Research Policy xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

# Comparing internal and external lead users as sources of innovation

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ARTICLE INFO

*Article history:*
Received 9 December 2015
Received in revised form 21 October 2016
Accepted 7 November 2016
Available online xxx

*Keywords:*
Lead user
Embedded lead user
Internal lead user
User innovation
Idea quality
Creativity

ABSTRACT

External lead users' ideas are valuable to firms but difficult to access due to their location outside organizational boundaries. A potential solution to this problem is to employ lead users *within* organizations, i.e. to use internal/embedded lead users. Due to their ability to link knowledge about needs and solutions, internal lead users can be expected to produce better ideas compared to external lead users or ordinary employees. We test this conjecture in the home appliances industry using a sample of 864 employees (283 ideas) and 239 users (66 ideas). We find that internal lead users' ideas are of higher quality than those of ordinary employees and users, but – unexpectedly – are of lower quality than the ideas of external lead users. These findings contribute to research on internal/embedded users by showing how their ideas differ from ideas from other relevant sources of innovation. Our findings contribute also to research on external users' compared to employees' ideas as inputs to new product development and the literature on individual knowledge recombination for innovation.



## 1. Introduction

Innovative ideas generated by external users are valuable because on average, their ideas are of greater novelty and greater user value compared to the ideas generated by employees (Magnusson, 2009; Magnusson et al., 2003; Poetz and Schreier, 2012). However, firms struggle to capture value from external user ideas because they are located outside the organizational boundary (Priem et al., 2012) and firms and users operate under separate thought worlds (Dougherty, 1992). On the one side, firm employees can find it hard to identify user innovators (von Hippel et al., 2009), may misunderstand user ideas (Mahr and Lievens, 2011), or may lack user knowledge or empathy towards users (Homburg et al., 2009). On the other side, user ideas are hard to integrate into firms because users may be unable or unwilling to formulate their ideas (von Hippel, 1994), may have little incentive to share their ideas (de Jong et al., 2015), lack knowledge about organizational processes, or generate ideas that do not fit the organization (Magnusson et al., 2003; Poetz and Schreier, 2012).

One solution to these problems may be internal or embedded lead users, i.e. firm employees who are lead users of their employer's products or services (Schweisfurth and Raasch, 2015). Internal lead users facilitate organizational innovation by processing external user ideas (Wadell et al., 2013), shaping the corporate culture (Harrison and Corley, 2011), testing prototypes (Schweisfurth and Herstatt, 2016), being highly customer-oriented (Schweisfurth and Raasch, 2015), and acting as catalysts for product diffusion (Schweisfurth and Herstatt, 2015). Internal lead users profit from their simultaneous role of user and employee. On the one hand, due to their lead userness, they operate within a need knowledge structure: they experience needs and problems during product use, they speak the language of other users, and they have access to user networks outside the organization. On the other hand, due to their position within the organization, they operate within a solution-based and organizational knowledge structure which external users lack: they have technological knowledge which they can apply to satisfying user needs, they know how to convert ideas into products, and they are aware of the organization's internal implementation procedures. Thus, internal lead users are expected to produce better ideas than other employees and users based on their ability to combine knowledge structures from their lead user position and their location within the firm: the ability to address diverse knowledge domains generally (Hunter et al., 2008; Koestler, 1969) and from the need knowledge and solution knowledge domain specifically (Lüthje et al., 2005; Poetz and Schreier, 2012; von Hippel, 1994) is positively related to creativity and innovation.

Research so far has not investigated how the ideas generated by internal lead users and external lead users differ. This is an important research gap because external user ideas can be very valuable but difficult for the organization to obtain and implement; internal lead users may be the solution to this problem.

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http://dx.doi.org/10.1016/j.respol.2016.11.002
0048-7333/

To fill this gap, we build on a recombinant view of creativity (Fleming, 2001; Hargadon, 2006; Schilling and Green, 2011) and argue that internal lead users combine unique domain-relevant knowledge structures stemming from their lead userness and their location within the organization. We explore whether ideas produced by internal lead users differ in quality from those of external lead users, ordinary users, and ordinary employees. By modeling interaction effects between lead userness and location inside/outside the organization we also investigate whether lead userness operates differently inside and outside the organization. We exploit a combined sample of 1103 users and employees (239 users and 864 employees) who provided 349 product ideas (66 user ideas and 283 employee ideas).

Our findings contribute to research in three ways. First, we add to the growing stream of research on internal lead users (Schweisfurth and Raasch, 2015; Wadell et al., 2013) and link it to existing research on external lead users (Franke et al., 2006; Schreier and Prügl, 2008; von Hippel, 1986). We show that internal lead users produce better ideas than ordinary employees and users, but that their ideas are less original and of lower value to users than external lead users' ideas. Our findings help to explain not only what internal lead users are capable of but also their limits compared to other relevant sources of innovation. We provide a rationale for our findings, and argue that internal lead users' entrenchment in organization-specific knowledge reduces their creative output.

Second, we contribute to research which compares users' and employees' ideas, and shows that on average, user ideas are more original than employee ideas (e.g. Kristensson et al., 2004; Magnusson, 2009; Magnusson et al., 2003; Poetz and Schreier, 2012). We discuss the limits to this finding and produce a more nuanced comparison of users and employees. We argue that conditional on their lead userness, employees might have more original and higher user value ideas than ordinary users do.

Third, we contribute to individual level research on knowledge recombination for innovation (Lettl et al., 2009; Lüthje et al., 2005). This stream of work investigates how knowledge from different technological domains is exploited for innovation (Audia and Goncalo, 2007; Fleming, 2001; Lettl et al., 2009) but does not investigate how combining different types of knowledge, i.e. need knowledge and solution knowledge, facilitates innovation (cf. Franke et al., 2013; von Hippel, 1994). We show that individuals recombining need and solution knowledge produce highly creative output unless they are constrained by the organization.

