

Collective firm-internal online idea development

Exploring the impact of feedback timeliness and knowledge overlap

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13

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Abstract

Purpose – New opportunities to nurture good ideas for innovation arise as firms use web-based ideation platforms for collective idea generation and development. What influences creative performance in firm-internal collective idea development is however not as well researched as idea generation and thus an important area of research is the feedback and commenting on ideas. More specifically, the purpose of this paper is to explore the role of feedback timeliness and knowledge overlap between feedback providers and ideas in collective firm-internal online idea development.

Design/methodology/approach – An empirical study has been performed, drawing on data collected from a Swedish multi-national company using a web-based system for collective firm-internal ideation. The investigation explicitly captures the effects on ideation performance played by idea development contributions, in terms of feedback timeliness and knowledge overlap between feedback providers and ideas.

Findings – The empirical results show that idea development is significantly influenced by feedback timeliness as well as by the knowledge overlap between feedback providers and ideas. Specifically, it is found that longer time to feedback and an increased knowledge overlap result in an increased likelihood of idea acceptance. However, beyond a certain point, the positive effects of a longer time to feedback and increased knowledge overlap decrease, resulting in curvilinear relationships with idea acceptance.

Research limitations/implications – The results do not only shed new light on theory about collective idea development, but also provides management implications for collective firm-internal ideation. As the data used in the study has been collected in one single firm, care should be taken in generalizing the results to other domains.

Practical implications – The results inform managers that it is not always better to involve more individuals in these emergent and distributed ideation systems, but that it might be beneficial to take measures to exercise some control in terms of when distributed and diverse employees can freely join in and out, especially considering the diversity of ideas, comments and creators.

Originality/value – The results from the empirical study reveal the effects of feedback timeliness and knowledge overlap on idea development. This provides us with new insights on the complex dynamics at place in collective firm-internal idea development and offers implications for how we can fruitfully manage this process.

Keywords Feedback, Online, Idea development, Timeliness, Knowledge overlap

Paper type Research paper

1. Introduction

Extant research on the front end of innovation has clearly pointed out that firms can benefit substantially from effective generation and management of innovation ideas at the early stages of the new product development process (see e.g. Verworn, 2009; Van den Ende *et al.*, 2015; Schemmann *et al.*, 2016). In this early phase, different digital approaches have been used for idea management programs to collectively fertilize, capture and mature online ideas

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(Van den Ende *et al.*, 2015). Digital technologies offer ample opportunities for innovation (Nambisan *et al.*, 2017) by allowing firms to overcome social, geographical and organizational limitations. However, they also pose new managerial challenges to firms, and this is also the case for online idea management programs. Specifically, the collective online efforts have generally resulted in an increased number of novel ideas (Hoornaert *et al.*, 2017; Schemmann *et al.*, 2017), but this does not necessarily transform into successful innovation outcomes (Chan *et al.*, 2018). Recent studies highlight the need to better understand the collective process taking place after innovation ideas have been generated (Beretta, 2019; Berg, 2014; Zhu *et al.*, 2019), and then in particular the idea development process (Hoornaert *et al.*, 2017; Ogink and Dong, 2019) when crowdsourcing principles are employed inside firms (Malhotra *et al.*, 2017). As only a limited amount of ideas deserves further investment (Beretta, 2019; Deichmann and van den Ende, 2014), feedback from a collective of individuals holds a potential to inform the idea selection process in such a way that it can be more accurate and consequently improve innovation performance.

Despite the outlined potential, extant knowledge about online idea development is limited (Kijkuit and van den Ende, 2007; Berg, 2014). More specifically, previous literature on front-end innovation and ideation has mainly focused on how to generate ideas, and far less attention has been paid to what occurs after an idea is generated (Beretta *et al.*, 2018; Beretta, 2019; Hoornaert *et al.*, 2017), particularly in a collective idea development process modifying an originally proposed idea through the contributions by others. Even in the more limited and recent research on idea development, we find that it frequently is proposed to resemble idea generation (e.g. Deichmann and van den Ende, 2014; Zhu *et al.*, 2019) or idea selection (e.g. Beretta, 2019; Chan *et al.*, 2018; Hoornaert *et al.*, 2017), indicating a lack of specific and independent studies on idea development. In order to fill this research gap, our study distinguishes the idea development from the generation and selection phases and focuses on idea development in the specific context of collective firm-internal online environment.

Some of the related studies recently identified that feedback in idea development is the best predictor of idea implementation, as compared to other factors such as the idea itself and ideator characteristics (Hoornaert *et al.*, 2017). In terms of the role of feedback in online ideation systems, feedback characteristics, such as constructiveness and positivity/negativity, as well as feedback providers have been argued to be important dimensions (Beretta, 2019; Zhu *et al.*, 2019). This highlights that how feedback is given and who gives feedback are critical questions to be addressed. Moreover, as feedback requires substantial cognitive effort and is time-intensive/flexible (Hoornaert *et al.*, 2017), two important aspects are whether feedback is given in real time (Hoornaert *et al.*, 2017) and whether feedback providers are familiar with the ideas or not (Zhu *et al.*, 2017). These aspects have been more carefully investigated in terms of feedback timeliness (Lurie and Swaminathan, 2009) and feedback frequency (Lam *et al.*, 2011), and in terms of knowledge relatedness and knowledge diversity of contributors (Acar and van den Ende, 2016; Beretta, 2019; Koch, 2011), respectively. However, the effects of these factors in collective firm-internal online idea development are still not well understood. As a response to these identified shortcomings of existing theory, the aim of this paper is to explore the role of feedback timeliness and knowledge overlap between feedback providers and ideas in collective firm-internal online idea development.

In order to fulfill this aim, we explore these two dimensions to test if and how feedback generated in firm-internal online communities improves originally submitted ideas, based on real idea data collected from a company's idea management system (IMS). In the extracted data set, the content of initial submitted ideas, the timeliness of feedback, and the knowledge domains of the feedback providers are related to ideation outcome. The results highlight that both feedback timeliness and knowledge overlap of feedback providers influence idea development positively. However, beyond a certain point the influence of feedback timeliness decreases, resulting in an inverted U-shaped relationship. Also for what concerns the role of knowledge overlap we observe a similar curvilinear effect. To our knowledge, this is the first study on the

role of feedback in online idea development, something which extends the existing body of knowledge about feedback and knowledge management in front-end innovation and ideation.

The paper is organized as follows: the next section reviews the literature concerning the nature of collective online idea development and feedback, in order to build the present conceptual framework. And in what follows, the hypotheses in terms of feedback timeliness and knowledge overlap of feedback providers are presented. The fourth section describes the methodology. In the fifth part, the results are presented, followed by a discussion including theoretical implications, practical implications as well as limitations and future study.

2. Literature review and conceptual framework

Although we see an increased use of digital tools in the front end of the innovation process we still have limited knowledge of how these new digital ways of working potentially increase the value of innovation initiatives in firms. In order to address this, we first attend broadly to the overall area of firm-internal collective online idea development, and thereafter present specific relevant aspects of feedback in idea development more in detail.

2.1 *Collective firm-internal online idea development*

Whether an idea is accepted for further investment does not only rely on idea generation, but also on the “shaping” (Weick, 1995) of the idea and the criteria used for the idea selection decision (Kijkuit and van den Ende, 2007). Scholars in the creativity and innovation area have emphasized that after ideas have been generated, they normally require further development and validation checks (Perry-Smith and Mannucci, 2017). It is thus not surprising that the idea development process starts to attract more interest of scholars, especially as the idea generation process recently has been quite well understood (Hoornaert *et al.*, 2017). Much attention is at present given to idea development in an organizational context, but this does not necessarily provide new insights about digital idea management programs (e.g. Berg, 2014; Kijkuit and van den Ende, 2007; Perry-Smith and Mannucci, 2017). Idea development in web-based system has actually received only limited attention (Beretta, 2019; Hoornaert *et al.*, 2017) and in these works idea development is often simply assumed to resemble idea generation (e.g. Deichmann and van den Ende, 2014; Zhu *et al.*, 2019) or idea selection (e.g. Beretta, 2019; Hoornaert *et al.*, 2017). In the light of these shortcomings of extant theory, we attend specifically to the specific area of firm-internal collective online idea development.

As a sub-process of idea management, idea development follows the generation of an idea, but precedes its evaluation/selection (Beretta *et al.*, 2018; Deichmann and van den Ende, 2014; Gerlach and Brem, 2017; Kijkuit and van den Ende, 2007). During this phase, the idea is normally still wide open for employees to collectively assess and comment (Kijkuit and van den Ende, 2007), through which the weak points are discovered or new directions for improvement are provided (Brem and Voigt, 2009; Westerski *et al.*, 2010), allowing them to better fit current practice and needs (Kijkuit and van den Ende, 2007; Zhu *et al.*, 2017). In this respect, the development of ideas is an essential phase where the initially generated ideas can be enhanced with the help of the idea development collective, eventually leading to a higher probability of idea acceptance and innovation success (Deichmann and van den Ende, 2014; Gerlach and Brem, 2017).

