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Promoting the Quality of User Generated Ideas in Online Innovation Communities: A Knowledge Collaboration Perspective

Completed Research Paper

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Abstract

Enabled by Internet-based technologies, users are increasingly participating and collaborating in idea generation in online innovation communities. However, with the limited understanding of the phenomenon, few studies have investigated what determines the quality of ideas. This study aims at addressing the knowledge gap. We find that idea experimentation effort, i.e., the effort associated with creating the idea, and idea review, i.e., comments by other users, directly influence idea quality. Further, idea recombination, i.e. peer users participating in wiki-based edits, have a positive influence on idea quality in case idea experimentation effort was low, and a negative influence in case of high initial idea experimentation effort. These results contribute to idea generation, knowledge collaboration, and user generated content literature by investigating the mechanisms through which collaboration influences the quality of the collaborative outcome (i.e., idea quality) in online contexts for the first time. Advice for organizations running online innovation communities is also provided.

Keywords: *Knowledge Collaboration Theory, Idea Quality, Idea Experimentation, Idea Recombination, Idea Review*

Introduction

Developing high quality ideas and successful innovations remains one of the essential challenges for organizations. In order to obtain a continuous stream of ideas, organizations are increasingly including external users such as customers in the innovation process with the help of the Internet (Feller et al. 2012; Majchrzak and Malhotra 2013). This is because users may generate innovation ideas that go way beyond the constraints of organizational idea generation processes enabling radical innovations (e.g., Di Gangi and Wasko 2009; Ye and Kankanhalli 2013; Zwass 2010). One such mechanism for including users in the process of idea generation is through online innovation communities that refer to the digital spaces where users freely reveal and share innovative ideas with other users and organizations (Di Gangi and Wasko 2009; Zwass 2010). These initiatives have been shown to be highly successful in previous research (e.g., Bayus 2013; Bretschneider et al. 2015; Di Gangi and Wasko 2009).

With the growing importance of innovation development in the long-term competitiveness in times of globalization, rapidly changing customer preferences, and short product life cycles, online innovation communities have become a strategic information system for organizations (von Krogh 2012; Majchrzak and Malhotra 2013). However, many organizations find it difficult to obtain a continuous stream of high quality ideas through their online innovation communities (Majchrzak and Malhotra 2013). Organizations may not be able build competitive advantages from their online innovation communities in case that these initiatives are ineffectively designed and managed (Feller et al. 2012; von Krogh 2012; Sedera and Gable 2010). Consequently, researchers and practitioners are constantly reaching out for improving the effectiveness of idea generation processes in online innovation communities (e.g., Blohm et al. 2013; Majchrzak and Malhotra 2013). One important strategy is to induce technology-afforded collaboration among users in order to leverage the collective wisdom of the crowd (e.g., Bayus 2013; Blohm et al. 2011; Faraj et al. 2011; Majchrzak and Malhotra 2013).

The idea generation literature has a long tradition in researching the effectiveness of collaborative idea generation processes (e.g., Girotra et al. 2010; Singh and Fleming 2010; Taylor and Greve 2006). For instance, Singh and Fleming (2010) reveal that collaboration increases the number of high quality ideas. This result agrees with recent analytical (e.g., Kavadias and Sommer 2009) and experimental findings (e.g., Girotra et al. 2010). However, the underlying mechanisms regarding how collaboration can help improve idea quality is unclear. Besides, in online settings, users can freely propose and revise content at any time without necessarily considering the presence of others (Ransbotham et al. 2012). Contributions are recorded and stored online, making it easy for users to retrieve the postings or comments (von Krogh 2012). This is different from previously examined offline contexts potentially affecting idea generation. Such contextual differences require further investigation of collaborative idea generation in online contexts.

Online collaboration literature has mainly focused on investigating motives for collaboration (e.g., Ma and Agarwal 2007; Sun et al. 2012; Wasko and Faraj 2005) and suggests that we need to design more effective participation architectures fostering online collaboration among users (e.g., Feller et al. 2012; von Krogh 2012; Majchrzak and Malhotra 2013). In this vein, Faraj et al. (2011) proposed knowledge collaboration theory according to which, technology can facilitate online collaboration and, as a result, improve the overall quality of knowledge contributed. However, this theory only implicitly relates different modes of online collaboration to the effectiveness of the collaboration process and does not outline borderline conditions for successful online collaboration.

We aim to fill these research gaps by developing and testing a theoretical model to address the question: *How does knowledge collaboration determine the quality of user generated ideas in online innovation communities*? In greater detail, we examine how different forms of technology-afforded knowledge collaboration enable users to generate ideas of better quality and how these effects are moderated by the effort of original idea creators associated with creating the idea (i.e., experimentation effort). The model is tested using archival data from the SAPiens online innovation community and an independent expert rating of idea quality. We find that idea reviews (i.e., comments on an idea from other users) have a positive effect on idea quality. In contrast, idea recombination (i.e., idea edits by other users) only influence idea quality in conditions in which idea creators put little experimentation effort into contributing the original idea. Further, idea experimentation effort also influences idea quality in a direct fashion.