## 2. Theoretical background

### 2.1. Users and employees as sources of ideas

User innovations are an important and prolific source of innovation (Bogers et al., 2010; von Hippel, 1976) and a main source of ideas for firms (Cohen et al., 2002; Poetz and Schreier, 2012). For example, 6.1% of consumers in the UK innovate, and taken as whole invest more in developing innovations than all UK firms combined spend on research and development (von Hippel et al., 2012). Users' ideation efforts are driven by the motivation to use an invention (von Hippel, 2005). Not all users are equally likely to innovate but innovative activity occurs especially among lead users (von Hippel, 1986). Lead userness is a continuous and domain-specific individual characteristic (Morrison et al., 2004) with two components (von Hippel, 1986). First, lead users are at the forefront of trends in the marketplace, and thus experience needs ahead of other users; second, lead users gain greater benefit from obtaining solutions to their needs. Lead users are more likely to innovate and also more likely to develop more commercially attractive innovations than other users (Franke et al., 2006).

Another key source for innovative ideas for firms is their employees (Poetz and Schreier, 2012), and internal ideas often represent the starting point of the innovation process (Van de Ven, 1986). Employees' creativity is the outcome of the interplay between individual and contextual factors (Woodman et al., 1993). In a recent review of employee creativity in organizations, Anderson et al. (2014) offer a comprehensive list of individual (e.g., traits and motivation), task context (e.g., job complexity and job requirements), and social context (e.g., leadership and social networks) related factors which affect individual creativity in organizations.

User ideas and employee ideas differ with respect to their quantity and their quality (Franke and Shah, 2003; Franke et al., 2006; Kristensson et al., 2004; Lilien et al., 2002; Magnusson, 2009; Magnusson et al., 2003; Poetz and Schreier, 2012). Some studies show that employee-generated ideas score higher than user-generated ideas on criteria such as realizability within the organization (Kristensson et al., 2004; Magnusson, 2009; Poetz and Schreier, 2012). In other words, it may be more difficult to develop users' ideas into commercial products, most probably because employees, in contrast to users, have knowledge about the technology in place and which ideas are implementable by the firm (Magnusson, 2009).

However, employees' ideas score lower than external users' ideas for use-related criteria such as originality, user value, and market potential (Kristensson et al., 2004; Magnusson, 2009; Magnusson et al., 2003; Poetz and Schreier, 2012). This argument is rooted in user innovation research which claims that it is users not producers who face problems during use, which in turn results in users generating more innovative ideas (Lüthje and Herstatt, 2004).

Absorbing ideas originating from users outside the organization can be difficult for firms (cf. Priem et al., 2012). Innovative users outside the firm can be hard to locate (von Hippel et al., 2009) and organizations may lack mental schemes to understand user knowledge (Dougherty, 1992; Mahr and Lievens, 2011). One way for firms to obtain user ideas without crossing organizational boundaries is to look for ideas from employees who are also users of the firm's products (Harrison and Corley, 2011; Hyysalo, 2009; Schweisfurth and Raasch, 2015; Wadell et al., 2013).

Such internal lead users are a very common phenomenon in consumer industries such as sports, healthcare, and the leisure industry. But they also exist in B2B settings, in which one organization contains a manufacturing unit and a user unit, e.g. in the construction industry (Block et al., 2016) or in the robotics industry (Roy and Sarkar, 2015). Internal lead users can assume various key roles in the new product development process which foster innovation in the firm, ranging from idea generators through product testers to opinion leaders in markets (Wadell et al., 2013). Firms often try to leverage these employees' use expertise by integrating them into new product development or by supplying them with prototypes for informal testing during their leisure time (Schweisfurth and Herstatt, 2016). Internal users span the two thought worlds (Dougherty, 1992) of users and the firm, and link user knowledge with organizational knowledge. Due to their dual embeddedness in the use and organizational contexts, we can expect them to combine knowledge from both domains, and to differ in their creative output from ordinary employees and external users.

### 2.2. Hypotheses

To develop our hypotheses we rely on a recombinant view of creativity (Fleming, 2001; Hargadon, 2006; Schilling and Green, 2011). In this view, individuals with access to diverse domains

Please cite this article in press as: Schweisfurth, T.G., Comparing internal and external lead users as sources of innovation. Res. Policy (2016), http://dx.doi.org/10.1016/j.respol.2016.11.002

of expertise combine these domains to come up with new ideas. Domain-specific expertise represents the raw material on which such individual creativity is built (Amabile, 1988; Dane, 2010) and is organized in domain specific schemas or knowledge structures (Fiske and Taylor, 2013). These structures are recombined and reorganized for creativity and are positively related to idea generation in that particular domain (Dane, 2010).

Creativity and product innovation rely especially on the schemas related to need knowledge and solution knowledge (Alexander, 1964; Arthur, 2007; Poetz and Schreier, 2012; von Hippel, 1988; Von Hippel and Von Krogh, 2016). The locus of creativity and innovation lies at the intersection between skills and knowledge from both domains. The need knowledge domain includes "problem-related knowledge about needs [to be faced] in current or future markets", and the solution knowledge domain includes "solution related knowledge needed to develop technologies and products" (Alexy et al., 2013). Need knowledge often accrues among users, and especially lead users (Schreier and Prügl, 2008), who experience problems during product use and recognize emerging needs (Lüthje et al., 2005; von Hippel, 1994). Solution knowledge often accrues within the manufacturing organization which has technological experience of designing and manufacturing products that satisfy customer needs (Lüthje et al., 2005; von Hippel, 1994). Nevertheless, some users may also have solution knowledge in a specific domain or can transfer solutions from analogous domains (Lüthje et al., 2005).

In our theorizing we formulate hypotheses drawing on the recombinant theory of creativity; we argue that individual creativity is driven by the ability to draw on relevant schemas in the domain of user needs (i.e. the individual's lead userness) as well as relevant schemes in the domain of technologies/solutions (i.e. the individual being internal/external to the firm). We formulate our hypotheses along these two dimensions (lead userness and being internal/external to the firm) to predict how employees with high lead userness (i.e. internal lead users) differ from employees with low lead userness (i.e. ordinary employees) and from external users with high lead userness (i.e. external lead users) and users with low lead userness (i.e. ordinary users). Because they combine need and solution knowledge we expect internal lead users to produce higher quality ideas than all other groups.