Collective firm-internal online idea development is one specific and popular type of idea development, frequently replacing the earlier use of traditional suggestion boxes (Sandström and Björk, 2010; Westerski *et al.*, 2013). In this case, online communities, self-organized by employees interacting around ideas after idea generation, engage in different organizational knowledge creation processes (Nonaka, 1994; Bergendahl and Magnusson, 2015). In these communities, reciprocal communication takes place between idea creators and commenters through feedback search (De Stobbeleir *et al.*, 2011;

Kijkuit and van den Ende, 2007), information input (Van den Ende and Kijkuit, 2009; Zhu *et al.*, 2017) and feedback responses (Wooten and Ulrich, 2016). Compared to the traditional ideation process in an organizational context (see Kijkuit and van den Ende, 2007; Perry-Smith and Mannucci, 2017), the pattern of collective online idea development is based on virtual interaction and improvement of initially submitted ideas where the knowledge creation is not bounded by ordinary limitations of time, expertise, organizational positions and geographic distance. This new digital and increasingly collective approach to manage ideas brings about a number of changes to idea development in terms of: improved possibilities for single individuals to comment on numerous innovation ideas, an increased number of contributors and their complex collective interactions, the participation of more individuals holding diverse knowledge sets (Beretta, 2019) and changes to the process as well as the economics of idea search. Taken together, these changes are not only likely to increase the overall contributions to the idea development process but may also result in increased dynamics, and consequently more pronounced complexity to manage, bringing about challenges to effectively develop ideas (Hoornaert *et al.*, 2017). This leads to an urgent need for both researchers and practitioners to understand what really happens in collective firm-internal online idea development.

In general, people, process and the ideas that drive innovation stand out as three key dimensions when trying to capitalize on creativity (Skerlavaj *et al.*, 2017). Similar to this, it can be noted that the literature focusing on idea development mainly addresses three aspects, including the idea itself (Chan *et al.*, 2018; Li *et al.*, 2016), contributors (Beretta *et al.*, 2018) as well as feedback (Hoornaert *et al.*, 2017; Zhu *et al.*, 2019). For example, Chan *et al.* (2018) investigated the impact of idea novelty, idea feasibility, idea length and the number of comments on online idea adoption. Kijkuit and van den Ende (2007) and Perry-Smith and Mannucci (2017) analyzed the idea contributors' interaction pattern based on social network theory and highlighted the necessity of feedback in idea development. In terms of feedback, one recent work on online idea generation by Zhu *et al.* (2019) has provided a framework for studying collective firm-internal online idea development. In addition, with the rapidly improving technology for text mining, the expertise of contributors (Zhu *et al.*, 2017) is at present starting to be investigated, following previous discussions on contributors' diversity in online communities (Beretta, 2019). Altogether, idea content, idea contributors and crowd feedback stand out as three key aspects of creativity in web-based ideation systems (Hoornaert *et al.*, 2017). In particular, feedback in idea development is argued to be the best predictor of idea implementation (Hoornaert *et al.*, 2017), given that ideators generally need feedback to improve and expand their ideas (Harrison and Rouse, 2015; Kijkuit and van den Ende, 2007). Therefore, in order to understand collective firm-internal online idea development, one particular research aspect in need of further elaboration is feedback.

To sum up, idea development stands out as increasingly essential in firm-internal online idea management, where a large volume of ideas are generated and a collective of individuals are enabled to contribute to the improvement and selection of ideas with their knowledge (Hoornaert *et al.*, 2017; Zhu *et al.*, 2017). Nevertheless, collective firm-internal online idea development is still not well understood. In order to address this identified need for new knowledge, we can gain insights from existing knowledge on feedback, as idea development in this particular setting can be regarded as collective feedback search, including input as well as response (Kijkuit and van den Ende, 2007; Wooten and Ulrich, 2016; Zhu *et al.*, 2017).

2.2 Feedback to develop ideas

What influences creative performance in firm-internal collective idea development is not as well researched as idea generation and idea selection (Beretta, 2019; Hoornaert *et al.*, 2017).

Since the use of IMS has largely facilitated open communication between ideators and commenters, predominately in the form of collective feedback, more research on feedback and commenting, which eventually might help improve idea quality, has been called for (Beretta *et al.*, 2018; Zhu *et al.*, 2019).

Scholars have since long been interested in different aspects of feedback, including such things as feedback providers, timing, specificity, type (Lam *et al.*, 2011) and valence (Zhou, 1998). When it comes to the role of feedback in creativity and innovation management, with the aim to further develop and improve an idea, as well as influencing its acceptance or rejection, feedback has been discussed in different ways. On the one hand it has been regarded as an emotional support (Özer, 2013), driving motivation for individuals' creative performance (Ilgen *et al.*, 1979; Zhou, 1998), and on the other hand as a continuous source of knowledge creation (Ashford and Cummings, 1983) driving idea novelty and usefulness (De Stobbeleir *et al.*, 2011; Van den Ende and Kijkuit, 2009). Nevertheless, most of the previous studies address creative tasks in traditional organizational settings, whereas the same tasks in a digital environment has received only limited attention. Even if scholars recently have started to pay attention to feedback in IMS (Beretta, 2019; Beretta *et al.*, 2018; Zhu *et al.*, 2019), the performed studies have mainly focused on feedback diversity, construction and valence, whereas less attention has been paid to the time perspective of feedback as well as feedback providers (Malhotra *et al.*, 2017).

With the digitalization of IMS, opportunities are provided not only to access a large volume and variety of feedback, but also to process feedback through real-time information seeking and providing. However, feedback given is typically characterized by voluntary and uncertain time resources (Amabile and Pratt, 2016; Faraj *et al.*, 2011), something which results in a challenge to manage how feedback is given, and then particularly in terms of the time perspective (Hoornaert *et al.*, 2017). For example, questions like whether feedback should be given in real time or not (Lurie and Swaminathan, 2009) and how often feedback should be given (Lam *et al.*, 2011) have been highlighted as key concerns for managers. In order to address this issue, we focus on feedback timeliness, something which has been previously examined in the research streams on feedback frequency and feedback timing in terms of real time or delay (e.g. Lam *et al.*, 2011; Lurie and Swaminathan, 2009). Feedback timeliness is important for engaging employees before they complete a set of assignments (Dow *et al.*, 2012) such as idea generation and development. More specifically, the importance of feedback timeliness is mainly reflected in two aspects, the perceived control and user activity over time (Ilgen *et al.*, 1979) that can be gained from immediate feedback and delayed feedback, respectively. Recent related studies within the innovation area have mainly investigated the idea evaluation time to a final go/no-go decision (Hoornaert *et al.*, 2017; Gerlach and Brem, 2017), whereas the role of feedback timeliness in idea development is still not clear. Therefore, in order to understand the role of feedback in idea development from the perspective of time, this study directly examines the role of feedback timeliness in idea development.

In terms of feedback providers, their knowledge background has been proposed as an important aspect in innovation management (e.g. Bonner and Walker, 2004; Koch, 2011). In particular, with the widespread use of digital technologies in idea management, questions regarding who contributes to ideas have long been emphasized. Different knowledge domains of feedback providers in idea development need to be identified, particularly in the use of IMS (Zhu *et al.*, 2017) where it is arguably problematic when the domains are overly distant, as this may hamper the knowledge search and integration required for ideation and innovation (Savino *et al.*, 2017). Nevertheless, most previous research has focused on either ideators' knowledge domains for online idea generation (e.g. Piezunka and Dahlander, 2015; Zhu *et al.*, 2019) or evaluators in online idea selection (e.g. Magnusson *et al.*, 2016), and less attention has been paid to feedback providers in online idea development who can

potentially help ideators by complementing their ideas prior to evaluation (Beretta, 2019). In order to fill this gap, this research attends to feedback providers in terms of their knowledge overlap. The concept of knowledge overlap, similar to the ones of knowledge relatedness (Koch, 2011) and knowledge redundancy (Bonner and Walker, 2004) represents the extent to which feedback providers are specialized in the same field. Generally, as research in contributors' homogeneity and heterogeneity (Baer, 2010) has tended to collapse knowledge overlap and diversity into the constructs of "cognitive distance" (e.g. Nooteboom *et al.*, 2007; Acar and van den Ende, 2016) and "information redundancy" (e.g. Nonaka, 1990) high cognitive distance and low information redundancy have come to imply high knowledge diversity and low knowledge overlap. However, knowledge diversity captures the overall breadth and redundancy of knowledge domains of feedback providers regardless of the ideas they actually contribute to (Wong, 2008), while knowledge overlap captures the knowledge domains of both feedback providers and the ideas they contribute to. Researchers have substantially improved these indirect measurements of knowledge diversity by using measures of demographic, geographic and organizational distance (e.g. Beretta, 2019; Bergendahl and Magnusson, 2015; Zhu *et al.*, 2019; Nooteboom *et al.*, 2007) at the individual level. Measuring knowledge overlap more directly considering the knowledge domains at both individual level and idea level may further increase knowledge-based views of feedback providers. Therefore, in order to understand the role of feedback providers' knowledge domains, this study directly examines the role of knowledge overlap between feedback providers and ideas in idea development.

