R&D MANAGEMENT

Knowing too much? On bias due to domain-specific knowledge in internal crowdsourcing for explorative ideas

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Internal crowdsourcing utilizes a firm's employees, of which many have a strong understanding of the domains in which the firm operates, for contributing with, developing and evaluating ideas. On the one hand, these employees can use their domain-specific knowledge to identify the value of what may seem a far-fetched solution to the average employee. On the other hand, previous research has shown that employees typically evaluate ideas in their domains less favorably if they do not align with ongoing exploitation activities. Hence, this study focuses on whether a higher degree of relevant domain-specific knowledge makes employees participating in internal crowdsourcing prefer exploitative solutions when evaluating ideas. An empirical study of an online platform for firm-internal innovation in a multinational engineering company showed that employees who only infrequently participated in internal crowdsourcing mostly contributed to and evaluated ideas within their own domain. Employees who frequently participated also contributed to and evaluated ideas outside their own domains. By statistically analyzing group differences during idea evaluation, we show that employees participating infrequently favor exploitable solutions, whereas employees participating frequently are more uncertain. The former difference is only seen concerning ideas that require domain-specific knowledge to understand, but the latter is observed for all types of ideas. This study makes three substantial contributions. First, employees with domain-specific knowledge, through their preference for exploitative solutions, bias the outcome of internal crowdsourcing when idea evaluation requires domain-specific knowledge. Second, this bias is aggravated by the overall higher level of uncertainty displayed by employees participating frequently in internal crowdsourcing and thereby tend to reach out to other domains. Third, in order to mitigate this, bias management can build engagement in internal crowdsourcing through idea challenges that do not require domain-specific knowledge and consider avoiding employees with a strongly associated domain knowledge for idea evaluation.

1. Introduction

The survival of a firm in the long term depends on its ability to strike the right balance between *exploring* new opportunities and *exploiting* current competencies (March, 1991). Instead of exploring opportunities, firms tend to exploit competencies which generate greater benefits in the short term (Levinthal and March, 1993; Levinthal and Marengo, 2020). One mechanism that has the possibility to support exploration with new and often unconventional solutions is *crowdsourcing* (Afuah and Tucci, 2012). However, this mechanism has mostly proven its worth in a structurally separated *external* context (Surowiecki, 2004; Afuah and Tucci, 2012; Feller et al., 2012; Schweitzer et al., 2012; Boulesnane and Bouzidi, 2013; Mladenow and Bauer, 2014; Lang and Bharadwaj, 2016; O'Leary, 2016). *Internal* crowdsourcing is a more recently proposed concept (Simula and Ahola, 2014; Malhotra et al., 2017), which coincides with a current increase in the use of new information technology (IT)-based tools for internal idea management in large corporations (Sandström and Björk, 2010; Kornish and Hutchison-Krupat, 2017). Arguably, also internal crowdsourcing constitutes a potential means to access new explorative ideas with a higher degree of novelty and diversity, as it allows firms to engage both a larger number of individuals and a more diverse knowledge base in the innovation activities than what is otherwise the case.

However, there exists a challenge centered on domain-specific knowledge for firms interested in leveraging internal crowdsourcing. Those taking part in crowdsourcing have to exert significant effort to understand domain-specific knowledge (i.e., facts, relationships, and terminology that are only [frequently] used by those concerned with a specific activity) (Nooteboom, 2000). On the one hand, many of the employees in firm-internal crowds will have in-depth knowledge of domains relevant to the firm's business, and thus be capable of evaluating solutions that require domain-specific knowledge (to understand the idea or problem). These employees could, in their domains, support the recognition of deserving *explorative* ideas from remote sources whose value is not apparent to other employees. However, on the other hand, it is known that experts also focus more on the feasibility aspect when evaluating ideas (Kristensson and Gustafsson, 2004; Poetz and Schreier, 2012) and are well aware of their firm's technologic trajectory (Dosi, 1982). This suggests that employees might favor more *exploitable* ideas in their domains, as these ideas more clearly take this technologic trajectory into consideration and also tend to be more feasible to implement. In other words, the domain-specific knowledge required to recognize the value of explorative solutions could, in a paradoxical way, predispose employees participating in internal crowdsourcing against these very same solutions. As firms have limited resources, employees thus biased toward exploitative solutions may foster insufficient exploration and, consequently, contribute less to firms' long-term competitiveness and performance.

The purpose of this study is to investigate whether a higher degree of relevant domain-specific knowledge makes employees prefer exploitative solutions when evaluating ideas during internal crowdsourcing.

The next section presents the theoretical background of the study and derives four hypotheses. These hypotheses tie the risk of bias in the outcome of internal crowdsourcing to the level of engagement by employees in cases where ideas require domain-specific knowledge. These causal relationships can be stipulated as internal crowdsourcing is centered on crowdsourcing tasks, which are likely to be limited to specific domains when requiring domain-specific knowledge. On the one hand, employees infrequently participating in internal crowdsourcing are thus able and likely to limit themselves to ideas and problems concerning their own domains. They will thus propose, develop, and – most importantly for this study – evaluate solutions primarily within their domains of expertise. On the other hand, employees participating frequently in internal crowdsourcing will be exposed to many domains different from their own. Most likely, this will not make them experts in these other domains, but the deeper understanding will at least make them more accepting when they evaluate (explorative) solutions from them. The third section describes the methods used and our empirical research setting – a multinational engineering company developing cyber-physical systems (CPS). We further describe the research design including both qualitative and quantitative research methods. The results section establishes that employees contributing frequently to internal crowdsourcing are more uncertain during idea evaluation than their peers, regardless of whether ideas require domain-specific knowledge or not. We also establish that when domain-specific knowledge is required, employees participating in internal crowdsourcing more infrequently value exploitable ideas higher than explorative ideas. Thus, during the idea evaluation phase of internal crowdsourcing, employees infrequently contributing to internal crowdsourcing might introduce a bias toward exploitation in the outcome. This bias is aggravated by the larger overall perceived uncertainty exhibited by employees frequently contributing to internal crowdsourcing during the same evaluation phase. In the analysis and discussion section, we present our contributions and discuss how

innovation management can potentially mitigate the identified bias by boosting engagement and using qualification-based preselection of the employees that are to participate in internal crowdsourcing. Several factors that boost engagement will be counteracted when most of the ideas require domain-specific knowledge. Innovation management might thus first have to focus on including a larger share of other types of crowdsourcing tasks. How to approach qualification-based preselection of the employees to participate in internal crowdsourcing is straightforward, but perhaps counterintuitive – employees with strong domain knowledge participating only infrequently in internal crowdsourcing might need to be excluded during idea evaluation. The last two sections describe the conclusions and limitations.