We expect that internal lead users' ideas will be of higher quality than those of ordinary employees due to their lead userness and associated user need knowledge structures. Lead userness originally is considered a factor of user innovativeness, with lead users' ideas shown to be more attractive (i.e., more original, more beneficial for users) (Franke et al., 2006) and of higher commercial value (i.e., higher sales value) than those originating from non-lead users (Herstatt and von Hippel, 1992; Lilien et al., 2002; Urban and Von Hippel, 1988). We expect lead userness to operate similarly inside the organization as it operates outside the organization. Internal lead users are at the edge of developments in a specific market segment and foreshadow future demands in this market which increases their ability to produce more original ideas with higher user and commercial value. First, due to their position ahead of the trend in a specific domain they perceive needs early and can generate solutions to these needs. This results in ideas which are more original than the ideas from ordinary employees. Second, because the ideas are based on real world needs and problems, internal lead users' ideas are of higher user value than those of ordinary employees. Future users will encounter the same needs, and obtain value from using the solutions devised based on the internal lead users' ideas. Third, employees' lead userness will be positively related to the market potential of ideas because by definition, lead users' ideas will be relevant to a larger share of users in the future.

We suggest also that internal lead users' ideas will be of higher quality than external users' ideas. Internal lead users, because they can link schemas in the need knowledge (lead userness) and solution knowledge (embeddedness into the organization) domains during ideation, are able to draw on more product related knowledge sets compared to external lead users. In general, access to multiple knowledge sets and divergent thinking stimulates creative performance (Hargadon and Sutton, 1997; Hunter et al., 2008; Koestler, 1969). Specifically, linking need knowledge and solution knowledge structures facilitates the generation of product ideas (Alexander, 1964; Arthur, 2007; Poetz and Schreier, 2012; von Hippel, 1988; Von Hippel and Von Krogh, 2016). Following this argumentation, because of their ability to draw simultaneously on solution knowledge and user experience, we would expect internal lead users to produce higher quality ideas than are produced by external users.

In summary, we hypothesize that:

**H1 a, b, c.** Internal lead users produce more valuable product/service ideas with respect to a) originality, b) user value, and c) market potential, than ordinary employees or external users (lead users and ordinary users) in a given domain.

## 3. Methodology

### 3.1. Sample and sample checks

We collected data from the home appliances industry, where both users and employees innovate (Schweisfurth and Herstatt, 2016). To compare lead users inside and outside the organization, we require two samples for joint analysis. We pooled both samples for analysis (Franke et al., 2013).

The first part of the sample consists of 864 responses from employees in a large producer of home appliances (stoves and ovens, dishwashers, washers and dryers, refrigerators and freezers, and small appliances). The corporate technology office administered our online survey to all division and department managers in Germany who were asked to send the survey link to their subordinates and to request their participation. At the request of the firm, sales agents (but not their supervisors) and shop-floor workers were excluded from the study. This sampling approach yielded 864 usable responses – a response rate of 32.3% using 2674 visitors to the survey site as the population size, common practice in online surveys (Balka et al., 2014). To check the representativeness of the whole organizational population, we checked whether early respondents (first quartile of respondents) differed from late respondents (last quartile of respondents) with respect to several variables (Rogelberg and Stanton, 2007). In this case, it could be argued that non-respondents, who are somewhat similar to late-respondents, are different from the sample. We checked whether early and late respondents differed with respect to lead userness, need knowledge, solution knowledge, openness to experience, cognitive style, gender, education, or age. We checked also for whether these groups differed with respect to variables not available to the user sample such as tenure, hierarchy, or function in the firm (development, marketing/sales, operations, human resources, finance, or other). We found differences between early and late respondents on only two variables (education and share of employees in marketing and sales); the other 14 variables did not differ significantly between early and late respondents ($p > 0.05$). Based on these findings, we are confident that our sample is generally representative of the population within the organization.

The second part of the sample is comprised by home appliance users. It was collected through a survey of technology and management students from a Western European University: 398 students accessed the online survey which was completed by 239 (a response rate of 60.0%). Student samples have been used in other studies (Kristensson et al., 2004; Magnusson, 2009; Magnusson

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et al., 2003; Ozer, 2009) which, like ours, compares users and employees. It is necessary to ensure that the results from our student sample are generalizable to the whole user population (but not necessarily to the buyer or customer population). For example, it might be that students in general are more or less innovative than the rest of the user population. However, representative studies in the UK show that neither age, education, nor being a student are significantly related to user innovativeness (von Hippel et al., 2012) which mitigates this concern. Alternatively, students' personality might be driving their innovativeness compared to other users of home appliances (Stock et al., 2016; Schreier and Prügl, 2008). Because it is not possible to say whether students differ significantly from the rest of the user population with respect to innovative personality, we control for this effect using thinking style and openness to experience. Finally, a factor which potentially could reduce the representativeness of our sample is that students' use intensity of home appliances might differ from that of the rest of the user population. However, home appliances are an ubiquitous product category, and almost every household in Western Europe has access to a refrigerator, a washing machine, etc.. Taking Germany as an example, among all households more than 99% are equipped with refrigerators, more than 95% with washing machines, and more than 93% with a stove/oven (FORSA, 2014). Also, students are likely to spend as much time using these home appliances as the rest of the population. Again taking Germany as an example, individuals aged between 18 and 29 (a span covering the majority of students), spend only 8% less time on activities involving home appliances (preparing food and working in the kitchen, baking, washing, cleaning dishes, home maintenance and cleaning, washing, ironing) than the average working population (DESTATIS, 2015). Thus, we would not expect students' use intensity of home appliances to differ significantly from the rest of the user population.

When comparing the user and the employee samples, we need to make sure that employees and users are not motivated differently to respond to the survey, e.g. because of different time pressure, different interest in the topic, or other confounding factors. To capture potential differences in motivations we used diligence of idea descriptions as a proxy. In the survey we asked individuals to describe their ideas as specifically and diligently as possible on the basis that adherence to this instruction would show that respondents were keen to comply with our request. We would argue that diligence in filling out the survey captures the motivation of interest in the topic and in participation in the survey. We used two raters to assess the degree to which respondents followed our instruction to be diligent (scale of 1 to 5) and averaged their ratings. Among those who described their ideas, we checked for differences between users and employees with respect to the diligence applied to responding to the survey; we found no significant differences ($p = 0.930$). In addition, the pattern of our regression results was unchanged if we entered diligence as an additional control variable. Thus, we are confident that our results are not driven by different motivations among users and employees to address the survey questions.

