovation Management*, *29*(2), 245–256.
Scannell, J. W., Blanckley, A., Boldon, H., & Warrington, B. (2012). Diagnosing the decline in pharmaceutical RandD efficiency. *Nature Reviews Drug Discovery*, *11*(3), 1.
Siccama, C. J., & Penna, S. (2008). Enhancing validity of a qualitative dissertation research study by using NVIVO. *Qualitative Research Journal*, *8*(2), 91–103.
Soukhoroukova, A., Spann, M., & Skiera, B. (2012). Sourcing, filtering, and evaluating new product ideas: An empirical exploration of the performance of idea markets: Idea markets. *Journal of Product Innovation Management*, *29*(1), 100–112.
Voss, C., Johnson, M., & Godsell, J. (2016). Case research. In C. Karlsson (Ed.), *Research mehods for operations management* (2nd ed., Vol. 1, pp. 165–197). London: Routledge.
Williamson, O. E. (1981). The economics of organization: The transaction cost approach. *American Journal of Sociology*, *87*(3), 548–577.
Ye, H. J., & Kankanhalli, A. (2015). Investigating the antecedents of organizational task crowdsourcing. *Information and Management*, *52*(1), 98–110.
Zhao, Y., & Zhu, Q. (2014). Evaluation on Crowdsourcing research: Current status and future direction. *Information Systems Frontiers*, *16*(3), 417–434.
Zheng, H., Li, D., & Hou, W. (2011). Task design, motivation, and participation in Crowdsourcing contests. *International Journal of Electronic Commerce*, *15*(4), 1.