Altogether, in order to better understand the collective firm-internal online idea development, we have focused on the collective feedback aspect, following previous discussions on how feedback is given and who gives feedback (Beretta, 2019). As the literature underlines that there is limited knowledge about how the time perspective of feedback as well as knowledge domains of feedback providers influence idea development, we specifically examine the influence of feedback to develop ideas in terms of feedback timeliness and knowledge overlap between feedback providers and ideas.

3. Development of hypotheses

3.1 Feedback timeliness

Feedback timeliness, as conceptualized here, refers to the time to feedback given after ideas have originally been submitted and reflects the speed of the feedback process. In this conceptualization, time to feedback is short when feedback is given early or frequently. From a normative stance, feedback timeliness potentially plays an important role in innovation (Hoornaert *et al.*, 2017). The role of feedback timeliness has long been argued in the literature about feedback timing and feedback frequency in the contexts of learning and decision making (Casas-Arce *et al.*, 2017; Hula *et al.*, 2008; Lurie and Swaminathan, 2009; Thornock, 2016). In this context, research on feedback timing has mainly considered whether feedback occurred immediately or after a delay. Although most previous research studies support the use of immediate feedback, the benefit of feedback delay is also highlighted, particularly when the long-term retention (Butler *et al.*, 2007; Hula *et al.*, 2008) for learning is taken into account. More specifically, providing feedback immediately is helpful in the short-term perspective, given the increased motivation normally gained from feedback (Ipeiritos and Gabrilovich, 2014), whereas feedback delay potentially leads to better performance in the longer term perspective as the accumulative and collective feedback is used for idea acceptance decisions. Furthermore, with delayed feedback, more time is provided for feedback providers to review and comment on ideas. This increases the probability to receive more extensive and more diverse information input (Butler *et al.*, 2007) to ideas. Hence, more time and opportunities are provided to improve ideas. In contrast, the informational support of feedback can hardly be guaranteed if feedback is given very

rapidly (Casas-Arce *et al.*, 2017). This is a particularly difficult issue in online idea development process where the feedback time available is substantially a trade-off for employees between the voluntary act of developing ideas and their formal work tasks inside the firm. Therefore, given that online feedback accumulates over time and people often take time to go back and forth between feedback and ideas (Hoornaert *et al.*, 2017), it can be argued that a longer time to feedback in online idea development might be more helpful for idea development.

Besides this, literature about feedback frequency in learning and its effect on work performance (e.g. Chhokar and Wallin, 1984; Lam *et al.*, 2011; Lurie and Swaminathan, 2009) supports the benefit of longer time to feedback as well. Generally, feedback receivers would have the feeling of being less controlled, and have less cognitive resource limitations to respond if feedback is provided with low frequency, something which might increase the understanding and the use of feedback for idea development. This is opposed to the influence of high feedback frequency hypothesized to give a feeling of being more controlled (Ilgen *et al.*, 1979). Specifically, more frequent feedback requires a more systematic processing of more recent data and might lead to failure to adequately process information across multiple time periods (Casas-Arce *et al.*, 2017; Lurie and Swaminathan, 2009). On the one hand, feedback receivers may experience increased tension and anxiety related to processing the feedback (Lam *et al.*, 2011) if the feedback is given within a short time. Thus, a high feedback frequency is likely to undermine the desire and willingness of feedback receivers (i.e. ideators) to respond (Chhokar and Wallin, 1984) and then process feedback for idea development. On the other hand, feedback given timely is synonymous with more frequent input to ideas (Lurie and Swaminathan, 2009). This to some extent increases the requirements of cognitive capacity to process feedback so that ideas can be improved. Thus, highly frequent feedback requires that the feedback receiver has sufficient cognitive resources to understand recent feedback in real time (Lam *et al.*, 2011), and may therefore bring about difficulties to effective processing feedback for idea development. In this case, contrary to the common thinking about feedback frequency, we contend that longer time to feedback, i.e. lower feedback frequency, might positively influence idea development.

To sum up, even if there tends to be a common belief that feedback given intensively, with high feedback frequency or in real time, benefits idea development, others argue that an overly high feedback intensity with too much input to ideas or too rapid feedback on ideas might constitute a constraint for fruitful idea development (Chhokar and Wallin, 1984; Lam *et al.*, 2011; Lurie and Swaminathan, 2009). Following this debate, we here argue that longer time to feedback provided is beneficial for ideas in collective firm-internal online idea development, as compared to immediate feedback and high frequency feedback. The likelihood of idea acceptance is therefore assumed to increase with a longer time to feedback. Hence, the following is hypothesized:

H1. A longer time to feedback in collective firm-internal online idea development increases the likelihood of idea acceptance.

However, a too long feedback delay may also be problematic. There may be a point of diminishing returns, where the benefits of longer time to feedback provided would no longer be superior to the shorter one. A first explanation of this can be derived from the negative effect of delayed feedback (or low frequency feedback) on motivation. Generally speaking, too late or infrequent feedback has been argued to affect individual motivation negatively, something which results in reduced further contribution efforts and thereby lower improvement performance (Lam *et al.*, 2011; Lurie and Swaminathan, 2009). Furthermore, delayed or low frequency feedback indicates that the idea itself might lack potential value to attract attention, which also indicates that the idea is less likely to be accepted. Yet another

reason might be that the attention of ideators is transferred to other ideas when the feedback input is delayed. Therefore, the feedback process might decrease the opportunity of idea acceptance in the presence of delayed or low frequency feedback.

Altogether, a certain time to feedback is proposed to support creativity, provided that the length of time is not so large as to be meaningless. Nevertheless, the beneficial effects from a long time to feedback arguably decrease once beyond a certain point. Following this, we expect that the association between feedback timeliness and idea acceptance over time will be curvilinear. More specifically, when time to feedback is very short, ideators may receive intensive feedback, overwhelming their cognitive capacity to process information or offer feedback with only limited informational support, thereby constraining their motivation to contribute and impairing their ability to improve ideas efficiently (Lam *et al.*, 2011). As time increases to a moderate level, ideators receive feedback information that can be used to improve ideas, but not so much feedback information that cognitive resources are overwhelmed. After a certain point, however, the time to feedback can reach a level that actually delays the ideators, thereby reducing their motivation to perform and consequently resulting in lost opportunities for further improvement:

- H2.* A longer time to feedback facilitates idea development, up to a point; beyond this point, it has a negative effect, constraining creative efforts and thereby leading to a reduced likelihood of idea acceptance.

3.2 Knowledge overlap

Apart from the time perspective of feedback, it can be seen in the literature that another key aspect is the heterogeneity or homogeneity of individuals' knowledge domains, as these can be seen to reflect the total knowledge content accessible through interactions between ideators and other contributors. This points to the role played by knowledge availability and its specific features. Arguably, more information input is beneficial for knowledge creation and development. However, the role played by information is not simple, as it is a function of both knowledge diversity and redundancy (Nonaka, 1994). A feasible way of capturing this is to attend more closely to the knowledge overlap between feedback providers and ideas.

Knowledge overlap, similar to the conception of knowledge relatedness (Koch, 2011) and knowledge redundancy (Bonner and Walker, 2004), can be used to note the similarity between knowledge domains of feedback providers and the related knowledge domains of ideas. As a major feature of innovation activities, knowledge overlap to some extent refers to the ability to combine and coordinate innovation activities across different domains of knowledge (Acar and van den Ende, 2016; Koch, 2011). Previous literature notes that knowledge overlap potentially plays an important role in innovation, but the role of knowledge overlap is different in different innovation processes (Kijkuit and van den Ende, 2007) and for different innovation outcomes (Acar and van den Ende, 2016). More specifically, it can be argued that low knowledge overlap positively affects divergent creativity, whereas a high knowledge overlap is positively linked to convergent creativity (Acar and van den Ende, 2016). Similar to the argument on the role of prior related knowledge across individuals in innovation process, literature notes that networks of ideas' contributors ideally should evolve from a non-redundant, heterogeneous structure into a smaller and more cohesive network with high prior related knowledge in the subsequent development phase (Kijkuit and van den Ende, 2007). Altogether, the significant role of knowledge overlap in convergent idea development process is highlighted compared to the one in divergent idea generation process. On this basis, it can be argued that a high knowledge overlap of feedback providers may increase the chance of idea acceptance in collective firm-internal idea development.