Since only 349 of the 1103 respondents from both samples provided a description of an idea, we needed to make sure that these ideas were not systematically different from the ideas not provided due to self-selection. To overcome this potential selection bias we calculated the inverse mills ratio for all 1103 respondents and then inserted this factor as a control variable in the regression (Heckman, 1976). We used the number of ideas an individual had in the last year as an exclusion restriction. The number of ideas was measured by asking respondents: "In the last year, did you have any specific ideas to improve existing home appliances or ideas for new pieces of equipment which were not yet available on the market?" The survey then asked how many ideas they had during the previous year (0 – None", 1 – 1-2 ideas", 2 – 3-5 ideas", 3 – More than 5 ideas"). The number of ideas in the past year should influence the likelihood to provide an idea in our study, but it should not affect idea quality (Reinig and Briggs, 2008). This was also true empirically, with the correlation between the number of ideas and idea provision ($r = 0.501$, $p = 0.000$) being much higher than the correlation between the number of ideas and the three quality outcomes (avg. $r = 0.049$, avg. $p = 0.504$). We used probit regression to predict the likelihood of providing an idea using the number of ideas as predictor (coefficient: $B = 0.698$, $p = 0.000$; model: Log likelihood = −544.834, $p = 0.000$) and calculated the inverse mills ratio based on these results. We included this ratio into the main regressions but it did not change the direction or significance of our results.

### 3.2. Measures

#### 3.2.1. Dependent variables

To assess idea quality, individuals in the consumer and the employee samples were asked to come up with their most innovative ideas, either for new products or for improvements to existing products in the field of home appliances. They were asked to be as specific and diligent as possible, and to describe both the problem experienced and the solution devised (cf. Franke et al., 2006). We obtained 349 ideas which were rated for the study (66 user ideas, 283 employee ideas).

Four consumer raters assessed idea quality using the consensual assessment technique (Amabile, 1982). These raters were university research assistants, commonly used to rate ideas (Girotra et al., 2010). They were blind to the origins of the ideas. Consumer raters meet Amabile's (1982, p. 1002) criterion for idea assessment that "judges need not themselves have produced work rated as highly creative; it is their familiarity with the domain that is important". Empirical research shows that consumers ratings are equally as good as (Magnusson et al., 2016; Mollick and Nanda, 2015) or better than (Kornish and Ulrich, 2014) expert ratings for predicting market-related outcomes of ideas related to the consumer product field. Two of the raters had a technical background (bachelors in engineering), and two had a business background (bachelors in marketing) which responds to Magnusson et al.'s (2016) prescription to use a mix of technically naïve and skilled user raters. With respect to their need knowledge and use expertise in the field of home appliances, our raters had some but not too much knowledge. This seems desirable since the literature is inconclusive about the role of domain knowledge in rating accuracy. Some studies suggest that lead userness and product expertise are beneficial for accurately predicting new product evaluations (Ozer, 2009) while others show that consumers with higher levels of domain knowledge undervalue more novel product ideas (Moreau et al., 2001). All our raters had used home appliances on a daily base, and their mean lead userness and need knowledge were not significantly different from the sample of idea generators ($p > 0.05$). All four raters reported having had ideas related to home appliances, a factor which has been shown to increase the evaluation accuracy of raters (Berg, 2016).

The raters were given the list of idea descriptions to provide an overview of the ideas in the sample. The ideas were then presented to them in random order along with the evaluation criteria (Franke and Shah, 2003; Magnusson et al., 2003; Poetz and Schreier, 2012): idea originality (i.e., uniqueness and novelty on a scale from "1 - not novel at all" to "5 – very novel"), user value (i.e., the extent of the benefit and value to users and relevance for satisfying users' needs and expectations on a scale from "1 – very low (no value for users)" to "5 – very high (great value for users)"), and market potential (i.e., the existence of a market for the product were it to be offered for general sale on a scale from "1 – very low (no potential

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**Table 1**
Interrater reliabilities.

| Scale | Corr. (mean) | Corr. p-value (mean) | Cronbach's α | ICC(2,1) |
|---|---|---|---|---|
| Originality | 0.372 | 0.000 | 0.751 | 0.708 |
| User value | 0.377 | 0.000 | 0.703 | 0.650 |
| Market potential | 0.248 | 0.000 | 0.561 | 0.465 |

n = 349.

market)" to "5 – very high (mass market)"). In scoring user value and market potential, raters were asked to assume that the idea would be developed further in a more professional form.

We used three different statistics to assess interrater reliability (see Table 1 for a detailed overview). The highly significant correlations ($p < 0.001$ for all correlations) among the four raters were on average 0.332, and Cronbach's alpha was 0.672, exceeding interrater reliability levels in similar studies (Kornish and Ulrich, 2014; Magnusson et al., 2016). The average intraclass correlation statistic of 0.608 indicates "good" interrater reliability (Cicchetti, 1994). Thus, we proceeded by averaging the scores to obtain an aggregate measure for the dependent variables (Kristensson et al., 2004; Magnusson, 2009; Magnusson et al., 2003, 2016; Poetz and Schreier, 2012).

The evaluators also rated the innovations with respect to their technical quality ("Please rate the extent to which you consider the idea technologically elaborated and sophisticated." 1 – very low tech/5 – very high tech) to cognitively separate our core constructs from the technological sophistication of ideas, as suggested by Amabile (1982).

#### 3.2.2. Independent variables

All constructs were measured on a 7-point Likert scale from "1 - I do not agree at all" to "7 - I agree to an exceptional degree". In line with other studies, we measured lead userness using a latent construct (Autio et al., 2013; Dahlander and Frederiksen, 2012; Faullant et al., 2012; Franke et al., 2013; Jeppesen and Frederiksen, 2006; Jeppesen and Laursen, 2009; Ozer, 2009). We measured the ahead-of-the-trend component based on an adapted measure using three items from Faullant et al. (2012), and measured the high-benefit-expected component using an adapted measure using six items from Franke et al. (2006). The measurements are highly reliable ($\alpha = 0.922$).