Our study provides three important contributions that will enhance our understanding about online innovation communities as strategic information system for innovation development. First, our study contributes to the idea generation literature by systematically investigating determinants of effective collaborative idea generation processes in online contexts. Second, we extend knowledge collaboration theory by specifically modeling and empirically testing the effectiveness of different mechanisms of technology-afforded online collaboration as well as their border conditions. Third, we contribute to user generated content literature by relating online collaboration to a direct measurement of collaboration effectiveness. In practice, these results will help design more effective online innovation communities.

Our paper proceeds as follows: In the next section, we lay the theoretical foundation for our study, review the relevant literature on idea quality, idea generation, and knowledge collaboration. We then develop our research model and describe our methods. After that we present results and discuss theoretical and managerial implications in the last sections.

Theoretical Foundation

This section reviews the relevant literature on idea quality, idea generation, and knowledge collaboration theory, which guides our study.

Idea Quality

Idea quality is a complex construct including four dimensions (Dean et al. 2006): novelty, usefulness, elaboration, and workability. Novelty refers to unique and unobvious ideas that have not been expressed before (e.g., Dean et al. 2006). Usefulness is the extent to which the idea responds to a tangible problem (Dean et al. 2006). This refers frequently to an innovation idea's relevance or financial potential (Cady and Valentine 1999; Kristensson et al. 2004). Elaboration can be seen as the extent that an idea is complete, detailed, and understandable (Dean et al. 2006). This refers not only to an idea's description but also to its maturity (MacCrimmon and Wagner 1994). Ideas that are vague or contain unclear causality are less useful than ideas that are more specific in these areas (MacCrimmon and Wagner 1994). Last, workability refers to an idea's feasibility and the degree to which an idea can be successfully adopted by an organization (Cady and Valentine 1999).

Idea Generation

The effectiveness of idea generation depends on the quality of ideas identified (Girotra et al. 2010). In order to unravel organizational structures promoting creativity, research has examined the effectiveness of idea generation by teams compared to that by the same number of individuals generating ideas in isolation (e.g., Girotra et al. 2010; Kavadias and Sommer 2009; Singh and Fleming 2010). Mixed results have been found about whether teams generate better ideas than do individuals. Some studies have found that working in teams leads to multiple creative stimuli and interaction among participants, resulting in ideas of better quality (Dennis et al. 1996; Girotra et al. 2010; Singh and Fleming 2010).

Other studies have found that the quality of generated ideas is not different between individuals and teams (e.g., Diehl and Stroebe 1987). They argue that idea generation by teams is less effective than by individuals due to *idea blocking* (only one person can speak at a given time, and consequently ideas might be forgotten while listening to and understanding the speaker) and *interpersonal tensions* (others may not criticize the idea in the presence of idea generators) (Diehl and Stroebe 1987; Gallupe et al. 1991). These studies suggest that idea generation should include significant effort by individuals working independently of one another.

In online innovation communities, users can freely propose and revise ideas at any time without taking into consideration the presence of other users. Collaborative idea generation is afforded by information technology such as commenting, wiki, and rating functionalities, or other types of social software (von Krogh 2012). Usually, contributions are anonymous such that users do not know who the original idea creator is. Further, all contributions are usually stored in discussion threads, making it easy to check through the history of these interactions. Anonymity may enhance idea generation as it reduces evaluation and communication apprehension (e.g., Connolly et al. 1990). With anonymity, users may be more open in sharing their views and contributing ideas (Sia et al. 2002). Therefore, the challenges of

offline collaboration (i.e., idea blocking and interpersonal tensions) may not be as salient in an online context. However, other problems of collaboration, e.g., *free-riding* (consuming content without sharing information or knowledge), may be exacerbated (Wasko and Faraj 2005). Such contextual differences may result in variations regarding how collaboration will affect the quality of ideas generated in online innovation communities as compared to offline settings. Therefore, the quality of user generated ideas through collaboration in online innovation communities requires further investigation.

Knowledge Collaboration Theory

Online knowledge collaboration is defined as individual acts of offering knowledge to others as well as adding to, recombining, modifying, and integrating knowledge that others have contributed (Faraj et al. 2011). Such collaboration can take various forms. It could involve a user posting a question or an idea and then engaging in a process of reflecting on incoming responses and posting clarifying questions or ideas (von Krogh 2012; Wasko and Faraj 2005). It could also involve users engaging in editing contributions (Jarvenpaa and Majchrzak 2010). Yet another form involves providing feedback on the knowledge contributed, while still waiting for others to include the feedback in the knowledge (Faraj et al. 2011). Literature hints that online knowledge collaboration may help generate better content (e.g., Ransbotham and Kane 2011; Ransbotham et al. 2012). For example, Ransbotham and Kane (2011) report that collaboration between new and experienced users in Wikipedia affects the success of content generation in terms of the articles being featured as "best articles." However, what specific aspects of knowledge collaboration will be salient in online innovation communities and how these specific aspects influence the quality of ideas have not been theorized and tested.

Due to the fluidity of online communities, fluctuations in resources (e.g., time, passion, and effort of users) which are necessary for online knowledge collaboration are created. This will cause tensions in creating effective online collaboration processes (Faraj et al. 2011; Majchrzak and Malhotra 2013). Tensions may cause content disorganization which makes it difficult for individuals to find and elaborate on ideas, or ways to enter into a topic and make a valuable contribution. As a result, tensions hamper the effectiveness of knowledge collaboration (Faraj et al. 2011).