The positive role of high knowledge overlap can be supported by the related works on the discussion of mutual understanding that may support idea development, deriving from studies of network redundancy (Kijkuit and van den Ende, 2007; Perry-Smith and Mannucci, 2017), knowledge relatedness (Koch, 2011), expertise (Deichmann and van den Ende, 2014; Magnusson *et al.*, 2016; Zhu *et al.*, 2017), as well as knowledge input. In the field of social networks, different levels of knowledge overlap of feedback providers are mainly related to the knowledge homogeneity or heterogeneity of employee-idea networks, resulting from actors with different levels of prior related knowledge. Generally speaking, the development of ideas requires sufficient prior related knowledge and domain familiarity (Acar and van den Ende, 2016), between ideators and feedback providers, to guarantee mutual understanding in terms of “[...] the ability to understand and build on each other’s knowledge base” (Kijkuit and van den Ende, 2007; p. 867). The higher prior related knowledge embedded in the network content, the better is the mutual understanding to improve ideas. In addition, as submitted ideas are initially normally incomplete and diverse, knowledge overlap, with high expertise and the ability to transfer novel perspectives to the domain of ideas, is typically required to complete them (Magnusson *et al.*, 2016; Perry-Smith and Mannucci, 2017). Consequently, a high knowledge overlap of feedback providers, referring to a high expertise in relation to the ideas, may positively influence the probability of idea acceptance. More specifically, a high knowledge overlap of feedback providers underlines that there is a match between the domain of feedback providers’ expertise and that of the ideators’ expertise embedded in the original and “raw” idea, something which to a large extent determines how well the feedback providers can understand and extend the features of the raw idea, such as its market potential (Zhu *et al.*, 2017). The idea development phase is therefore more effective when the knowledge domain of feedback providers overlaps with that of the ideators.

Apart from the discussion concerning mutual understanding, the perspective of feedback receivers’ limited resources, similar to the argument about feedback timeliness, can also support the positive role of knowledge overlap, as a low knowledge overlap of feedback providers might be costly (Beretta, 2019). For example, lower knowledge overlap and lower domain familiarity might lead to a higher likelihood of conflict (Zhu *et al.*, 2019), something which might not only cost time and cognitive attention in the idea development but also result in an increased risk of idea abandonment due to the characteristics of voluntary and extra-help efforts. In contrast, if feedback providers are more familiar with ideas, they might be more motivated and capable to form richer and more elaborate schemas of ideas, something which may help them identify useful improvements for ideas (Acar and van den Ende, 2016; Berg, 2014).

Taken together we see that “[...] familiarizing oneself with a new domain is critical to being able to transfer novel perspectives to that domain” (Acar and van den Ende, 2016, p. 2). Although a low knowledge overlap is likely to benefit the divergent thinking needed for knowledge creation, it might also result in negative effects in idea development as this is typically a convergent process. Collective firm-internal online idea development would thus benefit from a high knowledge overlap, which to some extent guarantees mutual understanding, motivates elaborate contribution and decreases interaction cost. It is therefore important for feedback providers during idea development to be familiar with ideas in order to be able to increase the chances of idea acceptance:

H3. A high knowledge overlap between feedback providers and ideas in collective firm-internal online idea development has a positive effect on the likelihood of idea acceptance.

However, the beneficial effects from a high knowledge overlap arguably decreases once beyond a certain point, eventually resulting in an inverted U-shaped relationship with idea

acceptance. The main reason for this is that contributors with a too large knowledge overlap might end up being too narrow minded (Beretta, 2019). More specifically, on the one hand it is likely that too much familiarity might lead to a cognitive lock-in of contributors (Parjanen *et al.*, 2011) and thus a lower acceptance of new ideas. On the other hand, contributors with a large knowledge overlap normally have more specific and critical assessment criteria for ideas (Magnusson *et al.*, 2016), something which would increase the risk of rejecting also potentially valuable ideas. Therefore, similar to the inverted U-shaped relationship between cognitive distance and innovation (Nooteboom *et al.*, 2007), it can here be argued that knowledge overlap has a curvilinear effect on the probability of idea acceptance. To be more specific, knowledge overlap between feedback providers and ideas will facilitate idea development through useful and specific information input, up to a certain point. Beyond this point, however, an increased knowledge overlap will constrain the further improvement of ideas due to narrow-mindedness (Beretta, 2019) and experts' overly critical evaluations (Magnusson *et al.*, 2016), in turn leading to a lower degree of idea acceptance. Followed by this, the fourth hypothesis is developed:

- H4.* A high knowledge overlap between feedback providers and ideas facilitates idea development, up to a point; beyond this point, it has a negative effect, constraining creative efforts and thereby leading to a reduced likelihood of idea acceptance.

4. Method

4.1 Research setting

This empirical study was conducted based on data from an online platform of idea management in the Swedish company. The case company is one of the world leaders in the mobile telecommunication equipment industry, and the online platform has been used to capture and develop ideas based on the ongoing internal collaboration and social media efforts since it was set up in 2008. Ideation is performed through the use of idea boxes for different specific problems, managed by one or more voluntary innovation managers. The different boxes are classified into competitive and non-competitive boxes. The non-competitive boxes are characterized by openness, collaboration and knowledge sharing, which is reflected in ratings, comments and recognition, whereas the competitive boxes are merely for idea submission and closed for online comments. At the time of the study, this platform had more than 70,000 ideas and around 100,000 comments from individuals throughout the global organization.

4.2 Data and data collection

The collaborative IMS was updated on November 2014 with new and increased user and management functionality. For this study, all ideas with comments created during one year, from November 30, 2014 to December 1, 2015, were selected. This selection of a one-year period was based on the consideration of data completion and quality. The chosen period started with the launch of the updated version of the platform and ended with ideas from one full calendar year. The end date for data collection provided a cut off in time earlier than the final time of idea creation and development in "idea boxes" so that all ideas in the selected data set had the possibility to be selected for further development or not.

To be more specific, variables in this study were selected with SQL syntax in a number of selection steps. The first step was the selection of idea boxes. As there are competitive and non-competitive boxes with different possibilities to provide feedback, only ideas in non-competitive active boxes were selected. Second, only published ideas created from November 30, 2014 to December 1, 2015 which received at least one feedback comment were selected. Third, the selection of all variables explicitly addressed hereafter was based on the combination of different tables in SQL with the index of idea ID. By doing so, it was found

that during the set time period a total of 6,348 comments were given to 2,413 ideas provided by 2,303 individuals.

4.2.1 Dependent variable. Idea acceptance. Idea acceptance is the dependent variable used in this study representing the go/no-go decision for an idea after idea development, something which has been regarded as a short-term performance variable (Beretta, 2019; Chan *et al.*, 2018; Hoornaert *et al.*, 2017). It is a dichotomous variable, with the value 0 and 1 indicating that ideas are accepted or not. A value of 1 is given if the idea has been accepted for interest, action and/or implementation. Hence, this measure reveals if the company has put more resources on the idea to be further investigated or exploited. On the contrary, a value of 0 means that the ideas had not been selected for further consideration or investment. In terms of this idea acceptance in the tested data set, 346 out of a total of 2,413 ideas were accepted.

4.2.2 Independent variables. Feedback timeliness (time to feedback). Feedback timeliness, representing the speed of feedback given, has been discussed as feedback timing and frequency in previous studies. On this basis, it is seen that there are two main ways to measure feedback timeliness. One way is to classify feedback frequency into low, low-moderate, moderate-high and high, respectively, based on the amount of feedback received in a defined time period (see Lam *et al.*, 2011). Another way is to measure the time distance between feedback interventions (see Chhokar and Wallin, 1984), something that in this study refers to the time distance between an idea is created and feedback is given. The main reason why the second way is selected in this study is that the accessed data about time is a big data set characterized by randomness and irregularity. It is thus not possible to define specific time periods to measure the number of comments as feedback frequency. However, it can be measured by the average time distance of feedback given after an idea is submitted (see Formula (1)). The date and time of feedback given and ideas created are labeled in the database, and the average time distance can be calculated by the second unit through SQL syntax:

$$T_{\text{timeliness}} = \frac{t_1 + t_2 + \dots + t_i + \dots + t_n}{n}, \quad (1)$$

$T_{\text{timeliness}}$ is the average of time to feedback, $t_i (i = 1, 2, 3, \dots, n)$ denoting the time when the i th feedback is given, n represents the number of comments on an idea.