Also in line with other similar studies (Franke et al., 2013), we controlled for age, gender, educational background, and creativity. To measure creativity we used measures used in the literature for openness to experience (two items, $\alpha = 0.804$, (Shalley et al., 2009)), and cognitive style (three items, $\alpha = 0.633$, (Rammstedt and John, 2007)).

The exact wording of all the scales is presented in Table 2.

**Table 2**
Scales for measurement.

**Lead userness**
I usually find out information about *home appliances* before others do.
I am regarded as being on the 'cutting edge' in the field of *home appliances*.
I have a comprehensive knowledge of *home appliances* available on the market.
I am often confronted with problems that cannot be solved by *home appliances* available on the market.
I am dissatisfied with some of the commercially available *home appliances*.
I have already had problems with my *home appliances* that could not be solved with the manufacturer's conventional offerings.
In my opinion, there are still unresolved problems with *home appliances*.
I have needs related to *home appliances* that are not covered by the products currently offered on the market.
I often get irritated about the lack of sophistication in certain *home appliances*.

**Cognitive style**
I am consistent in the way I tackle problems.
I pay attention to the order of the steps needed to finish a job.
I accept the usual way of doing things.

**Openness to experience**
I have many artistic interests.
I have an active imagination.

## 4. Results

Table 3 shows the means and correlations of our variables. We used regression analyses to investigate the effects of being internal/external to the firm and lead userness on idea quality (Franke and Park, 2006). We entered the control variables and the main variables (Model 1) and checked for an interaction effect between lead userness and being internal/external to the firm (Model 2).

### 4.1. Idea quality

We find that lead userness is significantly and positively related to all three measures of idea quality (H1a: $\beta = 0.140$, $p = 0.025$; H1b: $\beta = 0.208$, $p = 0.001$; H1c: $\beta = 0.155$, $p = 0.013$). We find also that being internal to the firm is significantly and negatively related to the originality (H1a: $\beta = -0.154$, $p = 0.031$) and user value (H1b: $\beta = -0.176$, $p = 0.012$) of an idea. External user and employee ideas do not differ in their market potential as indicated by a non-significant effect of the employee dummy variable (H1c: $\beta = -0.071$, $p = 0.315$). The analyses and graphs for the marginal effects of being internal to the firm and lead userness are shown in Table 4 and Fig. 1.

We found no significant interactions between being internal/external to the firm and lead userness for the three quality measures (p-values of the interaction terms were larger than 0.05 when we estimated the regressions).

In sum, the regression results and the graphs suggest that internal lead users produce higher quality ideas than ordinary employees and users do. However, and contrary to our expectations, the ideas of internal lead users are of lower quality than those of external lead users. Thus, H1a-c are only partially supported.

### 4.2. Post hoc analyses

#### 4.2.1. Analysis of internal ideas

In this analysis we use two additional variables[1], need knowledge and solution knowledge, to investigate why not all of our predictions for our hypotheses are supported. Specifically, we found no support for the expectation that internal lead users have better ideas than external lead users. In contrast, the quality of external lead users' ideas was found to be higher than the quality of internal lead users' ideas.

We based our hypotheses on the argument that lead userness is associated with need knowledge, and that being internal to the firm is associated with solution knowledge. Indeed, lead userness is related positively to need knowledge ($r = 0.602$, $p = 0.000$), and internals' solution knowledge is higher than externals' solution knowledge ($r = 0.318$, $p = 0.000$). We predicted also that internal lead users would have better ideas than external lead users and ordinary users because they are able to combine need knowledge schemas rooted in their lead userness with solution knowledge

[1] Both types of knowledge are measured using an adapted subjective knowledge scale (Flynn and Goldsmith, 1999) and are highly reliable (need knowledge $\alpha = 0.890$, solution knowledge $\alpha = 0.946$). A sample item for need knowledge is "I feel very knowledgeable about using home appliances.", a sample item for solution knowledge is "I feel very knowledgeable about the technologies in the field of home appliances.".

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**Table 3**
Means and correlations.

| | | n | min | max | mean | SD | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Originality | 349 | 1.00 | 4.50 | 2.52 | 0.77 | | | | | | | | | | |
| 2. | User value | 349 | 1.00 | 4.75 | 2.92 | 0.74 | 0.49*** | | | | | | | | | |
| 3. | Market potential | 349 | 1.00 | 5.00 | 3.07 | 0.72 | 0.44*** | 0.72*** | | | | | | | | |
| 4. | Education | 1103 | 1.00 | 5.00 | 4.53 | 0.83 | 0.04 | 0.08 | 0.03 | | | | | | | |
| 5. | Age | 1103 | 19.00 | 78.00 | 36.90 | 11.12 | −0.17** | −0.15** | −0.09 | −0.19*** | | | | | | |
| 6. | Gender | 1103 | 0.00 | 1.00 | 0.29 | 0.45 | 0.03 | 0.11* | 0.04 | −0.01 | −0.18*** | | | | | |
| 7. | Cognitive style | 1103 | 1.00 | 7.00 | 5.01 | 0.99 | −0.06 | 0.01 | 0.02 | −0.04 | 0.10** | −0.01 | | | | |
| 8. | Openness to experience | 1103 | 1.00 | 7.00 | 5.92 | 1.23 | −0.03** | −0.16 | −0.10 | −0.02 | 0.33*** | −0.16*** | 0.31*** | | | |
| 9. | Lead userness | 1103 | 1.00 | 7.00 | 3.98 | 1.44 | 0.07 | 0.06 | 0.08 | 0.15*** | 0.17*** | −0.23*** | 0.00 | 0.32*** | | |
| 10. | Internal to the firm | 1103 | 0.00 | 1.00 | 0.78 | 0.41 | −0.12* | −0.21*** | −0.09 | −0.06 | 0.47*** | −0.23*** | 0.11*** | 0.61*** | 0.32*** | |
| 11. | Idea quantity | 1103 | 0.00 | 3.00 | 0.93 | 1.02 | 0.00 | −0.03 | 0.11* | 0.10*** | 0.15*** | −0.23*** | 0.01 | 0.21*** | 0.53*** | 0.24*** |

* $p < 0.05$ (two-tailed test).
** $p < 0.01$ (two-tailed test).
*** $p < 0.001$ (two-tailed test).