Knowledge collaboration theory proposes that technology affordance is an important coping mechanism for such tensions and facilitates the effectiveness of knowledge collaboration. Three aspects of technology affordance are proposed for knowledge collaboration in online communities: (1) experimentation, (2) idea review, and (3) idea recombination. All three reflect different mechanisms of self-disclosure with which users may share their private information and knowledge (Wakefield 2013). (1) Experimentation refers to trying out, piloting, or prototyping novel ideas (Faraj et al. 2011). In online innovation communities, experimentation refers to creating and submitting novel ideas. While experimentation is per se not a collaborative act, it reflects the major requirement for knowledge collaboration by providing the shared materials for collaboration. (2) Idea review refers to mechanisms through which users are able to manage the content produced in the community over time (West and Lakhani 2008). Review functionalities, such as comments, allow users to provide feedback and contextual information regarding already generated ideas (Bayus 2013). (3) Idea recombination refers to forms of technology-afforded action where individual users directly build on others' contributions (Faraj et al. 2011). It enables users to extend existing contributions of others', e.g., ideas (von Krogh 2012). Functionalities affording recombination such as wikis, thus, exceed review functionalities that may provide somewhat loosely coupled feedback for an idea, by forcing users to directly integrate and adapt their ideas to another user's original idea. While knowledge collaboration theory has theorized the interactions among these three dimensions of technology affordance, no study has empirically tested the impact of three aspects on the effectiveness of knowledge collaboration. Consequently, this paper models and empirically tests the impact of their interactions on the quality of user generated ideas.

As per knowledge collaboration theory and past literature, the effectiveness of knowledge collaboration has been referred to improved or refined knowledge (Faraj et al. 2011), better content (e.g., Ransbotham and Kane 2011; Ransbotham et al. 2012), and quality ideas (Bayus 2013). The very important outcome of knowledge collaboration is the quality of ideas generated. Hence, we derive quality of user generated ideas as our dependent variable from knowledge collaboration theory.

Research Model and Hypotheses

Based on the idea quality, idea generation, and knowledge collaboration literature, we propose a research model explaining the influence of the different mechanisms of knowledge collaboration on the quality of the ideas being generated. The proposed model is shown in Figure 1.

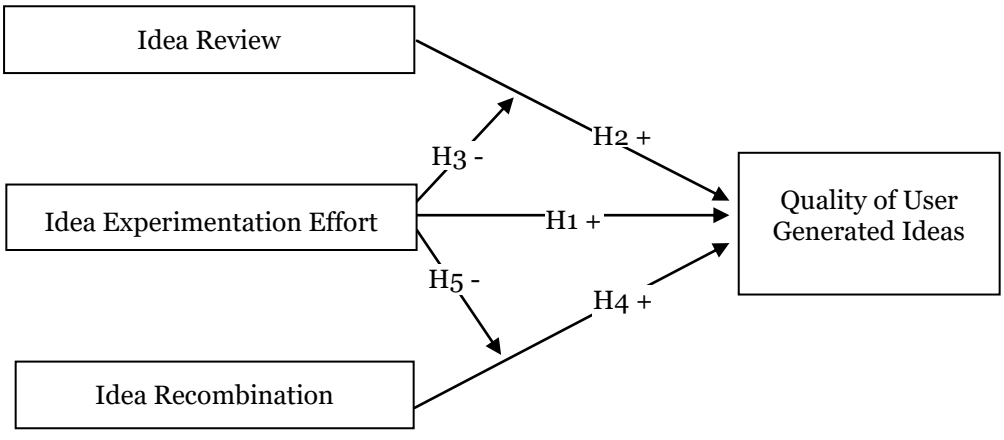

Figure 1. Proposed Research Model

Idea Experimentation Effort

Idea experimentation effort refers to the time and effort input by idea creators in constructing, developing, and codifying their ideas (Yang et al. 2009). In this regard, experimentation is directly associated with idea generation processes. It includes the cognitive sourcing of ideas as well as the processes that underlie their formation (Tschang and Szczypula 2006). Through idea sourcing, individuals will go through the process of searching for possible combinations or recombination of information, i.e., applying their knowledge and experiences to novel problems, as well as cognitive thought trials (Singh and Fleming 2010).

Extending this argument, idea generation literature suggests that the ability to generate novel ideas is based on the availability of knowledge, which can be shaped by individuals' search effort (Lyles and Schwenk 1992; Taylor and Greve 2006), e.g., selecting and codifying appropriate keywords. A search with generally codified keywords results in more idea variety (Santanen et al. 2004; Ye and Kankanhalli 2013), and can identify ways to combine knowledge (Taylor and Greve 2006). The effort put into codifying or clarifying keywords for search and diversity of information search determines the size of recombinant opportunities (Kornish and Ulrich 2011; Santanen et al. 2004), all of which will affect the quality of ideas generated (Singh and Fleming 2010). Further, the idea creator needs to compose the idea into language or words and communicate it to others (Kavadias and Sommer 2009). The more time and effort put into codifying and clarifying the idea will improve the quality of the ideas being generated (Diehl and Stroebe 1987).