2. Theoretical background

Internal crowdsourcing is still a developing research field, and the associated investigations can, by necessity, be phenomenon based (von Krogh and Rossi-Lamastra, 2012). As there is a lack of associated theory, this study delves into diverse literature streams to suggest hypotheses. First, this section thus describes a few salient characteristics of internal crowdsourcing. Second, this section builds on the fact that crowdsourcing tasks that concern domain-specific knowledge are likely to be limited to one domain to point to differences between employees participating infrequently and frequently in internal crowdsourcing. The former will be able and likely to limit themselves to ideas and problems concerning their own domains, whereas the latter will be exposed to many domains different from their own. This enables the forming of hypotheses concerning a biased outcome of internal crowdsourcing through the way infrequent and frequent participants in internal crowdsourcing will perceive ideas requiring domain-specific knowledge to understand. Third, as this diverse literature suggests that domain-specific knowledge is only one factor among many that might affect idea evaluation, this section also emphasizes the need to test hypotheses related to the strength of the hypothesized bias. Any identified bias should be weaker for ideas that do not require domain-specific knowledge to understand.

2.1. Salient characteristics of internal crowdsourcing

Internal crowdsourcing can be seen as the convergence of crowdsourcing techniques and internal IT-based collective ideation practices into "an IT-enabled group activity based on an open call for participation in an enterprise" (Zuchowski et al., 2016). Internal crowdsourcing is thus different from employees' ordinary work tasks as a problem is explicitly broadcasted to explore ideas based on knowledge and experience from a wider set of domains (Wimbauer, 2020). This is handled through four phases (Zuchowski et al., 2016), namely, *preparing* business-relevant tasks for a crowd of employees to work on, issuing an open call for participating employees to *execute* by contributing solutions to each task, *evaluating* the results for each task, and finally, *resolving* the process by (for instance) rewarding participants. The execution phase, which is always a group activity, can be collaborative if participants are allowed to help refine each other's solutions. The evaluation phase is often, but not necessarily, collaborative.

This loose definition of the concept probably contributes to the scarce knowledge on what constitutes effective management of internal crowdsourcing (Pedersen et al., 2013). However, for the purposes of this paper, a few salient characteristics can be identified:

- Internal crowdsourcing is a voluntary effort outside of the employee's day-to-day hierarchy-based work, based on the employee's own interests.
- Theoretically speaking, employees can thus, based on their interests, engage with any idea in any phase of a particular internal crowdsourcing effort. However, internal crowdsourcing is held together by separate crowdsourcing tasks that propagate through the crowdsourcing phases. This means that employees are likely to propose, help develop, and evaluate ideas within the tasks that align with their interests.
- The purpose of internal crowdsourcing is to draw on the expertise of employees from different backgrounds and allow them to generate ideas and/or solve problems together. Although internal crowdsourcing is likely to affect a participating employee, that employee's in-depth knowledge will come from day-to-day hierarchy-based work and for example, associated, self-organizing communities of employees at knowledge-intensive organizations (Wenger, 2010).

This study does not investigate idea evaluation in other contexts than internal crowdsourcing, but as the extant knowledge on this particular type of crowdsourcing is quite limited, we deliberately draw on evidence from associated studies. Idea evaluation by external crowds has been shown to select for more novel ideas in comparison to

organizational evaluator boards, as well as being better at identifying "hidden treasures" (Wimbauer, 2020). Similarly, when the process of evaluating research proposals is strictly controlled through randomization and anonymization, evaluators tend to favor research proposals that are not from their own domain (Boudreau et al., 2016). Evidence also shows that the firms that conduct the most explorative research are not necessarily those that produce the most product innovations (Laursen, 2012). Knudsen and Levinthal (2007) point at a possible explanation for this in the way organizational structure relates to idea evaluation. Hierarchical organizations are more likely to root out inferior alternatives, as ideas are subject to evaluation at several hierarchical levels. However, evaluating for increasingly optimal solutions might render an organization unable to back out of what is only a locally optimal solution. Flat organizations, and possibly also flat innovation approaches, could avoid this problem better as they are more prone to allow what are (temporarily) less optimal alternatives. By contrast, studies on research proposal evaluation, focusing on evaluator boards in which the evaluation is not blind and conducted through open discussions, suggest a bias toward exploitative solutions (Li, 2017). Arguably, the *dominant* factors influencing idea evaluation in internal crowdsourcing are not well established. Specifically, it is noteworthy that differences between external and internal crowdsourcing are understudied, with few comparisons made between internal and external crowds (Wimbauer, 2020).

Furthermore, this study does not investigate the proposal and development of solutions in crowdsourcing. However, subsequent subsections will argue that these activities provide a unique context for idea evaluation and also draw parallels to what influences these phases. As an example, Afuah and Tucci (2012) list a set of factors that will bound an agent's rationality during problem-solving: the domains in which the agent possesses in-depth knowledge, and the agent's problem-solving routines, cognitive frames, and absorptive capacity (external). Crowdsourcing is seen as a superior alternative when proposing the best solutions requires distant search during problem-solving, as it can transform distant search into local search. The underlying reasons given could apply also to idea evaluation: distant search involves learning new knowledge and makes routines and cognitive frames less useful for reducing alternatives. In fact, routines and cognitive frames could carry even stronger implications for idea evaluation: those with much domain-specific knowledge are often less flexible during problem-solving, as they find it more difficult to adapt new conditions when reflecting about problems in their domains (Dane, 2010). Furthermore, Chen and Magnusson (2019) identified that employees displayed different contribution patterns in firm-internal ideation, which were based on both the activities they took part in and how frequent this participation was. Internal crowdsourcing will compete with day-to-day hierarchy-based work for the attention and time of employees, which suggests that employees will fill different roles also in this innovation approach.