Knowledge overlap. The level of knowledge overlap is dependent on the related knowledge that feedback providers have and the knowledge domains of ideas. As the studied IMS is open for employees to briefly label the knowledge area of ideas with tags when they submit ideas, tags (e.g. Windows platform, simulator, Android) in the selected database are first used to categorize the knowledge domains of ideas. More specifically, tags of the target idea represent the key knowledge domain and constitute a basis for the measurement of knowledge overlap between contributors and ideas. On this basis we investigated the knowledge of feedback providers based on their contributed ideas, and tags of all ideas except the target idea contributed by feedback providers were collected to represent their knowledge domains. This measurement through tags is inspired by the measurement of expertise overlap by Reagans and McEvily (2003) based on the same areas. Thus, knowledge overlap was eventually measured by counting the amount of identical tags between the target idea and feedback providers' contributions (see Formula (2)). More specifically, a high overlap shows that the knowledge background of feedback providers is closer to the knowledge domain of the idea:

$$KO = \text{Card}(P \cap I), \quad (2)$$

where KO represents the level of knowledge overlap between feedback providers and an idea, P is the set of tags reflecting a feedback providers' knowledge domain, while I is the set of tags labeled on an idea. $\text{Card}(P \cap I)$ denotes the number of identical tags between P and I .

4.2.3 Control variables. Several other variables could impact idea acceptance and should therefore be controlled for. According to previous studies on the antecedents of idea selection (e.g. Beretta, 2019; Beretta *et al.*, 2018; Chan *et al.*, 2018), variables at idea, ideator, as well as feedback levels, which have been tested as factors for go/no-go decision of ideas, are included as control variables. At the idea level, the variables considered were idea sentiment, idea length, idea relatedness and idea effectiveness.

Idea sentiment. Positive and negative sentiments of ideas to some degree reflect the characteristics of creators' mood side, signal their future participation (Coussement *et al.*, 2017) and have potential impact on innovation (O'Leary, 2016). Hence, it appears logical to include sentiments as a control variable. With the technology development of the sentiment analysis method, the positive and negative degree of ideas could be measured based on nature language processing (NLP) (Nasukawa and Yi, 2003). Here, we used the "sentiment" package in R based on NLP, trained using Naive Bayes classifier on Janyce Wiebe's subjectivity lexicon (Riloff and Wiebe, 2003) by which the text of ideas can be classified as positive or negative by the sentiment value.

Idea length. Idea length to some extent can indicate its elaborateness (Beretta, 2019), which might impact on the final idea success (Zhu *et al.*, 2019). Here we add it as a control variable through the function "length ()" of SQL syntax.

Idea relatedness. Idea relatedness, the extent to which ideas are specialized in required and related fields of idea boxes, has been proposed as an important factor for innovative performance (see. Koch, 2011; Semasinghe and Davidsson, 2009). As idea relatedness is reflected by the similarity level of knowledge domains of ideas and their submitted idea boxes, we added idea relatedness as one of the control variables and measured it based on the number of the same tags between an idea and its submitted idea box.

Idea effectiveness. Idea effectiveness, representing the number of tags labeled to ideas, to some extent influences the degree of knowledge overlap, according to the measurement of knowledge overlap in this study. On this basis, idea effectiveness is added as a control variable.

Other variables are from the level of commenters. More specifically, these are idea by manager and idea network size.

Idea by manager. As ideation is performed through the use of idea boxes and managed by one or more voluntary innovation managers, managers' participation in the development of ideas may to some extent influence the further idea acceptance by box managers. The level of managers' participation is here measured by the number of comments provided by box managers on an idea.

Idea network size. Idea network size refers to the number of commenters around a specific idea, something which according to previous works on social networks and innovation management might influence idea acceptance (e.g. Beretta, 2019; Björk and Magnusson, 2009). Commenters are here individuals who give information input for idea development through commenting on the idea, excluding the ones commenting on its comments. It is measured by using the function "count (distinct column)" of SQL syntax.

At the ideator and comment level, the times of being edited after commenting by ideators, the number of ideators' self-comments, feedback length and time to first feedback were added as control variables.

Modified times. Ideators would modify ideas if they perceive feedback as helpful and are motivated to improve ideas further. The times of modification to some extent reflect the quality of feedback and the engagement of ideators, something which might impact idea acceptance. Therefore, we control for this variable and measure it based on the times of an idea being edited from the idea historic event data through the SQL syntax.

Ideators' self-comments. The number of ideators' self-comments reflects the strength of interactions between commenters and creators. As interactions of individuals in a community

contribute to the amplification and development of new knowledge (Nonaka, 1994) and thus influence quality (Zhu *et al.*, 2019), the number of ideators' comments is included to reflect the degree of two-way communication. Moreover, considering this response behavior, this variable is helpful to separate the commenters and ideators who both have commenting behavior in the IMS. Here, we measure it through the number of comments contributed by ideators around each idea.

Feedback amount. Feedback amount, representing the number of comments, to some extent influences the level of feedback timeliness. Generally, feedback amount is calculated by the number of comments given to an idea. Nevertheless, as there is a high correlation (0.70) between the number of comments and the length of comments, and the latter plays a more important role in idea development (seen in a higher increased Nagelkerke R^2), the length of comments is here used to measure the feedback amount. Similar to the idea length, length of comments is affected by the engagement level and the specific level of commenters, reflecting the amount of information embedded in feedback, which might influence the idea development as well. Here, we measure it in the same way as idea length.

4.3 Statistical analysis

In order to avoid the high correlations among all variables, the mean and the standard deviation of all variables we discussed were measured. Table I represents descriptive statistics and correlations of all variables. However, if high correlations existed, the types of relations including moderating and mediating effects (Baron and Kenny, 1986) should be discussed. Here, we applied variance-inflated factors (VIF) to analyze the interaction effects (Robinson and Schumacker, 2009) of all variables by comparing the results when a certain variable is included or excluded. VIF is also used to assess whether there is multicollinearity among control variables and independent variables or not. The values of VIF suggest that multicollinearity is not a concern in the regressions, as the highest VIF is 2.05, well below the suggested threshold level of 10 (Cohen *et al.*, 2003).

In addition, in order to test effects of independent variables on dichotomous dependent variables, a binary choice model was first selected. Logit and probit models are similar to concern the binary variables. A logit model is usually faster to use on larger problems (multiple alternatives or large data sets) (Aldrich and Nelson, 1984). Considering the large data set of 2,413 ideas that we collected and analyzed, and given the dichotomous nature of dependent variable, a logistic regression was used and the statistical software R (Ihaka and Gentleman, 1996) was used to perform the analyses.

5. Results

5.1 Data description

In order to better understand the effects of the different independent variables, the distribution of ideas related to different levels of independent variables are analyzed and shown in Table II. In Table II, it can be seen that there are three types of knowledge overlap degrees and time to feedback classified, respectively. More specifically, knowledge overlap was classified into low, medium and high knowledge overlap, where the values of knowledge overlap are (0, 3], (3, 10] and (10,) respectively. Moreover, for the time to feedback, it is considered short if the average time distance between idea creation and feedback given is less than 6 h, and it is considered medium if the average time distance is between 6 h and 48 h. A long time to feedback is more than 48 h. Based on the above classification, it can be seen that few ideas (10 percent) received feedback shortly and provided by commenters with low knowledge overlap, while the majority of ideas have been provided with long delay feedback by the ones with low knowledge overlap. In addition, it can be seen that the highest percentage of accepted ideas was with long delay feedback by feedback providers with medium knowledge overlap.

Table I.
Descriptives and
correlations

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Idea sentiment	1											
2. Idea length	-0.09	1										
3. Idea relatedness	-0.02	0.08***	1									
4. Idea effectiveness	-0.02	0.04	0.24	1								
5. Idea by manager	0.00	-0.03	0.06	0.00	1							
6. Idea network size	-0.03	0.04	0.05*	0.03	0.01	1						
7. Modified times	-0.02	0.15***	0.12***	0.10***	0.06	0.19***	1					
8. Ideator's self-comments	-0.01	0.04	0.04*	0.19***	0.04***	0.10	0.17***	1				
9. Feedback amount	-0.04*	0.05***	0.08***	-0.03***	-0.02***	0.61***	0.23***	0.10***	1			
10. Feedback timeliness (time to feedback)	0.00	0.02	-0.01	0.02	0.04**	-0.07**	0.01	-0.03*	0.03	1		
11. Knowledge overlap	-0.01	0.03	0.10	0.08***	0.13***	0.10***	-0.05	0.02	0.03***	-0.04*	1	
12. Idea acceptance	-0.01	-0.02	0.01	-0.01	0.07	0.03	0.04	0.06***	0.15***	0.1***	0.04***	1
Mean	9.27	2.034	0.36	3.83	0.33	2.13	0.39	0.11	406.20	4,618,220	0.86	0.15
SD	26.22	3,672.51	0.64	2.89	0.66	1.86	2.29	0.50	378.11	5.7E+06	3.35	0.35
Min.	0.02	13	0	0	0	1	0	0	4	63	0	0
Max.	337	32,759	5	29	6	33	58	9	5,097	3.0E+07	58	1

Notes: Number of observations: 2,413. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table II.
Data description

Degree of knowledge overlap	Feedback timeliness (time to feedback)	Number of all ideas	Number of accepted ideas
Low	Short	179	15
Low	Medium	222	14
Low	Long	1,871	290
Medium	Short	12	1
Medium	Medium	12	1
Medium	Long	94	17
High	Short	0	0
High	Medium	0	0
High	Long	23	8

5.2 Logistic regression results

In Table III, four models were built after testing the influence of each variable step by step. Model 1, the basic model used for all the other models, only includes the control variables. In Model 2, the variables about feedback timeliness (time to feedback) and the square of time to feedback were added. In Model 3, the other investigated independent variables, i.e. knowledge overlap and the square of knowledge overlap, were instead included. Finally, Model 4 is a model with the full set of variables.