Creativity literature also suggests that generating high quality ideas requires application of deep knowledge because individuals must understand a knowledge domain to push idea beyond their boundaries (Sternberg and O' Hara 2000). In the context of our study, exploring the knowledge domain and pushing ideas beyond its boundaries may require users to invest time, effort, and cognitive resources. Thus, increasing idea experimentation effort should affect the quality of generated ideas.

This is also consistent with previous user generated content literature, which has found that the experimentation effort by users will directly affect the value of user generated content (e.g., Ransbotham et al. 2012). This is because more input by content creators will help improve the content quality not only by clarifying it with a language that can be commonly understood but also by searching for more

information with keywords. Following the logic discussed above, the experimentation effort input by idea creators should directly affect the quality of user generated ideas. Therefore, we hypothesize:

H1: Idea experimentation effort is positively related to the quality of user generated ideas.

Idea Review

Idea review refers to other users' suggestions posted regarding the idea enabled by commenting functionalities (von Krogh 2012). According to knowledge collaboration theory, idea reviews enable users to receive important feedback and contextual information regarding posted ideas (Faraj et al. 2011). This may help the community cultivate ideas of better quality as idea reviews point out the necessity for improvement. Such information provided by users could help original idea creators to edit the idea and improve it accordingly (Chen et al. 2013; Dominick et al. 1997). Improvement information could include further elaboration of the idea using examples, or describing the idea with simpler language. Further, idea reviews may serve as a clue for idea creators to reflect on their original idea (Santanen et al. 2004). By learning from idea reviews, creators may start to think about the drawbacks of the idea and exert more effort on resolving these to improve it (Gilson and Shalley 2004).

In past educational learning literature, feedback and reviews have been found to provide students with information that may help improve their existing knowledge. Nicol and Macfarlane-Dick (2006) suggest that feedback serves as a form of formative assessment, designed to improve and accelerate learning. Similarly, Ermter et al. (2007) found that receiving feedback from peer students significantly improves the quality of discussion postings in an online course. In the context of our paper, following this logic, idea reviews should not only reflect an opportunity for idea creators to learn and improve on the idea, but also improve idea quality itself as the discussion per se may already add value to the original idea (Bayus 2013).

Similar arguments have been found in the innovation literature. For instance, Hargadon and Sutton (1997) note that the product development organization IDEO invited designers not associated with a focal project to provide feedback and advice in the initial design stages. In this way, IDEO attempted to facilitate the combination of different knowledge domains to generate more creative designs. Similarly, in the context of our study, we expect that idea reviews will serve as a source of diverse knowledge, and facilitate novel combinations of knowledge to generate ideas of quality. Thus, we expect:

H2: Idea review is positively related to the quality of user generated ideas.

Idea reviews from other users may indicate under-considered but important factors and inspire idea creators to further improve the ideas (Bayus 2013; Ermter et al. 2007). However, as more idea experimentation effort is put in the idea by the original idea creator, the idea becomes more mature and it becomes more difficult for other users to provide valuable feedback. As ideas mature with more effort put into experimentation, they have already surpassed many thought trials such that they will be less adaptive to changes in the underlying knowledge. In this case, reviewing users need a detailed understanding of the idea as well as its boundary conditions in order to push ideas beyond its boundaries. In contrast, at the early stage of idea development with low effort put into experimentation, idea reviews could help shape the idea and improve its quality in a significant way. Users can easily contribute to the idea by commenting on its limitations (Bayus 2013), helping clarify its boundary and premises, and contributing necessary components to make it mature (Blohm et al. 2011). Thus, only small comments may positively influence an idea's quality. Consequently, we suggest the positive effect of idea reviews on the quality of user generated ideas is conditional on the original idea creator's experimentation effort:

H3: Idea experimentation effort negatively moderates the relationship between idea reviews and the quality of user generated ideas.

Idea Recombination

Creativity literature frames innovative ideas as arising from diverse knowledge bases, processes allowing creativity, and tasks directed toward creative solutions (Gilson and Shalley 2004). Diverse knowledge provides more components that are useful for making innovative combinations, which give the opportunity for significant advances (Santanen et al. 2004). A high number of collaborators is an important source of diverse knowledge (Ransbotham et al. 2012; Taylor and Greve 2006). Individuals

have different cognitive strategies and experiences, leading to variation in knowledge and problem solving approaches that can help identify, and use, multiple knowledge components (Taylor and Greve 2006). Thus, collaboratively working with peers exposes individuals to a broader set of perspectives, and cross-fertilization of ideas results in more creative outcomes (Taylor and Greve 2006).

According to knowledge collaboration theory, recombination enables users to build on others' ideas and aggregate the content for a consistent and comprehensive understanding (Faraj et al. 2011). Idea recombination in the context of online innovation communities refer to users participating in revising, developing, and clarifying the idea by directly integrate their information and knowledge into the ideas. Extending this argument, the greater the number of idea recombination provided by other users, the better the ideas generated. Thus, enabled by technologies such as wikis, users can contribute a unique set of diverse knowledge to the idea and improve its quality (Blohm et al. 2011). Diverse perspectives should allow users as well as original idea creators to have more options for combination and improving idea quality. Thus, more recombination by other users integrate insights from different perspectives. This will also improve the opportunity space of ideas by including different elements inside it such that the idea will be suitable for a greater set of application domains (Kornish and Ulrich 2011). Similar arguments have been suggested in the open source software literature. For example, Lakhani and von Hippel (2003) proposed that peer developers can collectively develop better software as users can directly edit the source code of other users. Consequently, we hypothesize:

H4: Idea recombination is positively related to the quality of user generated ideas.