2.2. *When infrequently participating employees favor exploitable solutions*

An individual often favors exploitation over exploration because the returns are closer in time and less abstract (Levinthal and March, 1993). Also, the continuous investment in facilities, training, and intellectual property makes the returns from exploitation more certain (Stuart and Podolny, 1996). In an uncertain environment, individuals tend to concentrate on historical experiences for guidance (Stuart and Podolny, 1996). Furthermore, according to previous empirical studies, experts may prefer exploitative solutions due to their experience (Afuah and Tucci, 2012; Schlagwein and Bjørn-Andersen, 2014) or focus on the aspect of feasibility while evaluating solutions (Kristensson et al., 2004; Poetz and Schreier, 2012). As employees are usually not forced to participate in internal crowdsourcing, their motivation remains tied to (benefits in) their day-to-day hierarchy-based work (Zuchowski et al., 2016). In other words, employees are likely to prioritize crowdsourcing tasks related to their day-to-day activities and first thereafter engage in other tasks. This has two implications for internal crowdsourcing. First, as crowdsourcing tasks are business relevant, proposed by a specific requestor, and described to facilitate collaborative ideation (Zuchowski et al., 2016), they are likely to be limited to a well-defined problem. This also implies that tasks that concern domain-specific knowledge are limited to a specific domain. As infrequently participating employees only provide relatively small contributions, they are thus both able and more likely to selectively focus on their specific domain. Second, infrequently participating employees will thus be aware of the technologic trajectory (Dosi, 1982) of any hierarchy-based work associated with most of the crowdsourcing tasks they engage with.

Thus, employees who are not frequently active in internal crowdsourcing propose, develop, and evaluate solutions primarily within their domains of expertise. They would favor exploitable solutions over explorative ones when domain-specific knowledge is required, as they would be aware of the limitations to the firm when acting on such solutions in their domains.

There will also most likely be a smaller group of employees involving themselves extensively in many different crowdsourcing tasks (Zhu and Djurjagina, 2014). Less discerning about the crowdsourcing tasks that they develop and evaluate, they eventually form a partial understanding of other firm functions. In other words, they gradually increase their breadth of knowledge by acquiring a greater understanding of domains other than their own. Tackling prevalent problems, which enables them to understand their domain in greater detail, is also likely to increase their depth of knowledge. Consequently, it is thus easier for them to combine knowledge from a broader set of domains, also giving them a larger informal network throughout the firm. These employees will be less prone to dismissing reasoning or concepts that are not well established in their own domain as they will be more likely to understand these or have contacts who can explain them. Furthermore, we know that employees seek to join and successfully support explorative efforts because they already have both breadth and depth to their experience (McDermott and O'Connor, 2002). This implies that it is easier for such employees to become and stay active in internal crowdsourcing activities, as they would already be familiar with the other parts of their firm that these group activities include. Explorative solutions can also draw employees into internal crowdsourcing activities – when these require domain-specific knowledge, there would be informal clarification discussions within self-organizing communities of employees at knowledge-intensive organizations (Wenger, 2010). These communities are also the centers for organizational learning (Wenger, 2000), a fact that has been actively leveraged to benefit knowledge management in firms (Bolisani and Scarso, 2014). Internal crowdsourcing might thus resonate with those involved in other efforts to change practices in a firm. Such experts, involved in promoting novel techniques elsewhere, would likely exhibit greater understanding, acceptance, and motivation to help develop and evaluate novel solutions proposed during crowdsourcing activities.

Thus, compared with their peers, employees who engage more frequently in internal crowdsourcing should be, and will become more, accepting when they evaluate explorative solutions, even when these solutions are strongly linked to their own domains. These employees will not only be able to identify value that is not readily apparent to everyone but are also more likely to be open to and involved in explorative trends within their communities. This leads us to formulate our first hypothesis.

> **Hypothesis 1** While evaluating solutions requiring domain-specific knowledge, employees who engage less frequently in internal crowdsourcing will favor exploitable solutions.

2.3. When frequently participating employees are more uncertain

Firms align their employees' understanding to enable them to work together toward common goals. While exploitation relies on the strength of this common understanding between those who work together closely, exploration depends on how successfully employees with a less shared understanding overcome their differences (Nooteboom, 2000). The latter, a product of communicating for work-related tasks, is rendered difficult because of the tacit nature of relevant information on organizational routines, objectives, and practice (Cohen and Levinthal, 1990; Brown and Duguid, 2000). This information can be difficult to transform into something communicable, and thus, those who do not possess it may even be unaware of its existence (Brown and Duguid, 2000).

In the context of internal crowdsourcing, this is further complicated by the need to relate each solution to a crowdsourcing task to the larger context of the enterprise (Zuchowski et al., 2016). Relevant ideation often depends on relating problem-solving to the firm's core business, which is seldom a strong capability of technologists, for instance (Rice et al., 2001).

If a solution requires domain-specific knowledge, it will take considerable effort for employees without this particular knowledge to evaluate it confidently. Not only do they have to absorb enough knowledge to understand the idea, but they must also identify this knowledge as well as the wider implications of the solution for the firm's business in a relatively short amount of time. Until employees can absorb this knowledge successfully, they will be uncertain about the full implications of the solution.