**Table 4**
Regression results for idea quality.

| | **Originality** | | | | | | **User value** | | | | | | **Market potential** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Model 1 | | | Model 2 | | | Model 1 | | | Model 2 | | | Model 1 | | | Model 2 | | |
| | B | Beta | p-value | B | Beta | p-value | B | Beta | p-value | B | Beta | p-value | B | Beta | p-value | B | Beta | p-value |
| Constant | 2.570 | | 0.000 | 2.743 | | 0.000 | 2.790 | | 0.000 | 3.023 | | 0.000 | 3.368 | | 0.000 | 3.368 | | 0.000 |
| Mills ratio | −0.030 | −0.016 | 0.780 | −0.017 | −0.009 | 0.874 | 0.010 | 0.005 | 0.925 | 0.027 | 0.015 | 0.794 | −0.218 | −0.122 | 0.032 | −0.218 | −0.122 | 0.034 |
| Education | 0.031 | 0.030 | 0.572 | 0.031 | 0.030 | 0.574 | 0.062 | 0.063 | 0.235 | 0.061 | 0.062 | 0.237 | 0.014 | 0.015 | 0.784 | 0.014 | 0.015 | 0.784 |
| Age | −0.011 | −0.162 | 0.006 | −0.011 | −0.155 | 0.009 | −0.007 | −0.097 | 0.091 | −0.006 | −0.087 | 0.135 | −0.006 | −0.093 | 0.112 | −0.006 | −0.093 | 0.117 |
| Gender | −0.014 | −0.007 | 0.898 | −0.031 | −0.016 | 0.775 | 0.096 | 0.052 | 0.345 | 0.073 | 0.039 | 0.484 | 0.043 | 0.024 | 0.673 | 0.043 | 0.024 | 0.680 |
| Cognitive style | −0.027 | −0.037 | 0.514 | −0.028 | −0.039 | 0.487 | 0.063 | 0.089 | 0.107 | 0.060 | 0.086 | 0.122 | 0.060 | 0.088 | 0.120 | 0.060 | 0.088 | 0.121 |
| Openness to experience | 0.043 | 0.062 | 0.366 | 0.047 | 0.069 | 0.320 | −0.088 | −0.132 | 0.051 | −0.082 | −0.123 | 0.072 | −0.088 | −0.137 | 0.048 | −0.088 | −0.137 | 0.050 |
| Lead userness | 0.082 | 0.140 | 0.025 | 0.025 | 0.043 | 0.748 | 0.119 | 0.208 | 0.001 | 0.042 | 0.074 | 0.568 | 0.086 | 0.155 | 0.013 | 0.086 | 0.155 | 0.243 |
| Internal to the firm | −0.301 | −0.154 | 0.031 | −0.595 | −0.304 | 0.119 | −0.333 | −0.176 | 0.012 | −0.727 | −0.383 | 0.045 | −0.132 | −0.071 | 0.315 | −0.131 | −0.071 | 0.715 |
| Lead userness x Internal | | | | 0.072 | 0.207 | 0.408 | | | | 0.096 | 0.286 | 0.243 | | | | 0.000 | 0.000 | 0.999 |
| n | | 349 | | | 349 | | | 349 | | | 349 | | 349 | | | | 349 | |
| $R^2$ | | 0.057 | | | 0.059 | | | 0.095 | | | 0.099 | | 0.056 | | | | 0.056 | |
| Adjusted $R^2$ | | 0.035 | | | 0.034 | | | 0.076 | | | 0.075 | | 0.034 | | | | 0.031 | |
| Significance $R^2$ | | 0.010 | | | 0.013 | | | 0.000 | | | 0.000 | | 0.011 | | | | 0.019 | |
| $R^2$ change | | 0.057 | | | 0.002 | | | 0.095 | | | 0.004 | | 0.056 | | | | 0.000 | |
| F change | | 2.581 | | | 0.686 | | | 4.470 | | | 1.368 | | 2.536 | | | | 0.000 | |
| Significance $R^2$ change | | 0.010 | | | 0.486 | | | 0.000 | | | 0.243 | | 0.011 | | | | 0.999 | |

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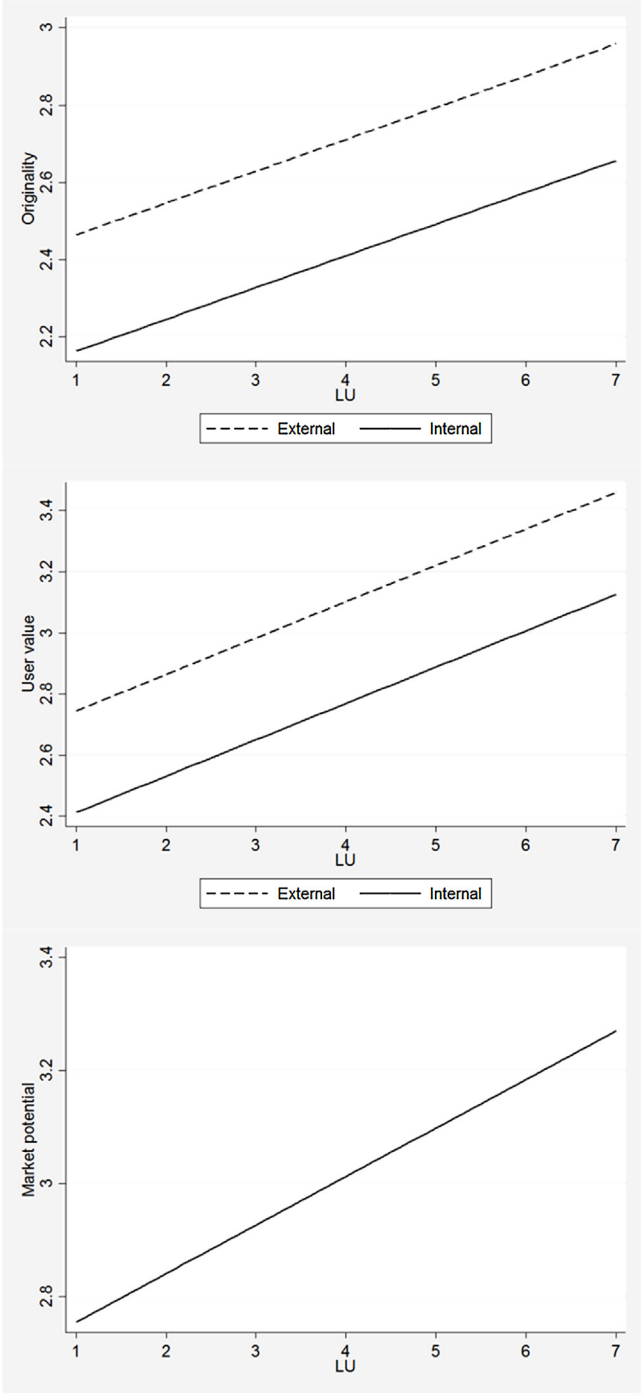