We expect that there is an interaction between idea recombination and idea experimentation effort. As more effort is put in generating and codifying the original ideas and the idea becomes more mature (Bayus 2013), it is difficult for users to combine their own ideas with the original idea using wikis. This is because the idea becomes saturated and reaches a stable equilibrium as more components are incorporated into the idea's description. This is particularly prevalent in online settings where the collaborative platform can preserve and synthesize recombination and contributions of other users (Faraj et al. 2011). As a result, idea recombination is less influential to improve idea quality. This argument is in line with previous literature. For example, Ransbotham et al. (2012) purport that, as the user generated content becomes mature, others find it difficult to contribute to the content. On the contrary, with low levels of initial idea experimentation effort, idea recombination may easily improve the idea quality through ongoing refinements. Therefore, combining the above reasoning, we propose:

H5: Idea experimentation effort negatively moderates the relationship between idea recombination and the quality of user generated ideas.

Apart from these factors, there could be other variables affecting idea quality. Such factors may include the time elapsed after an ideas submission (idea duration), the voting an idea received by the users (idea voting), and the experience of idea creators in terms of number of ideas submitted. We include these variables as controls.

Research Methodology

Research Context

We conducted our research in *SAPiens* an online innovation community (www.sapiens.info) initiated and operated by the software producer SAP. SAPiens was launched in 2009, targeting SAP users that are invited to submit ideas improving SAP solutions or SAP in general. Ideas have to be submitted via an Internet toolkit designed especially for SAPiens. Each submitted idea is visualized in an idea pool, a public section of the online platform. By March 2014 SAPiens consisted of 320 users of those 233 actively participated by submitting at least one idea.

SAPiens is suitable for our study for several reasons. First, it provides users with opportunities of experimentation as it invites users to contribute ideas improving SAP software. Second, users collaborate with each other allowing the review (i.e., using comments) and recombination (i.e., using wikis) of ideas. Overall, it is a successful community with broad-based participation.

Variables and Measures

Our unit of analysis is reflected by the ideas submitted in the online innovation community. Table 1 provides an overview of all variables and their measurements.

We measured the dependent variable, i.e., *quality of user generated ideas*, with the four dimensions of novelty, relevance, elaboration, and workability. We adopted the Consensual Assessment Technique (CAT) (Amabile 1996), a technique which has been commonly used to evaluate user generated ideas in product innovation (e.g., Blohm et al. 2011; Kristensson et al. 2004). The validity of CAT is independent of any particular theory used and has been well established empirically (Baer and McKool 2009).

For our independent variables, we adopted measurements from past literature (see Table 1). We measured *idea experimentation effort* with idea length in characters. The longer the length of the idea, the more time and effort the idea author has spent on constructing and codifying the idea (Yang et al. 2009). We measured *idea recombination* with the number of peer users participating in editing original idea applying the wiki functionality (Ransbotham et al. 2012). We measured *idea review* with the number of comments an idea received by other users than the original idea creator. It is argued that as long as users comment, they acknowledge the value of the idea and provide value by improving it (Bayus 2013; Ransbotham et al. 2012).

Following the user generated content literature these operationalizations might be different, as the number of users providing idea reviews and idea recombination may reflect the number of different perspectives contributed; whereas the number of idea reviews and idea recombination contributed to one idea by all users may reflect the number of different perspectives and the effort of these users to communicate and integrate their standpoints (e.g., Ransbotham et al. 2012).

Regarding controls, we directly collected the time elapsed since an idea has been published as *idea duration*, the number of idea assessments (i.e., likes) that an idea has obtained as *voting*, and the number of ideas created, reviewed, or recombined as *experience* of the original idea creator.

Table 1. Construct Measurement

Variable	Measurement		Data Source	Reference
Quality of User Generated Idea	Novelty	The idea is novel.	Expert rating	(Blohm et al. 2011; Dean et al. 2006)
	Relevance	The idea has an attractive market potential.		
	Elaboration	The idea is described accurately and precisely.		
	Workability	The idea is feasible.		
Idea Experimentation Effort	The length of the idea in terms of the number of word of the idea.		Archival data	(Ransbotham and Kane 2011; Yang et al. 2009)
Idea Recombination	The number of peer users participating in idea editing			(Ransbotham et al. 2012)
Idea Review	The number of comments the idea received			
Idea Duration	The time elapsed after the submission of the idea in months			
Idea Voting	The number of votes an idea received			(Ransbotham and Kane 2011)
Idea Creator's Experience	The number of ideas that a user has submitted			

Data Collection and Expert Evaluation

We combined archival data from SAPiens and an expert rating of idea quality. For independent variables and controls, we collected data from the SAPiens database. We drew a random sample of 86 ideas, which were contributed by distinct users. Using Soper's (2013) calculator, we find our sample size has the power of 0.99, higher than the cut-off value of 0.80. Therefore, our sample has enough power to test our model (Cohen et al. 2003).