As noted in the previous subsection, crowdsourcing tasks are likely to be limited to specific domains and infrequently participating employees are more likely to limit themselves to crowdsourcing tasks that concern their domain. These employees should thus not be asked to evaluate ideas outside

their domain as often as frequently participating employees. Furthermore, although frequently participating employees should learn enough from other domains to *appreciate* more explorative solutions, it is unlikely that they will become *experts* in all the domains. To become an expert, individuals need to work within a domain for a prolonged time (Brown and Duguid, 2000). Frequently participating employees will thus more often be exposed to domain-specific knowledge that is not from their own domains, whereas the opposite will be true for infrequently participating employees. A mechanical engineer who participates frequently in internal crowdsourcing could for instance be likely to be exposed to ideas requiring domain-specific knowledge related to finance or logistics. This suggests that frequently participating employees will be uncertain more often while evaluating ideas which require domain-specific knowledge. This brings us to our second hypothesis.

Hypothesis 2 While evaluating solutions that require domain-specific knowledge, employees who engage frequently in internal crowdsourcing will be more uncertain.

2.4. Ideas that require domain-specific knowledge are special

Factors other than domain-specific knowledge might influence the preference for exploitative solutions or the uncertainty during idea evaluation. Even if domain-specific knowledge has the hypothesized effect, it might only be one factor among many. Therefore, it is important to investigate differences in outcomes that point to domain-specific knowledge as significant.

First, the reasoning in the previous subsections implies that solutions that do not require domain-specific knowledge or are easy to communicate will not be as strongly affected by employee bias or uncertainty. For instance, the mapping between one's own cognition and another's during communication and understanding (Nooteboom, 2000) is simplified considerably by the possibility of drawing an analogy. Such analogies, when drawn to a successful concept, can, for instance, make it easier to see the business value of a solution and thus decrease the bias it faces. That domain-specific knowledge complicates communication and understanding should also have a direct effect on employees' uncertainty during collaborative innovation.

Second, employees can also interact with domains other than their own during hierarchy-based work. This might also influence their evaluation of ideas during internal crowdsourcing. For instance, employees who have had to exert additional effort due to disruption brought on by explorative solutions during their hierarchy-based work might come to view them unfavorably. There are also strong implications for the social capital formed by employees who interact frequently through networks within firms (Nahapiet and Ghoshal, 1998). A history of working together could form enough social capital to allow teams to overcome difficulties while collaborating efficiently in digital communication environments (Robert Jr, 2008). Associated expectations for mutual support could instead make employees to evaluate even flawed solutions favorably, or in the worst case, lead to groupthink or crowd hijacking (Wilson and Robson, 2017). However, as these factors are not related to the internal crowdsourcing itself, they should affect frequently and infrequently participating employees uniformly.

This suggests that although the direct influence of domain-specific knowledge is only one of the several factors that might lead to the aforementioned effects, its significance should appear in a difference between solutions that require domain-specific knowledge to understand and those that do not. Therefore, tests for Hypotheses 1 and 2 should be complemented by similar tests for ideas that do not require domain-specific knowledge, including those that are communicated through an analogy.

Hypothesis 3.A The preference toward exploitation in idea evaluation is weaker for solutions that do not require domain-specific knowledge.

Hypothesis 3.B The effect of uncertainty on idea evaluation is weaker for solutions that do not require domain-specific knowledge.

3. Method

This study draws on a quantitative analysis of 4 years of activities within an online platform for firm-internal innovation collaboration. The following subsection describes the research setting, followed by a subsection presenting the tests designed for each of our hypotheses.

3.1. Empirical research setting

This study is based on a multinational engineering company developing CPS. CPS allows interaction

with physical processes through IT and includes technical products in the aerospace, automotive, marine, and nuclear industries. The firm in consideration employs about 50,000 individuals across 150 countries to develop products for both civil and defense purposes. Engineering is set up in organizationally separate business sectors that focus on different industries. However, certain functions and initiatives have an enterprise-wide reach. One such initiative is an online platform for firm-internal innovation collaboration, henceforth called the Innovation Portal (InnP). The InnP has roughly 23,000 registered employees, of which about 4,500 can be traced to activities which include submitting, commenting, and voting on ideas. Actively involved employees belong to all parts of the firm such as the engineering, financial, manufacturing, project management, and secretarial functions. All the continents in which the firm is present are represented, for instance, by employees from Australia, Canada, Chile, England, Germany, and India. However, the user base reflects the demographics of the firm (i.e., engineers from the largest offices of the firm make up a large percentage). Still, the InnP was designed to fulfill an important component of the innovation strategy of the Firm – to allow employees to propose or influence ideas in domains they would otherwise be isolated from, whether this is by exploiting existing capabilities or by exploring new approaches not yet tested within the firm.

The InnP process is straightforward but relies on both crowdsourcing and a committee to select ideas for implementation. Employees participate in crowdsourcing tasks and phases voluntarily based on their own interests. A challenge sponsor advertises for solutions to an engineering or organizational problem on the InnP and all employees are asked to provide solutions. After a few weeks, a *maximum* of 10 submitted solutions is selected for crowd evaluation. These solutions are discussed on the InnP and eventually voted on. The top three solutions *chosen by the crowd* are then handed over to the committee who provide in-depth feedback based on their expertise and the discussion on the InnP. Finally, the challenge sponsor *can* choose a *winning solution* based on the committee's feedback.

To date, the InnP has hosted 119 challenges. These have resulted in 5,503 proposed solutions, 456 solutions chosen by the crowd, and 80 winning solutions. In-depth interviews with 10 frequently participating employees and three InnP administrators using the 7 stages described by Brinkmann and Kvale (2015) established that the InnP had led to the implementation of exploitative solutions. Few, if any, exploratory solutions have been among the winning solutions, even though this was the original reason for the existence of the InnP. This bias in the outcome has largely been attributed to the challenge sponsors, who were seen to prefer exploitative solutions over explorative ones. Indeed, the winning solutions were generally thought to be more exploitative than the alternatives. Although this is an interesting area for research, this study does not focus on the challenge sponsors, but on the evaluation stage prior to the final selection of solutions. In other words, this study makes use of the observation that the most exploitative solutions would typically win to test for bias in earlier phases of internal crowdsourcing. More specifically, as discussed in the next subsection, this observation by the firm allows the test for Hypothesis 1 to be conducted.