**Fig. 1.** The effect of lead userness on idea quality.

schemas rooted in their location within the firm. However, our findings do not support this logic.

This might be because being internal to the organization is associated with different domain schemas, i.e. schemas from the domain of solution knowledge which would enable creativity and also other domain schemas which could inhibit creativity. For example, employees have to comply with organizational rules, are embedded in routines, and know about ideas which have been rejected by the organization. This is part of the individual's organization-specific knowledge schema which is built over time and can lead to cognitive entrenchment, fixedness on the status quo, cognitive inflexibility, and ultimately, generation of less creative ideas (Dane, 2010).

To test the conjecture that being inside the organization entails not only solution schemas enabling creativity but also organization-specific schemas inhibiting creativity (Kristensson et al., 2004; Poetz and Schreier, 2012), we split the effect of being internal to the firm into solution knowledge and organization-specific knowledge and use both as predictors in the regression model used in the original analyses. Organizational tenure measures the extent to which individuals hold organization-specific schemas. For this analysis, we can only use individuals within the firm on the assumption that the effect of organizational-specific schema will be lower for external users than for all employees. The results are presented in Table 5.

First, focusing on idea originality and user value, we find that lead userness is positively and significantly related to both quality outcomes ($p < 0.01$) but the effect of solution knowledge is superimposed by a negative and significant effect of tenure ($p < 0.05$). Thus, the missing positive effect of being internal to the firm may be rooted in the fact that organization-specific schemas hinder the creation of truly novel ideas.

Second, focusing on market potential, we only found a positive and significant effect of lead userness which mirrors the findings from our main analysis.

#### 4.2.2. Analysis of idea realizability

In this post hoc test we establish additional validity of our study by testing the assumption that there is a trade-off between novelty and user value of ideas on the one hand and their realizability within an organization on the other hand, and that internal ideas are more easily realizable than external ideas[2] (Magnusson, 2009; Magnusson et al., 2003; Poetz and Schreier, 2012).

To come up with a measurement of idea realizability we followed the rating strategy described in section 3.2.1, but used different raters. As the firm we studied could not commit resources to providing internal experts to rate the ideas and we could not have other industry experts rate the ideas due to secrecy concerns, we used two technical experts from our university as raters. Both had a technical background (master degree in mechanical engineering), were doctoral students in the field of product development, and had also cooperated with the home appliance industry in a large research project. They thus had sufficient knowledge to rate the realizability of ideas. We asked them to take the perspective of a large manufacturer of home appliances and to rate the realizability of the ideas on a scale from 1 to 5. Their ratings showed considerable agreement (correlation: $r = 0.345$, $p = 0.000$; $\alpha = 0.512$; ICC(2,1) = 0.507).

Correlation analysis shows that realizability is negatively related to originality ($r = -0.221$, $p = 0.000$), to user value ($r = -0.144$, $p = 0.007$), and to market potential ($r = -0.101$, $p = 0.059$) which is in line with the tradeoff expected from prior research. Using the same specification as for the other dependent variables, we next investigate if idea realizability is different depending on employees' and external users' lead userness (see Table 6). The findings show that internal ideas are more easily to realize than external ideas ($p < 0.05$). Please note that the overall model is not significant, so these results need to be interpreted with caution. This is also consistent with the literature which has shown that the difference between internal and external ideas with respect to realizability is not very pronounced (Poetz and Schreier, 2012).

[2] We thank an anonymous reviewer for suggesting us to draw a more complete picture by including realizability as dependent variable.

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**Table 5**
Post hoc analyses for firm only.

| | Originality | | | User value | | | Market potential | | |
|---|---|---|---|---|---|---|---|---|---|
| | B | Beta | p-value | B | Beta | p-value | B | Beta | p-value |
| Constant | 2.627 | | 0.000 | 2.699 | | 0.000 | 2.780 | | 0.000 |
| Education | −0.113 | −0.109 | 0.136 | −0.059 | −0.057 | 0.427 | −0.051 | −0.051 | 0.489 |
| Age | 0.004 | 0.045 | 0.588 | 0.007 | 0.078 | 0.346 | 0.006 | 0.071 | 0.401 |
| Gender | 0.096 | 0.044 | 0.487 | 0.218 | 0.100 | 0.108 | 0.274 | 0.130 | 0.041 |
| Cognitive style | 0.005 | 0.007 | 0.911 | 0.089 | 0.123 | 0.055 | 0.080 | 0.114 | 0.081 |
| Openness to experience | −0.008 | −0.009 | 0.895 | −0.113 | −0.118 | 0.066 | −0.108 | −0.115 | 0.077 |
| Lead userness | 0.139 | 0.216 | 0.002 | 0.174 | 0.271 | 0.000 | 0.097 | 0.156 | 0.028 |
| Solution knowledge | −0.045 | −0.076 | 0.292 | −0.050 | −0.084 | 0.236 | 0.028 | 0.049 | 0.498 |
| Tenure | −0.018 | −0.212 | 0.027 | −0.017 | −0.196 | 0.037 | −0.010 | −0.125 | 0.191 |
| n | | 283 | | | 283 | | | 283 | |
| $R^2$ | | 0.061 | | | 0.093 | | | 0.057 | |
| Adjusted $R^2$ | | 0.034 | | | 0.066 | | | 0.030 | |
| Significance $R^2$ | | 0.026 | | | 0.010 | | | 0.037 | |