5.2.1 Feedback timeliness. *H1* predicted the existence of a positive relationship between an increased length of time to feedback given and idea acceptance. In Model 4, time to feedback, i.e. the time distance between feedback given and idea creation, was found to have a significant positive influence on the dependent variable ($\beta = 1.041e-07$, $p < 0.01$). Hence, longer time to feedback correlate with a higher likelihood of idea acceptance, which supports *H1*.

Furthermore, the significance of the squared term in Model 4 indicates that there are decreasing returns on the probability of idea acceptance ($\beta = -4.185e-15$, $p < 0.05$) when the time interval for feedback continuously increases. Hence, we find an inverted U-shaped effect of feedback timeliness on idea acceptance. This supports *H2*, which predicted that ideas would be more likely to be accepted when the length of time to feedback is at a certain point, and that an increased length of time to feedback beyond this point instead has a negative effect. Figure 1 shows the inflection point after which a longer time to feedback seems to have a negative effect on idea acceptance.

5.2.2 Knowledge overlap. *H3* predicted the existence of a positive relationship between knowledge overlap and idea acceptance. In Model 4, it can be seen that the overlap of tags between feedback providers and ideas is positively and significantly related to the dependent variable ($\beta = 1.517e-01$, $p < 0.01$), which offers support for *H3*.

Furthermore, the significance of the squared term in Model 4 indicates that there are decreasing returns on the probability of idea acceptance ($\beta = -4.128e-3$, $p < 0.01$) when the knowledge overlap continuously increases. Hence, we find an inverted U-shaped effect of knowledge overlap on idea acceptance. This supports *H4*, which predicted that ideas would be more likely to be accepted when the knowledge overlap is at a certain point, and that an increased knowledge overlap beyond this point instead has a negative effect. Figure 2 shows the inflection point after which a higher knowledge overlap seems to have a negative effect on idea acceptance.

Apart from the independent variables, the investigation of control variables shows some interesting results as well. For example, the idea network size, representing the number of commenters, has a negative effect ($\beta = -1.095e-01$, $p < 0.01$) while feedback amount has a positive effect on the likelihood of idea acceptance ($\beta = 7.290e-04$, $p < 0.01$). As these two control variables are closely related to knowledge overlap and feedback timeliness

Table III.
Logit model predicting
the likelihood of an
idea acceptance

	Model 1	Model 2	Model 3	Model 4
<i>Control variables</i>				
Idea sentiment	-3.564e-04 (2.313e-03)	-1.970e-04 (2.341e-03)	-5.494e-04 (2.315e-03)	-3.339e-04 (2.340e-03)
Idea length	-1.641e-05 (1.834e-05)	-1.943e-05 (1.831e-05)	-1.680e-05 (1.843e-05)	-2.011e-05 (1.844e-05)
Idea relatedness	1.361e-02 (9.369e-02)	1.974e-02 (9.389e-02)	-2.506e-02 (9.588e-02)	-1.833e-02 (9.601e-02)
Idea effectiveness	-1.619e-02 (2.189e-02)	-1.787e-02 (2.197e-02)	-2.959e-02 (2.247e-02)	-3.176e-02 (2.258e-02)
Idea by manager	1.815e-01** (7.902e-02)	1.600e-01** (7.956e-02)	1.879e-01** (8.004e-02)	1.635e-01** (8.077e-02)
Idea network size	-1.207e-01*** (4.010e-02)	-1.035e-01*** (3.945e-02)	-1.264e-01*** (4.097e-02)	-1.095e-01*** (4.014e-02)
Modified times	1.038e-02 (2.040e-02)	1.367e-02 (2.059e-02)	1.216e-02 (2.089e-02)	1.528e-02 (2.113e-02)
Ideator's comments	1.154e-01 (9.823e-02)	1.193e-01 (1.001e-01)	1.549e-01 (9.961e-02)	1.622e-01 (1.018e-01)
Feedback amount	8.881e-04*** (1.806e-04)	8.057e-04*** (1.814e-04)	8.162e-04*** (1.821e-04)	7.290e-04*** (1.826e-04)
<i>Independent variable</i>				
Feedback timeliness (time to feedback)		1.018e-07*** (2.372e-08)		1.041e-07*** (2.387e-08)
Time to feedback ²		-4.134e-15** (1.902e-15)		-4.185e-15** (1.913e-15)
Knowledge overlap			1.457e-01*** (3.740e-02)	1.517e-01*** (3.768e-02)
Knowledge overlap ²			-4.053e-03*** (1.395e-03)	-4.128e-03*** (1.418e-03)
Nagelkerke R ²	0.03	0.05	0.04	0.06

Notes: $n = 2,413$. Huber-White robust standard errors are reported in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

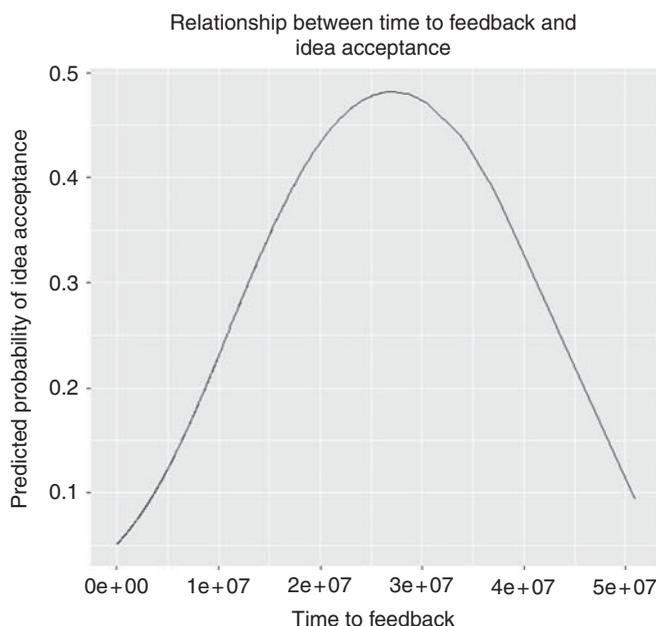


Figure 1.
Probability of idea
acceptance influenced
by feedback
timeliness

(see Table I), respectively, their detailed relationship shows that the majority of individuals provide fast feedback and the individuals who have high knowledge overlap with ideas normally provide more feedback information.

6. Analysis and discussion

Although contributions to ideas in the process of idea development, in terms of e.g. feedback and comments, arguably constitute some of the most important activities for converting ideas to innovations (Kijkuit and van den Ende, 2007; Perry-Smith and Mannucci, 2017), little attention has thus far been paid to the characteristics and content of this input. This underlines that there is still limited understanding about the emergent and non-linear online maturation process of ideas (Beretta, 2019; Hoornaert *et al.*, 2017; Zhu *et al.*, 2019), particularly in terms of how feedback is given and who gives feedback. In order to investigate these issues, this study explored the role of feedback timeliness and knowledge overlap between feedback providers and ideas in collective firm-internal online idea development. To this aim, data including the amount and characteristics of ideas, comments and contributors were collected from an online platform of idea management in a Swedish multi-national company, and their relationships with idea acceptance were analyzed using a logistic regression analysis. Briefly put, the results show that idea development is positively influenced by feedback timeliness and knowledge overlap. Moreover, it was found that both the relationships of feedback timeliness and knowledge overlap with idea acceptance are curvilinear. To the best of the authors' knowledge, this is the first study that investigates how idea development is influenced by feedback timeliness and knowledge overlap between feedback providers and ideas in collective firm-internal online idea development, shedding new light on the complex dynamics at place in collective firm-internal idea development, and providing new insights on how this process can be fruitfully managed.