A noteworthy characteristic of the InnP crowd voting is that it is performed on pairs of solutions. Thus, employees are not asked to vote on their favorite solution, but on the superior of two that the InnP presents. The pairing that a particular employee is asked to vote on is generated by the InnP based on past voting by the employee and the rankings are still deemed uncertain by the InnP. This is not the most common approach to crowdsourcing. However, as discussed in the next subsection, it fits the tests designed for Hypotheses 1 and 2.

3.2. Hypothesis testing

This subsection describes the preparations and tests designed for each of our hypotheses.

3.2.1. Preparations for testing hypothesis 1

A cluster analysis was performed with the expectation to identify roles similar to those found in previous studies (Björk et al., 2013; Malhotra and Majchrzak, 2014). Latent class analysis was chosen for the cluster analysis, as this method outperforms traditional cluster analysis (Magidson and Vermunt, 2002). The mclust package was used to analyze the data as it is easy to access and is not associated with the same performance problems as other freely available tools (Haughton and Legrand, 2009). Furthermore, to mitigate the more difficult user interface of R packages in comparison to bespoke tools, we sought the support of contacts already familiar with this tool from the research community.

The cluster analysis included the following parameters defined as significant by Björk et al. (2013):

- Out-degree centrality (ODC): The number of outgoing relationships of an employee is measured as the number of comments written on the ideas submitted by others.
- In-degree centrality (IDC): The number of comments directed to an employee.
- Reciprocal communication (RC): Self-comments by an employee.
- Number of ideas submitted (NoIS): The number of ideas submitted by an employee.

To test our hypotheses, this was further extended with two parameters as follows:

- Pairwise votes (PV): Number of votes by an employee.
- Outreach preference (OP): The preference of employees to reach out in remote contexts by directing comments toward ideas outside their immediate sphere of knowledge. This was measured as the part of an employee's comments directed toward employees belonging to other firm functions.

Table 1 presents the three clusters based on these parameters.

The context of the study is thus as expected based on the literature surveyed in Section 2. Given that crowdsourcing tasks are likely to be limited to one domain, the participants' development of solutions points at infrequently participating employees mostly engaging with solutions within their domains of expertise, and frequently participating employees, to a large degree, engaging with ideas outside their domains.

3.2.2. Testing hypothesis 1

As shown in Table 1, the three clusters differed with respect to their level of activity, ranging from those that are seldom active to a small group of highly active employees. Based on the preference of the sponsors for exploitation, we measure the preference of employees with different levels of engagement. We call this the "Affinity for Exploitation" (AfE) score (i.e., the correlation between an employee's voting preference and the known preference of the challenge sponsors for exploitation). This is measured as the part of an employee's votes that endorsed ideas eventually chosen by challenge sponsors when in the position to vote between these ideas and other ideas.

Table 1. InnP clusters

Activity level	Low	Medium	High
Out-degree centrality	0.61	3.34	80.80
In-degree centrality	0.07	6.03	60.34
Reciprocal communication	0	1.36	16.02
Number of ideas submitted	0.23	2.11	16.22
Pairwise votes	10.38	36.98	260.67
Outreach preference	0.32	0.71	0.85
Cluster size	2,884	1,438	111

Ideally, the test of differences in data such as AfE scores is performed using a one-way ANOVA. However, even if all data sets did not contain outliers, as assessed by the inspection of a boxplot, none of them were normally distributed, as assessed by Shapiro-Wilk's test ($P < .05$). This means that the characteristics of the data motivated the use of a Kruskal–Wallis H test to establish differences between the clusters (Draper and Smith, 1998; Montgomery, 2000).

We note that this test identifies the degree of preference of employees for a specific solution in comparison with other solutions. This is difficult to test based on the votes or rankings of individual solutions but is easily tested based on pairwise comparisons. Pairwise comparisons also motivate the examination of the case firm in isolation because comparisons with other voting procedures might confuse the results. Furthermore, we note that this test does not rely on the Firm's explanation for *why* the outcome of the InnP was exploitative rather than explorative solutions. The hypothesis testing is solely based on the observation of this outcome by the interviewees, which they made a note of as it was not expected.

3.2.3. Testing hypothesis 2

As shown in Table 1, the preference of the cluster members to engage with ideas outside their domain was proportional to the activity of the cluster. The less active employees were mainly concerned with ideas within their particular domain of knowledge – they preferred to engage with ideas that they had the suitable domain-specific knowledge to understand. Based on the crowd's ranking of the ideas, we can identify the ideas which should stand out as the most different ones during evaluation.

Thus, we can measure the uncertainty of employees with different levels of domain-specific knowledge based on their hesitation when they are in the position to vote between an idea mostly evaluated favorably (a top three idea, *chosen by the crowd*) and an idea mostly evaluated unfavorably (an idea not *chosen by the crowd*). We call this the "Uncertainty with Crowd Preference" (UwCP) score and measure it as the part of an employee's votes that did not favor either idea.

Asking employees to vote on or rank individual solutions does not highlight uncertainty as such, as it is difficult to know whether an idea was not understandable or simply not good enough. In a pairwise comparison, there is the risk that an employee will

refuse to choose between two solutions because they are perceived as equally good. However, it is far more likely that such refusals will be caused by uncertainty, especially when the comparison is made to eventually rank the solutions. Furthermore, when the ranking of ideas is finally established, this can also be used to narrow down the comparison to pairwise votes, where one of the ideas is deemed better than the other.

Using the reasoning outlined for testing differences in the AfE data, the use of a Kruskal–Wallis *H* test can also be established as appropriate for the UwCP data.