Through the CAT, the ideas were evaluated by a jury consisting of experts in the domain of SAP. Eleven employees of SAP and the German SAP University Competence Centers (UCC) agreed to be jury members (see Table 2). All judges were male. Their mean age was 37.2 years. On average they have a working experience of 9.8 years in their organizations. SAP employees were based in the marketing or R&D department. SAP UCCs provide hosting, computer center management and application support to academic clients including all major SAP solutions.

Table 2. Jury Members

#	Function	Organization
1	Senior Vice President	SAP
2	Project Director	SAP
3	Senior Consultant	SAP
4	Project Manager	SAP
5	Executive Director	SAP UCC (Location 1)
6	Project Manager	SAP UCC (Location 1)
7	Project Manager	SAP UCC (Location 1)
8	Executive Director	SAP UCC (Location 2)
9	Academic Director	SAP UCC (Location 2)
10	Technical Director	SAP UCC (Location 2)
11	Project Manager	SAP UCC (Location 2)

The experts were randomly assigned to three panels A (reviewer 1, 5, 7, and 10), B (reviewer 2, 3, and 8), and C (reviewer 4, 6, 9, and 11) to which also the 86 ideas were randomly assigned (panel A and B received 29 ideas, panel C 28). We created three panels as evaluating all ideas and the accompanying information would have implied a substantial workload and we wanted (1) mainly senior executives to evaluate quality, and (2) to prevent negative effects such as "evaluation fatigue." This approach is frequently applied (e.g., Amabile et al. 1996; Kristensson et al. 2004). Mimicking real-world idea evaluation practice, we provided experts with all information produced in SAPiens including ideas, idea reviews, and idea recombination (Blohm et al. 2013). The judges were told to use all of the information. Each judge received the ideas in a randomized order and evaluated the ideas independently. For evaluation, all idea descriptions were pasted into separate paper-based evaluation forms, which also contained evaluation scales. Each judge was asked to rate idea quality according to its novelty, elaboration, relevance, and workability with a 5-point rating scale. Thus, Intra-class Correlation Coefficients (ICC) requiring interval data, can be used in order to calculate the judges' inter-rater reliability as required by the CAT.

Data Analysis

We analyzed the data performing multiple regressions with SPSS 21.0. SPSS is a statistical analysis software for social science and have predictive analytics capabilities (IBM 2009). We generated our

quality measure by averaging the value of its four items. Interaction terms were computed by cross-multiplying the standardized items of the relevant constructs (Cohen et al. 2003).

Measurement Validity

Since idea quality was rated by experts, we calculated ICCs. We calculated the $ICC_{(1,k)}$ for each quality dimension in each expert panel (Amabile et al. 1996). ICC coefficients should not be lower than 0.5 to ensure a sufficient inter-rater reliability such that our results are satisfactory (Amabile, 1996) (see Table 3).

Table 3. $ICC_{(1,k)}$-coefficients for Dimensions of Quality of User Generated Ideas

Dimension	$ICC_{(1,k)}$-Coefficient			
	Panel A	Panel B	Panel C	Mean
Novelty	0.53	0.70	0.67	0.64
Relevance	0.46	0.48	0.65	0.53
Elaboration	0.56	0.60	0.69	0.62
Workability	0.64	0.53	0.49	0.55

Table 4. Correlation Table

	Mean	SD	1	2	3	4	5	6	7
Quality of User Generated Idea	2.90	0.38	1.00						
Idea Duration	21.10	6.44	-0.14	1.00					
Idea Voting	3.41	2.76	0.21	-0.27	1.00				
Idea Creators' Experience	8.57	7.97	0.14	-0.41	0.30	1.00			
Idea Recombination	0.91	1.58	0.11	0.09	0.10	-0.03	1.00		
Idea Review	0.67	0.70	0.27	-0.36	0.51	0.25	0.12	1.00	
Idea Experimentation Effort	3.22	0.32	0.34	0.19	0.11	-0.02	0.24	-0.09	1.00

Table 4 indicates that the correlations between constructs are lower than 0.6. The variance inflation factor values for all the constructs are acceptable (i.e., between 1.01 and 1.10). These results suggest no multicollinearity. Since data for the independent and dependent variables derived from two independent sources, common method variance should not influence the results.

Table 5. Results of Hypotheses Testing

	Controls	Main Effects	Main and Interaction Effects
Idea Voting	0.02	-0.01	-0.01
Idea Duration	-0.01	-0.01	-0.02
Idea Creator's Experience	0.01	0.01	0.00
Idea Experimentation Effort		0.48***	0.46 ***
Idea Review		0.14*	0.18*

Idea Recombination		-0.07	-0.02
Idea Experimentation Effort * Idea Review			0.02
Idea Experimentation Effort * Idea Recombination			-0.14*
R^2	0.06	0.20	0.28
*p<0.05; **p<0.01; ***p<0.001; n = 86			

Results of Hypothesis Testing

The results are shown in Table 5. The model explains 28% of the variance of idea quality (R^2 = 0.28). Controls do not affect idea quality. Idea experimentation effort and idea reviews are positively related to idea quality such that we find support for H1 and H2. Idea experimentation effort does not moderate the relationship between idea reviews and idea quality indicating that idea reviews of other users add to idea quality regardless of the idea experimentation effort put in the original idea. Thus, we find no support for H3. Contrary to our prediction, idea recombination has no impact on idea quality such that we reject H4.