Contrary to most normative accounts, the first finding shows that the time to feedback has a significant positive effect on the likelihood of idea acceptance. This could be explained

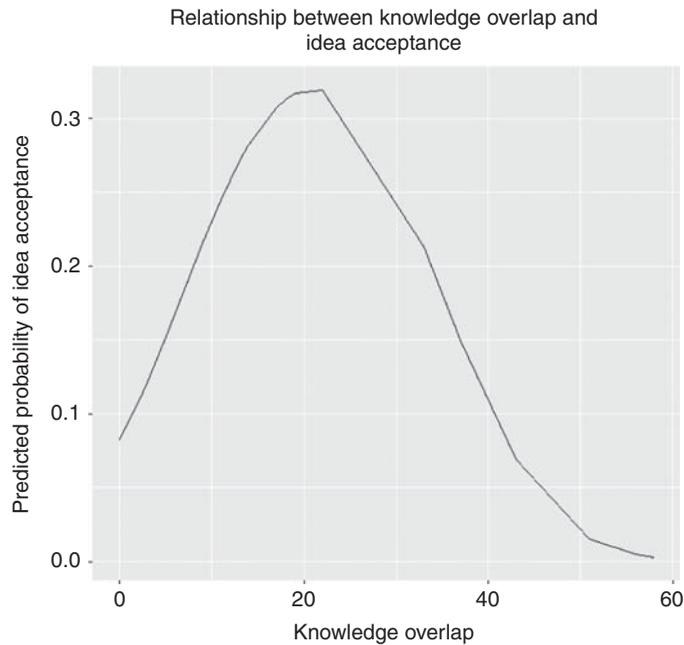


Figure 2.
Probability of idea
acceptance influenced
by knowledge overlap

by feedback receivers being less controlled and having less limitations of resources to respond, compared to a situation with high feedback frequency which arguably influences the improvement performance negatively (Chhokar and Wallin, 1984; Lam *et al.*, 2011; Lurie and Swaminathan, 2009). More specifically, a shorter time to feedback is accompanied by more informational control (Ilgen *et al.*, 1979). This is on the one hand likely to lead feedback receivers to feel increased tension and anxiety to further contribute to idea development (Lam *et al.*, 2011). On the other hand, it challenges the cognitive capacity of ideators to process recent feedback in real time and move ideas further, particularly in collective online idea development where contributors generally participate voluntarily, with uncertain and ill-defined contributions (Lurie and Swaminathan, 2009; Majchrzak and Malhotra, 2016). Despite the negative effect of rapid feedback from feedback receivers, this rapid feedback itself was found to normally offer limited informational support due to its limited length. Therefore, leaving a certain time for feedback receivers to go back and forth between feedback and ideas, and allow feedback providers to contribute more informational feedback, would be helpful for idea development. However, it was found that the increased time to feedback would lose its advantage beyond a certain point. Possible explanations for this could be that the ideas in question are not very attractive or that their potential value is low if there is still no feedback within a long time period after the ideas have been submitted. Another explanation is that the motivation to further improve ideas would be constrained and the attention of ideators transferred to other new ideas if an idea is not active for a long time, something which is then likely to result in a decline of idea acceptance.

The third finding about knowledge overlap between feedback providers and ideas highlights the importance of the familiarity of feedback providers with ideas in idea development, which can increase the probability of idea acceptance. The examined positive role of knowledge overlap supports the argued benefits of knowledge relatedness and knowledge redundancy (e.g. Acar and van den Ende, 2016; Koch, 2011) in innovation management. One explanation is that an increased knowledge overlap refers to an increased

ability to combine diverse knowledge sets and transfer new insights to the domain of ideas (Acar and van den Ende, 2016). Another possible reason is that the mutual understanding is better guaranteed with higher knowledge overlap, as feedback providers feel that it is then easier to form richer and more elaborate schemas of ideas, something which potentially supports idea development. However, compared to the related literature about the positive role of knowledge diversity in terms of demographic (Zhu *et al.*, 2019), geographic (Beretta, 2019), organizational (Bergendahl and Magnusson, 2015), as well as cognitive distance (Nootboom *et al.*, 2007) in innovation management, the observed inconsistency could be explained by the different views on the conception of knowledge domain, innovation process, as well as innovation type. First of all, one possible explanation for these results is that the terms of the above-mentioned knowledge diversity and the knowledge overlap in this study represent two different aspects, although both of them are about the knowledge domains of contributors. Feedback diversity in terms of demographic (Zhu *et al.*, 2019), geographic (Beretta, 2019), organizational (Bergendahl and Magnusson, 2015), as well as cognitive distance (Nootboom *et al.*, 2007) is about the difference of knowledge domains across all contributors (Nootboom *et al.*, 2007; Bergendahl and Magnusson, 2015), whereas knowledge overlap is about the familiarity of contributors with ideas that they comment upon (Acar and van den Ende, 2016). On this basis, there is a possibility that contributors with high knowledge overlap actually have high knowledge diversity as well. Another reason could be that knowledge overlap has different effects in different phases of innovation process and for different types of innovation (see e.g. Bergendahl and Magnusson, 2015; Hemphälä and Magnusson, 2012; Kijkuit and van den Ende, 2007). More specifically, on the one hand, different knowledge of contributors is helpful in different parts of the innovation process (Kijkuit and van den Ende, 2007). In the initial part of the innovation process, namely idea generation, a larger number of looser relationships with diverse knowledge access are argued to be helpful for innovation, whereas the later phases of innovation, such as idea development, are furthered by more cohesive relationships with higher prior related knowledge (Kijkuit and van den Ende, 2007; Bergendahl and Magnusson, 2015). On the other hand, the prior related knowledge of contributors supports radical and incremental innovations in different ways (Acar and van den Ende, 2016; Nootboom *et al.*, 2007). As argued by Nootboom *et al.* (2007), knowledge diversity is positive for innovation when an innovation is radical. However, also knowledge overlap, in terms of being familiar with a knowledge domain, has been found to be positively associated with more radical innovation through the use of recombinant creativity (Acar and van den Ende, 2016). Therefore, training employees to be familiar with the knowledge area of ideas that they contribute to would be helpful for idea development, where high prior related knowledge is needed for mutual understanding (Kijkuit and van den Ende, 2007) and extra-help passion to develop ideas (Acar and van den Ende, 2016; Berg, 2014). However, it was found that the increased knowledge overlap would lose its positive effect beyond a certain point. A possible explanation for this could be criticism caused by narrow-mindedness (Beretta, 2019; Magnusson *et al.*, 2016). This investigated curvilinear effect is not only similar to the U-shape relationship between cognitive distance and innovation (Nootboom *et al.*, 2007), but also supports the previous argument that the prior related knowledge of feedback providers has different effects under different conditions.

6.1 Theoretical implications

Theoretically, this study mainly contributes to recent calls about better understanding of internal crowdsourcing of ideas (Malhotra *et al.*, 2017; Zuchowski *et al.*, 2016), by showing effects of contributions to the development of ideas (Beretta, 2019; Majchrzak and Malhotra, 2016; Perry-Smith and Mannucci, 2017) in terms of feedback timeliness as well as knowledge overlap between feedback providers and ideas. More specifically, this study contributes to

the digital innovation literature by exploring the use of firm-internal IMS based on crowdsourcing principles. With the digitalization of innovation (Nambisan *et al.*, 2017), crowd-based approaches for online idea management have been popular for practice and scholars alike (Van den Ende *et al.*, 2015). Nevertheless, most related research is focused on the online idea management contributed by external sources such as customers and suppliers, whereas online internal crowdsourcing to manage ideas inside firms solely with internal sources is not as well understood (Malhotra *et al.*, 2017; Zhu *et al.*, 2019). By focusing on the idea development in the context of firm-internal IMS, this study provides a better understanding of how firms achieve innovation capacity through managing ideas in the crowdsourcing process self-organized by employees.

Second, this study contributes to the digital front-end innovation and ideation literature by providing a more comprehensive understanding of contributions to idea development. Digital front-end innovation and ideation research tends to focus either on the generation of novel ideas (e.g. Björk, 2012; Christensen *et al.*, 2017; Toubia and Netzer, 2016; Zhu *et al.*, 2019) or the selection/evaluation of ideas (e.g. Beretta, 2019; Chan *et al.*, 2018; Magnusson *et al.*, 2016), while the intermediate process where ideas are nurtured is often neglected (Beretta, 2019; Hoornaert *et al.*, 2017). Different from idea development in the context of offline face-to-face interaction around ideas (Kijkuit and van den Ende, 2007; Perry-Smith and Mannucci, 2017), in terms of crowd participation pattern and knowledge trajectories (Majchrzak and Malhotra, 2016), online idea development provides an additional channel with more opportunities for employees across organizational and knowledge boundaries to freely and voluntarily interact and add knowledge to others' ideas by giving feedback (Beretta, 2019). At the same time, this offers more substantial challenges in terms of understanding how to manage idea development. To the best of our knowledge, this is the first study on online idea development. By focusing on the feedback aspect, something which arguably plays a critical role in the future innovation (Hoornaert *et al.*, 2017), this study extends previous knowledge about the front-end innovation or ideation to include also idea development.