3.2.4. Preparations for testing hypotheses 3.A and 3.B

To separate the ideas that do not require domain-specific knowledge, we addressed two questions:

- "Does the associated challenge require engineering expertise to understand?" This question separated ideas into "Engineering" and "Nonengineering" (NE). The interviews indicated that the NE ideas did not require domain-specific knowledge to understand. This is possible because engaging with NE ideas only required knowledge of the firm's organizational culture and structure. It was available to all employees but not to those external to the Firm.
- Regarding Engineering ideas, we address the question, "Does the idea description include an easily understandable example that captures the essence of the idea?" This separated ideas into "Domain-Specific Engineering" (DSE) and "Nondomain-Specific Engineering" (NDSE). In practice, the only examples of NDSE ideas were those that transferred concepts from one domain to another. For example, an NDSE idea suggested a magnetic solution like "that found when connecting chargers to mobile phones."

We arrived at three classes of ideas, namely, NE ideas that all employees should have the domain-specific knowledge to develop and evaluate properly, NDSE ideas that should not require domain-specific knowledge beyond that of an ordinary person but are perceived as within the domain of an engineering community, and DSE ideas that many InnP participants would lack the required domain-specific knowledge to develop and evaluate properly. We note that these classes are firm-internal as they are grounded in the type of firm under consideration (i.e., a firm that focused on engineering complex products). The innovation focus of other types of firms would lead to similar classes. However, these would be based on other knowledge domains such as financial firms having classes grounded in business or funding models.

3.2.5. Testing hypotheses 3.A and 3.B

Hypotheses 1 and 2 were first tested according to the procedures described in Sections 3.2.2 and 3.2.3 and involved only DSE ideas. To test Hypotheses 3.A and 3.B, the two other classes of ideas were subjected to the same tests.

4. Results

This section provides the results of the hypothesis testing described in the previous section.

4.1. Domain-specific knowledge and bias toward exploitable solutions

Using the AfE score, we measured the preference of different clusters in supporting exploitation while voting on DSE ideas. A Kruskal–Wallis *H* test revealed that statistically, the distributions of AfE scores for DSE ideas were significantly different between clusters, $\chi^2(2) = 15.25$, $P < .001$. The distributions of AfE scores were not similar for all groups as assessed by the visual inspection of a boxplot. Subsequently, pairwise comparisons were performed using Dunn's procedure with a Bonferroni correction for multiple comparisons. Adjusted *P* values are presented. This post hoc analysis revealed statistically significant differences between the low (1.00) and medium (0.71) active employees ($P = .001$) and the low and highly (0.74) active employees ($P = .016$) but not between the medium and highly active employees.

Thus, Hypothesis 1 is supported by our data. When solutions require domain-specific knowledge to understand, employees who are less active favor exploitable solutions more than their peers.

4.2. Domain-specific knowledge and employee uncertainty

We measure the hesitation of different clusters in supporting the DSE ideas using the UwCP score. A Kruskal–Wallis *H* test revealed that the distributions of UwCP scores for DSE ideas were statistically significantly different between clusters, $\chi^2(2) = 17.00$, $P < .001$. Distributions of UwCP scores were not similar for all groups, as assessed by visual inspection of a boxplot. Subsequently, pairwise comparisons were performed using Dunn's procedure with a Bonferroni correction for multiple comparisons. Adjusted *P* values are presented. This post hoc analysis revealed statistically significant differences between the low (0) and medium (0.05) active employees ($P = .001$) and

low and highly (0.08) active employees ($P = .021$) but not between medium and highly active employees.

Thus, Hypothesis 2 is supported by our data. When solutions require domain-specific knowledge to understand, more active employees are more uncertain than their peers.

4.3. Are ideas that require domain-specific knowledge to understand special?

To test Hypotheses 3.A and 3.B, we repeated the previous tests for the other classes of ideas.

4.3.1. Stronger bias toward exploitable ideas

Using the AfE score, we measure the preference of different clusters in supporting exploitation while voting on NE ideas. A Kruskal–Wallis H test revealed that statistically, the distributions of AfE scores for NE ideas were not significantly different between clusters, $\chi^2(2) = 2.17$, $P < .001$.

Additionally, we measure the preference of different clusters in supporting exploitation while voting on NDSE ideas using the AfE score. Again, a Kruskal–Wallis H test revealed that the distributions of AfE scores for NDSE ideas were not statistically significantly different between clusters, $\chi^2(2) = 2.01$, $P = .337$.

Thus, Hypothesis 3.A is supported by our data. When solutions do not require domain-specific knowledge to understand, less active employees are more similar to their peers during the evaluation of exploitable solutions.

4.3.2. Overall uncertainty of highly engaged employees

We use the UwCP score to measure the hesitation of different clusters in supporting the NE ideas chosen by the crowd. A Kruskal–Wallis H test revealed that the distributions of UwCP scores for NE ideas were statistically significantly different between clusters, $\chi^2(2) = 7.23$, $P = .027$. Distributions of UwCP scores were not similar for all groups, as assessed by the visual inspection of a boxplot. Subsequently, pairwise comparisons were performed using Dunn's procedure with a Bonferroni correction for multiple comparisons. Adjusted P values are presented. This post hoc analysis revealed statistically significant differences between the low (0) and highly (0.08) active employees ($P = .034$) but not between the medium (0.05) active employees and other clusters.

The hesitation of different clusters in supporting the NDSE ideas chosen by the crowd is measured using the UwCP score. A Kruskal–Wallis H test revealed that the distribution of UwCP scores for NDSE ideas were not statistically significantly different between clusters, $\chi^2(2) = 2.73$, $P = .256$.

Thus, we see that Hypothesis 3.B is not supported by our data. When solutions did not require domain-specific knowledge, more active employees were still more uncertain than their peers during idea evaluation.

5. Analysis and discussion

This study has focused on whether a higher degree of relevant domain-specific knowledge makes employees participating in internal crowdsourcing prefer exploitative solutions during idea evaluation. In the following section, we provide an analysis and discussion of how uncertainty aggravates the fact that domain-specific knowledge can filter out explorative solutions in internal crowdsourcing and the associated implications for innovation management. When possible, we contrast our findings with those of other studies to suggest dominant factors during idea evaluation in internal crowdsourcing.