Finally, we find partial support for the idea recombination and idea experimentation effort interaction (H5) that we plotted in Figure 2. Idea experimentation effort negatively moderates the relationship between the *number of users* providing idea recombination and idea quality while it does not moderate the relationship between the total *number of idea recombination* and idea quality.

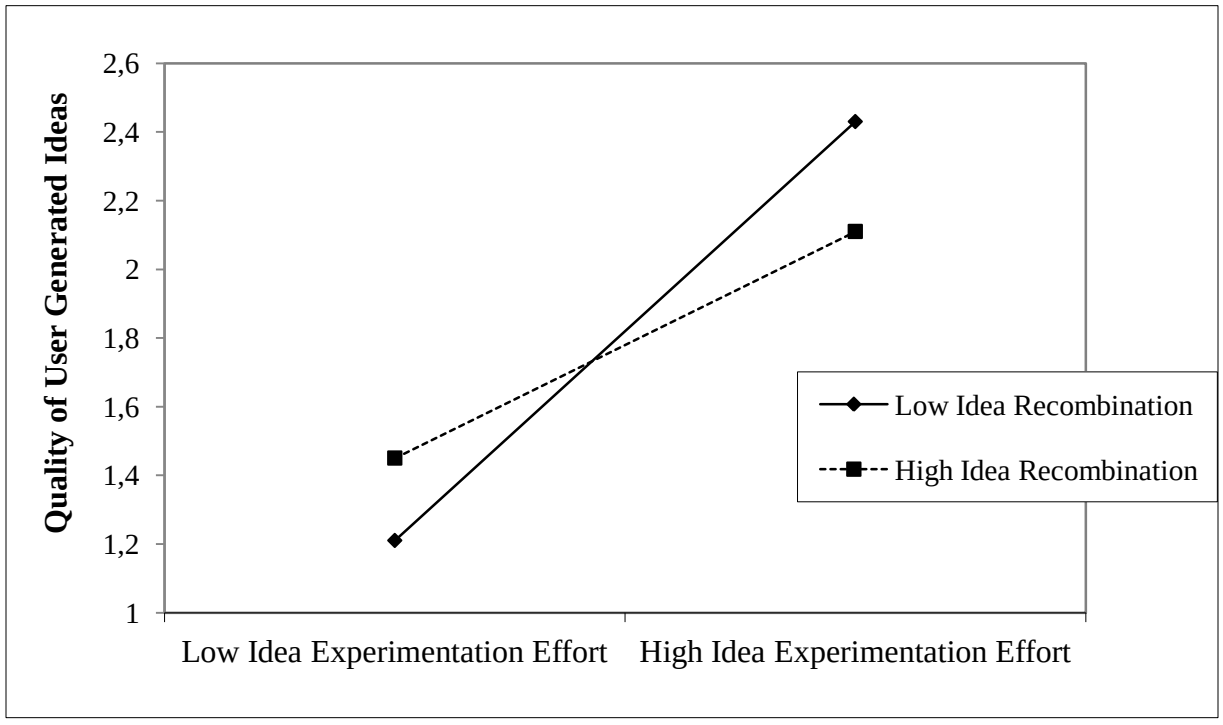

Figure 2. Idea Recombination and Idea Experimentation Effort Interaction

Discussion

Our study aimed to explore in which way mechanisms of knowledge collaboration determine the quality of user generated ideas in online innovation communities. We found evidence that idea experimentation

effort (H1) and idea reviews (H2) positively affect idea quality. This means that the more effort in the form of searching, combining or codifying, which idea creators put in the development of ideas, the higher will be the quality of the resulting ideas. Further, idea reviews help shape ideas and improve the quality of ideas significantly. However, contrary to our hypothesis, idea experimentation effort does not moderate the relationship between idea reviews and idea quality (H3). Idea reviews do influence idea quality regardless of the idea experimentation effort put in the original idea suggesting that the evolving discussion reflects an independent mechanism improving idea quality that contains value per se (Ermter et al. 2007). It could be possible that suggestions in reviews have been captured and implemented via idea recombination instead of interacting with the idea creators via idea experimentation.

Further, idea recombination have no effect on idea quality (H4). This could be due to the reason that users may fail to integrate their novel ideas into the original idea. Too many new elements can distract the original ideas, leading to a different direction, and obscure the original ideas' boundaries (Singh and Fleming 2010). Similarly, too many idea recombination may also introduce conflicting arguments, and, hence, decrease the quality of the original idea (Singh and Fleming 2010). These negative effects are likely to curtail the positive effect of collaboration on idea quality. This argument is also backed by an analysis of the idea recombination and idea experimentation effort interaction (H5). We found that idea experimentation effort negatively moderates the relationship between the number of users providing idea recombination and idea quality. In case idea creators put low experimentation effort in developing and codifying their ideas, an increasing number of users that recombine their ideas with the original idea help improve idea quality. However, if the original idea has already been well elaborated, an increasing number of users recombining their ideas decrease the quality of the original idea. These results substantiate the argument that the integration of too many elements and different user perspectives into one idea may distract idea quality. However, we found no interaction effect between the total *number of idea recombination* and idea quality. These results suggest that the effect of idea recombination is rather a question of how many different perspectives users may bring in, than the effort these users undertake in integrating their ideas.