Third, this study contributes to the research on digital innovation research in different ways, by investigating the role of feedback timeliness. What concerns how feedback given, feedback timeliness have been treated as an important aspect in the context of offline creativity and innovation management (Chhokar and Wallin, 1984; Ilgen *et al.*, 1979; Kijkuit and van den Ende, 2007). Studies within this field highlight that feedback timeliness plays a role for emotional motivation and knowledge learning (Lam *et al.*, 2011), and thereby further decision making (Lurie and Swaminathan, 2009). Although a short time to feedback with high frequency, synonymous with more information, ought to bring about more opportunities to use diverse knowledge assets for knowledge creation, our findings contradict this and instead support the view that too many cooks spoil the broth (Rese *et al.*, 2013). Frequent feedback may bring about more stress and anxiety due to a lower feeling of personal control and higher demand for cognitive capacity (Ilgen *et al.*, 1979; Chhokar and Wallin, 1984; Lam *et al.*, 2011).

Last but not least, the present study seeks to extend current innovation research, by investigating the knowledge of contributors (Beretta, 2019; Zhu *et al.*, 2019) with the examined effect of knowledge overlap on ideation outcomes in the context of firm-internal IMS. With the widespread usage of crowd-like approaches, questions regarding who contributes to ideas has long been emphasized due to the growing uncertain contributions by diverse and distributed contributors. Nevertheless, most previous research has focused on either ideators' knowledge domains for online idea generation (e.g. Piezunka and Dahlander, 2015; Zhu *et al.*, 2019) or evaluators for online idea selection (e.g. Magnusson *et al.*, 2016). Less attention has been given to feedback providers in online idea development who can help ideators by adding complementary knowledge to their ideas prior to

evaluation (Beretta, 2019). Furthermore, although researchers have substantially improved measurement of individual knowledge, the improved measurement to some extent is indirect by using measures of demographic, geographic, organizational and cognitive distance (e.g. Beretta, 2019; Bergendahl and Magnusson, 2015; Zhu *et al.*, 2019; Nooteboom *et al.*, 2007) at individual level. This study contributes to the measurement of knowledge overlap by more directly considering the knowledge domains at both individual and idea levels, something which may further increase knowledge-based views of feedback providers. Our findings show that the feedback providers are suggested to be familiar with ideas commented upon, something which does not only support the recent arguments by Acar and van den Ende (2016) and Piezunka and Dahlander (2015) in terms of cognitive focus search, but is also consistent with the previous research based on social networks, implying that prior related knowledge embedded in network content is suggested to be high (Kijkuit and van den Ende, 2007; Perry-Smith and Mannucci, 2017). Nevertheless, this does not mean that the participation of diverse contributors is not important for idea development. The observed inverted U-shaped relationship between knowledge overlap and the likelihood of idea acceptance shows that the knowledge distance from ideas is helpful up to a certain point of knowledge overlap. With respect to the previously developed concept of cognitive distance (Nooteboom *et al.*, 2007) and knowledge distance (Acar and van den Ende, 2016), these results add to the discussion on the different requirements for knowledge search (depth and scope) for different types of innovation and different parts of the innovation process (Bergendahl and Magnusson, 2015; Hemphälä and Magnusson, 2012; Kijkuit and van den Ende, 2007). Moreover, this study extends existing theory on network diversity and cognitive distance from the perspectives of demographical, geographical and organizational distance to the knowledge distance through examining the knowledge network connecting ideas with its commenters in idea development (Zhu *et al.*, 2019), something which contributes to the multi-dimensional measurement of contributor diversity in innovation management.

6.2 Practical implications

This study also provides some practical implications for management. With the observed significant influence of feedback on the go/no-go decision of ideas in idea development, one of the important managerial aspects concerns the explicit use of online internal IMS to develop ideas, as the focus of these platforms is frequently only on the generation of ideas and not on developing them further with the help of collective feedback (Malhotra *et al.*, 2017). The frequent lack of open calls for feedback to develop ideas currently brings about roadblocks to the success of internal IMS (Malhotra *et al.*, 2017). On this basis, the results of this study suggest that firms should do more than simply concentrate on how to generate a large volume of ideas, especially since idea quantity does not necessarily mean eventual innovation success, particularly if the idea quality is not guaranteed (Van den Ende *et al.*, 2015). By contrast, it is even more important for companies to actively facilitate in-house knowledge resources to as far as possible nurture ideas of high quality (Zhu *et al.*, 2019). In addition, the findings suggest that firms need to pay attention to managing the feedback in firm-internal online idea development in order to remove the main roadblocks. For example, managers are suggested to motivate the active participation to process feedback in idea development (Malhotra *et al.*, 2017). However, as different dimensions of feedback have different effects on idea development, different management approaches are suggested, so that the feedback does not undermine the ideas or result in their premature rejection (Malhotra *et al.*, 2017; Perry-Smith and Mannucci, 2017; Berg, 2014).

More specifically, in terms of how feedback given, feedback timeliness is an important aspect to be taken into account. Conventional wisdom is that employees need fast feedback for learning to improve their work (Lam *et al.*, 2011), but our results clearly contradict this

conventional wisdom. In fact, feedback given in real time possibly kills ideas in the middle way. Therefore, firms should not merely assume that timely feedback and more feedback with high frequency are always better (Lam *et al.*, 2011; Lurie and Swaminathan, 2009). Emotional motivation and cognitive capacity should be taken into account when managing the timeliness of feedback. For example, leaving some time and space for ideators to accept and understand feedback is necessary, so that they do not feel unnecessary stress and anxiety, but allow them to have sufficient personal control and cognitive resources to respond to and process feedback. Furthermore, having available time to contribute fruitful information is critical. However, as too much time for waiting feedback might destroy the motivation to improve ideas, feedback timeliness needs to be managed in a balanced way.

Besides the management implications about how feedback is given in terms of feedback timeliness, we can also derive implications about who gives feedback, as there is an issue that it is difficult to identify the most suitable way to manage contributors. First, the negative effects of the number of commenters on ideation acceptance should remind managers that it is not always better to involve more individuals in these emergent and distributed ideation systems, but that it might be beneficial to take measures to exercise some control when the distributed and diverse employees can freely join in and out, especially considering the diversity of ideas, comments and creators. Moreover, apart from the mere number of contributors, the quality of contributors in terms of their knowledge domains should also be considered during the idea development. Previous studies advocate open calls for contributors from diverse knowledge domains for knowledge creation (Beretta, 2019; Zhu *et al.*, 2019), but our results show that contributors should ideally be familiar with the knowledge domains of ideas commented upon. Therefore, firms should not simply try to expand the knowledge diversity of employees for online idea generation. It may be more important to train employees to have specific experience and knowledge to specifically help the improvement of others' ideas.

6.3 *Limitations and future studies*

Although this study has a salient strength of proprietary data on ideas, comments and contributors in idea development, it still bears some limitations, some of which call for further research. A first drawback is the limited generalizability of research findings to other firms, as data in this research derive from a single company. This limitation calls for a replication of similar studies in other firms to assess to what extent these findings are specific or general in collective idea development. A second shortcoming is that a number of other related factors which might be related to idea development are not considered because of the lack of such data. Among other factors, a key aspect potentially influencing the effect of knowledge overlap is the type of ideas involved (in terms of radical and incremental innovation) and this aspect should be taken into account in future studies. Furthermore, it would also be interesting to capture the effects of different managerial styles, different creative climates and cultures, and individual characteristics such as the goal and value of creators and commenters (Son and Kim, 2015). Further studies could also look into more factors, like different management models, different types of contributors' behaviors or roles, and the subjective biases of contributors in terms of positive or negative tendencies. A third limitation concerns the knowledge of feedback providers as well. Different terms like knowledge relatedness, redundancy, distance and cognitive distance have been used to describe the knowledge domains of feedback providers, as there is still a lack of unified terms in the literature. Although these different usages of terms based on different measurements on the one hand enrich the knowledge perspective of feedback providers, they also bring confusion to understanding their roles in idea development. Therefore, it would be interesting and valuable to see specific studies on the relationships among different aspects of knowledge domains such as knowledge

overlap and cognitive distance. A fourth limitation is the ambiguity of idea success and the related possible variation in the definitions of idea success used in different idea boxes. This calls for more detailed research on idea quality through exploring specific and general criteria of success. Despite the mentioned limitations, this research offers substantial insights for both scholars and practitioners into the micro-foundations of collective idea development, contributing to current innovation literature by shedding more light on the mechanisms influencing the specific process of collective firm-internal online idea development.

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