5.1. Uncertainty aggravates domain-specific knowledge filters

Uncertainty signals that there are barriers to knowledge integration. The results suggest that such barriers exist for most types of ideas, even after a long history of internal crowdsourcing, with the exception of ideas that succinctly transferred concepts from one domain to another by providing easily understandable examples. One explanation for this could be in the knowledge required to understand NE ideas or the ability to absorb this knowledge. It is possible that our approach is too simplistic in regard to "generic" solutions, and that we have not identified a specific type of knowledge required to understand NE ideas. These barriers could also be due to organizational structure, requiring employees to understand and be familiar with the context from which an idea originated to understand it properly. Possibly, evidence from other contexts suggests that the explanation might be found in the routines and cognitive frames that employees use during idea evaluation (Afuah and Tucci, 2012; Dane, 2010). The overall higher level of uncertainty might be the result of having to consider a larger set of solutions simultaneously, as employees find themselves without accumulated assumptions that help them narrow down the list of optimal solutions. This is not necessarily negative, as accepting less optimal solutions can allow an organization to

back out of local optima (Knudsen and Levinthal, 2007). Further study is also required to ascertain what causes this uncertainty, whether the cause differs across types of ideas, and how to mitigate it properly.

However, regardless of the answers to these questions: as frequently participating employees exhibit this larger uncertainty for ideas that require domain-specific knowledge to understand, it will aggravate any other bias in the evaluation of these ideas that could have been mitigated by their engagement. Thus, the management of crowdsourcing requires attention to uncertainty during idea evaluation, especially when ideas require domain-specific knowledge to understand.

The intention of the firm was to facilitate more explorative ideas, as crowdsourcing allows employees from potentially diverse backgrounds to ideate together. The domain-specific knowledge of employees should have helped in this regard by allowing the crowd to achieve a common and sufficient understanding of all ideas, either through information sharing or through competence development (Brown and Duguid, 2000; Erickson, 2012; Malhotra et al., 2017). However, the results suggest that crowds remain divided on how to evaluate ideas that require domain-specific knowledge, as infrequently participating employees value exploitation more highly. The explanation can most likely be found in the context of internal crowdsourcing. In well-controlled (Boudreau et al., 2016) and external (Wimbauer, 2020) contexts, crowd members with domain-specific knowledge seem to prefer explorative solutions, while open collaboration during evaluation in an organizational context seems to allow for (or even generate) bias toward the evaluators' domains (Li, 2017). This supports a perspective on idea evaluation in internal crowdsourcing that accepts that other considerations than the purely objective can be important when solutions risk impacting employees' hierarchy-based work. However, Hypothesis 3.A was corroborated suggests that the explanation is not simply tied to social capital (Nahapiet and Ghoshal, 1998), as the impact should otherwise have been more uniform across types of ideas. In other words, the results corroborate the idea that expertise can be limiting in how it makes domain experts unable to view problems from distant perspectives or consider novel assumptions (Dane, 2010), but also suggest that this is an especially dominant factor when an idea evaluator has a (even indirect) stake in the outcome of the evaluation. This likely aggravates the problem, making evaluations more conservative. The fact that employees choose which tasks to engage in, and are exposed to solutions already from their inception, might thus not be as positive as in external crowdsourcing. Even if it attracts those with relevant knowledge, and facilitates the understanding of others, the open environment might not be enough to overcome the impact of (unreasonable) criticism or (unfounded) assumptions.

Presumably, two approaches would alleviate the situation: either infrequently participating employees, constrained by their domains, are pushed toward becoming more open to explorative innovation by increasing their engagement with internal crowdsourcing, or frequently participating employees, driven by their openness and passion, are singled out during idea evaluation. Indeed, the discourse suggests that leveraging activities such as internal crowdsourcing for exploration is best achieved by giving employees clear permission to allocate time and thought to these activities outside the roles of hierarchy-based work (Andriopoulos and Lewis, 2009; Dane, 2010; Malhotra et al., 2017). However, while the approaches described in the next subsection may have been considered previously, their special implications with respect to domain-specific knowledge have not been examined yet.

5.2. *Implications for management of internal crowdsourcing*

On the one hand, given that the preferences of different employees during idea evaluation risk a bias in the outcome of internal crowdsourcing, it is prudent to question the use of internal crowds for idea evaluation. On the other hand, the discourse suggests that it might allow an organization to back out of local optima (Knudsen and Levinthal, 2007) and – if it can be made similar enough to external crowdsourcing – identify novel ideas that will otherwise not become apparent until years later (Wimbauer, 2020).

To enable the identification of more explorative ideas, our findings suggest that innovation managers should first consider the feasibility of engaging more employees with ideas outside their domains. The discourse on internal crowdsourcing suggests several possible actions based on this assessment, as long as the bias in the outcome engendered by domain-specific knowledge is also considered.

5.2.1. Boosting the engagement of infrequently participating employees

If the easiest issue to solve is that of employees not engaging enough with internal crowdsourcing to accept explorative innovation, innovation

management might need to look at both negative and positive factors to boost engagement.

Malhotra et al. (2017) suggest that management can boost engagement by balancing crowdsourcing activities with hierarchy-based work, considering anonymous participation to avoid peer pressure, and ensuring that the outcomes of the activities are reported back to employees. Others have identified the same factors and emphasized the need for an appropriate reward structure to incentivize participants (Zuchowski et al., 2016). Such rewards do not have to be monetary but can constitute recognition within the firm.

Of these factors, anonymous participation and nonmonetary rewards have special implications for the identified bias. With respect to the former, in this case, the self-organizing communities of employees likely to emerge in knowledge-intensive organizations might render the possibility of anonymity moot. An employee that is not part of such a community might misunderstand technical details and be unfamiliar with the jargon used. Regardless of anonymity, it may thus become obvious that an employee is not a member of the "right" communities while discussing ideas that require domain-specific knowledge. Regarding the latter, recognition will most likely be strongest within the domain of the successful idea. Thus, these rewards might become an important way to acquire social capital within domains. Such informal power might clash with the consensus of knowledge communities, who might react forcefully against contributions from "nonexperts" within internal crowdsourcing. Both these cases illustrate how common ways to boost engagement might be counteracted in the context of internal crowdsourcing, when most ideas require domain-specific knowledge.