Conclusion

Despite organizations' increasing recognition of the importance online innovation communities for integrating users in innovation development, there is still a lack of understanding about the design of effective idea generation processes in these communities. Investigating technology-afforded mechanisms of knowledge collaboration, our study illustrates the determinants of high quality ideas. Overall, this study should be useful for understanding collaborative idea generation in online contexts and help organizations develop strategies to make more effective use of their online innovation communities.

Theoretical Contribution

This paper contributes to theory in the following ways. First, it adds to the idea generation literature by examining the influence of online knowledge collaboration on the quality of user generated ideas. Specifically, we empirically test the influence of experimentation effort, idea review, and idea recombination on idea quality. In so doing, we extend past research (e.g., Girotra et al. 2010; Singh and Fleming 2010) by investigating the mechanisms of how collaboration may influence idea quality in online settings, since prior research only focused on exploring collaborative idea generation in offline settings. Extending these results, we show that collaboration may have positive, but also negative effects on idea quality. These results may help to explain, various conflicting results in this research field as most high quality ideas emerge trough the tension of individual effort and joint collaboration with other users.

Second, this research contributes to knowledge collaboration theory. Faraj et al. (2011) conceptually propose that three aspects of technology affordance, i.e., experimentation, idea review, and recombination, may spur knowledge collaboration. Our paper contributes to knowledge collaboration theory in three ways: (1) our study is, to our knowledge, the first study that empirically verifies the technology affordance dimension of Faraj et al.'s (2011) knowledge collaboration theory. Thus, we answered Faraj et al.'s (2011) call to empirically test their theoretical propositions. (2) Our research expands knowledge collaboration theory by relating the mechanisms of knowledge collaboration to the effectiveness of the collaboration process, namely the quality of the ideas being generated. Testing the interrelated effects between these mechanisms of technology affordance, we are able to investigate their

effectiveness and borderline conditions. (3) This study contributes to knowledge collaboration theory by extending and testing its applicability to the domain of idea generation in online innovation communities. The explanatory power of the model indicates that knowledge collaboration theory is an appropriate lens to explain user generated idea quality.

Further, our study contributes to user generated content literature. Previous studies have tended to use proxies of quality such as articles being featured in Wikipedia (e.g., Ransbotham and Kane 2011) or viewership (e.g., Ransbotham et al. 2012). We suggest an expert-rated multi-dimensional operationalization of idea quality extending previous literature by directly measuring the effectiveness collaboration, i.e., idea quality. This contributes to a more effective and theoretically grounded measurement of the outcome of online collaboration processes. Similarly, user generated content studies have investigated content quality from network (e.g., Ransbotham et al. 2012) and membership turnover perspectives (e.g., Ransbotham et al. 2012). This study extends previous research by examining the quality of user generated ideas from a knowledge collaboration perspective, which provides a much more mature and stronger theoretical underpinning of the research phenomenon.

Practical Implications

Our research offers important practical implications for organizations running online innovation communities. Our results suggest that a user's individual idea experimentation effort, i.e., the time and effort input by idea creators in constructing, developing, and codifying their ideas, is a main driver of idea quality. Thus, organizations should design and implement incentives that would attract idea creators to invest time and effort in idea experimentation, e.g., using gamification approaches (Blohm et al. 2013). Similarly, idea reviews are also important drivers of idea quality. This is a useful insight for organizations, since it provides them with an idea where to focus on when designing and implementing incentives that should attract users to actively participating in collaborative ideation. For example, organizations should create reward strategies for the users providing idea reviews in order to facilitate exchange among users (Chen et al. 2013). Further, organizations should develop mechanisms and approaches for investigating the appropriateness of idea recombination such as peer voting for identifying appropriate idea recombination.

Attracting users with incentives for providing feedback would increase feedback culture in online innovation communities and in turn would lead to ideas of higher quality (Chen et al. 2013). In case online innovation communities afford recombination of ideas, e.g., via wikis, they should also review the original ideas in order to not overlook high quality ideas while selecting the most promising ones for implementation (Blohm et al. 2013). Online innovation communities should also design better tools to facilitate users to experiment their ideas and recombine existing knowledge in the community for new ideas, e.g., different toolkits (Kankanhalli et al. 2015).

Limitations and Future Research

Our findings should be interpreted in the face of their limitations. First, the expert rating might be deficient, although experts generally outperform non-experts (Ericsson and Lehmann 1996). Experts might be more prone to a fixed mind-set rather than users and, thus, certain aspects of some ideas might not have been considered. However, as true value of our ideas is not directly observable (Girotra et al. 2010), assessment of idea quality through experts is generally performed in research (e.g., Amabile et al. 1996; Girotra et al. 2010; Kristensson et al. 2004) and also in practice (Blohm et al. 2011). Second, our results pertain to the specific context of SAP software such that our study should be replicated in other contexts. Third, we found that idea recombination do not directly affect idea quality. This could be an interesting and important direction for future studies to explore under what conditions idea recombination would have an impact on the quality of user generated ideas. Fourth, we measured idea experimentation as a unidimensional construct. Future study can explore the dimensions of this construct. For example, researchers can use the LIWC (Linguistic Inquiry and Word Count software - http://liwc.wpengine.com/) causal language count to capture how extensively the authors have reasoned through their ideas.

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