If the aim is to facilitate explorative innovation, and employees do not engage enough in internal crowdsourcing, then innovation management might need to include a larger share of other types of idea challenges.

5.2.2. *Singling out frequently participating employees*

If it is unfeasible to engage employees more frequently, then innovation managers might have to look beyond factors for boosting engagement to solve the problem. This suggests that firms should not allow all employees to participate in all internal crowdsourcing phases and tasks to increase serendipity (Simula and Ahola, 2014; Zuchowski et al., 2016). Instead, qualification-based preselection of employees should be used during idea evaluation to *avoid* including infrequently participating employees with strongly associated domain knowledge.

Arguably, this increases the risk that unfeasible ideas will be chosen by the crowd. Objections raised by those with much domain-specific knowledge need not be grounded in blindness to, but the rather sober assessment of, alternatives. During idea evaluation, this is further aggravated by the higher level of uncertainty displayed by highly active employees who frequently engage with ideas outside their own domains. However, a lack of domain expertise among employees participating in internal crowdsourcing does not mean that their ideas will automatically rank low in terms of feasibility (Poetz and Schreier, 2012). Besides, if the intent of a firm's internal crowdsourcing activities is to generate explorative ideas, it might be impossible for most employees to accurately evaluate the feasibility, as such ideas are by their very character more farfetched and untried. Last, as discussed previously, a horizontally organized innovation approach with suboptimal solutions might actually allow an organization to avoid local optima.

Furthermore, innovation management can take steps to mitigate the risk of generating unfeasible ideas. We see that better solutions are generated by offering advice regarding which type of knowledge to share and how it should be shared (Malhotra and Majchrzak, 2014). Even if employees are not invited to participate in idea evaluation, they could be singled out in earlier phases and, for instance, be asked to provide little-known facts, share tradeoffs that are difficult to spot and elucidate succinct examples.

6. Conclusions

We contribute to existing theory by investigating bias that counteracts explorative solutions when ideas are evaluated during internal crowdsourcing. We established that frequently participating employees, choosing to interact with many ideas they did not possess the necessary domain-specific knowledge to understand in detail, were more uncertain during idea evaluation than their peers. This uncertainty existed regardless of whether the ideas required domain-specific knowledge. We also established that infrequently participating employees, mostly engaging with ideas they possess the necessary domain-specific knowledge to understand in detail, valued exploitable ideas more highly than explorative ideas when this required domain-specific knowledge. Thus, during the idea evaluation phase of internal crowdsourcing, employees infrequently participating in internal crowdsourcing might introduce a bias toward exploitation in the chosen solutions; a bias that would be aggravated by the larger overall uncertainty

exhibited during the same phase by employees frequently participating in internal crowdsourcing.

We contribute to innovation management practice by suggesting methods for management to handle the identified bias toward exploitable ideas. This would involve considering the factors that boost engagement in internal crowdsourcing and using qualification-based pre-selection of employees. However, several common ways to boost engagement in the context of internal crowdsourcing could be counteracted when most ideas require domain-specific knowledge. Thus, innovation management might first need to focus on including other types of idea challenges to engage employees in internal crowdsourcing. Changing the approach to qualification-based preselection of employees is straightforward, but perhaps counterintuitive – it should be used during idea evaluation to *avoid* including infrequently participating employees with strongly associated domain knowledge.

7. Limitations

Whereas external crowdsourcing has received much attention during the last decade, a theory concerning internal crowdsourcing is still scarce. The appropriate methods and primary hypotheses for studying internal crowdsourcing are still being defined. Thus, this is early phase phenomenon-based research (von Krogh et al., 2012) in which we piece together relevant theory and carefully consider the limitations of the case at hand. In this study, the firm in consideration described its problems based on the difference between exploitative and explorative solutions. Thus, the InnP is studied through this lens. However, much the same hypotheses could be designed to suggest an influence of domain-specific knowledge on incremental and radical innovation. Therefore, a limitation of this study is that immature theory does not allow us to state how the effects that we see reference to relevant concepts closely aligned with exploitation versus exploration (such as incremental vs. radical). Similarly, there might be other factors brought on by frequent interaction with internal crowdsourcing that have an effect on the preference for explorative solutions or uncertainty during idea evaluation. The paucity of existing theory does not allow us to rule out the existence of such confounding factors. However, the results of the tests on Hypotheses 1 and 3.A indicate that such a factor affects ideas that require domain-specific knowledge differently compared to those that do not. Neither extant theory nor our interviews with the Firm have allowed us to identify and explain such a factor. Regardless, it is only regarding the testing of Hypothesis 3.B that we can report unexpected results. Even if that result might indicate the existence of a confounding factor, it does not make the *implications* of our study on internal crowdsourcing less interesting. Therefore, even with these limitations, this study is particularly valuable in the way that it can guide further research (von Krogh et al., 2012).

This study does not rule out that domain-specific knowledge has different implications for solutions in other internal crowdsourcing phases or with regard to other roles. An employee who helps develop a solution might, for instance, like to see it implemented regardless of whether it is explorative or exploitative. Hopefully, this type of topic will see the further study in the future.

Finally, it would have been easier to argue against the existence of confounding factors if additional control variables at individual and organizational levels could have been added. A univariate analysis is inevitably weaker as it might not provide a full understanding of the results and make it more difficult to compare the results with those from future studies. However, regardless of the privacy issues that make such control variables difficult to obtain, the obvious desire for control variables needs to be weighed against the complexity of activities and outcomes in contemporary firms. The generalizability brought on by a high ecologic validity might indeed be critical to further our understanding of relatively new phenomena, especially when the complete set of valuable control variables are still unknown.

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