**Table 6**
Post hoc analysis for idea realizability.

| | Realizability | | | | | |
|---|---|---|---|---|---|---|
| | Model 1 | | | Model 2 | | |
| | B | Beta | p-value | B | Beta | p-value |
| Constant | 2.558 | | 0.000 | 2.247 | | 0.000 |
| Mills ratio | 0.384 | 0.156 | 0.007 | 0.360 | 0.146 | 0.011 |
| Education | −0.007 | −0.006 | 0.919 | −0.008 | −0.006 | 0.914 |
| Age | −0.002 | −0.027 | 0.646 | −0.003 | −0.037 | 0.536 |
| Gender | 0.045 | 0.018 | 0.747 | 0.077 | 0.031 | 0.592 |
| Cognitive style | −0.064 | −0.069 | 0.227 | −0.061 | −0.065 | 0.252 |
| Openness to experience | −0.008 | −0.009 | 0.896 | −0.016 | −0.018 | 0.794 |
| Lead userness | −0.026 | −0.034 | 0.584 | 0.077 | 0.101 | 0.447 |
| Internal to the firm | 0.378 | 0.149 | 0.037 | 0.907 | 0.358 | 0.067 |
| Lead userness x Internal | | | | −0.129 | −0.288 | 0.251 |
| n | | 349 | | | 349 | |
| $R^2$ | | 0.037 | | | 0.041 | |
| Adjusted $R^2$ | | 0.015 | | | 0.016 | |
| Significance $R^2$ | | 0.107 | | | 0.107 | |
| $R^2$ change | | 0.037 | | | 0.004 | |
| F change | | 1.661 | | | 1.321 | |
| Significance $R^2$ change | | 0.107 | | | 0.251 | |

## 5. Discussion

### 5.1. Summary

In this paper we use a sample of 864 employees (283 ideas) and 239 users (66 ideas) to investigate whether internal lead users generate better ideas (in terms of originality, user value, and market potential) than ordinary employees, external lead users, and ordinary users. Our predictions are not fully supported: internal lead users generate ideas of higher originality and user value than ordinary employees and users do, but the highest quality ideas measured on those dimensions come from external lead users. In relation to market potential, location of the individual inside or outside the organizational boundary has no effect: internal and external lead users produce ideas with higher market potential than the ideas of ordinary users and ordinary employees.

### 5.2. Theoretical implications

We contribute to the growing stream of research on internal users (e.g. Harrison and Corley, 2011; Schweisfurth and Raasch, 2015; Wadell et al., 2013) by showing that the creative output of internal lead users differs from the output of other relevant groups. So far, this stream of work has focused on the benefits of employing lead users but has not investigated how their contribution differs from other relevant sources of innovation such as external lead users and ordinary users. We find that internal lead users generate more creative output than ordinary employees and users do, but that their ideas are less original and of less user value than the ideas of external lead users. These findings put into perspective internal lead users as sources of innovation, and compare the creative output of internal lead users and external lead users, thereby linking the literature on internal lead users with the vast body of work on external lead users (Franke et al., 2006; Schreier and Prügl, 2008; von Hippel, 1986).

Our first post hoc test provides a rationale for our unexpected finding that internal lead users do not produce better ideas than external lead users. Being internal to the organization provides internal lead users with creativity-enhancing knowledge schemas (e.g. solution knowledge) but also creativity-hindering knowledge schemas (e.g. organization-specific knowledge). Embeddedness in the organization is associated with organization-specific schemas which may contain knowledge relating to resistance to change (Janssen, 2003), consideration of what is appropriate for the organization (Dane, 2010), and restrictions on the implementation of innovations (Magnusson, 2009). Over time, internal lead users may become entrenched in organization-specific knowledge. This may reduce the number of highly innovative ideas which deviate too far from the existing organization specific knowledge (Dane, 2010). Another rationale which could explain why external lead users' ideas are the most original and of highest user value is that external lead users are more likely to draw on solution knowledge from

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distant domains. Internal lead users' solution knowledge schema are based on solution knowledge embodied into existing products from the firm. External lead users are likely to use solution knowledge which is local to them (Lüthje et al., 2005), but distant to firms in a specific domain. Such distant knowledge from analogous markets is likely to produce highly novel and useful ideas (Franke et al., 2013).

A second contribution of this study is to the field of innovation management and new product development which investigates how external users' ideas and employees' ideas differ (Kristensson et al., 2004; Magnusson, 2009; Magnusson et al., 2003; Poetz and Schreier, 2012). This stream of research finds that on average, external users' ideas are of higher quality than employees' ideas. We also found that, ceteris paribus, external users' ideas are more original and of higher user value than employees' ideas. However, if we include lead userness as a predictor of idea quality, the picture becomes more nuanced. Internal lead users produce higher quality ideas than do ordinary users and ordinary employees, and external lead users produce higher quality ideas than do internal lead users. Thus, our findings introduce contingencies on the findings in the literature on new product development, and predict the conditions in which the ideas of employees are better or worse than the ideas of users.

These considerations have implications for the research on co-creation in new product development which suggests that the detriments of co-creation have been neglected (Gemser and Perks, 2015; Hoyer et al., 2010). Our findings suggest that co-creation with internal instead of external users may help firms alleviate the costs and risk of customer co-creation such as knowledge spillovers, time-consuming identification of target groups, and decreased process control, in exchange for reduced idea novelty and user value.

The third contribution of this study is to research on knowledge recombination for innovation at the individual level. This stream of work focuses on the exploitation of knowledge from different technological domains, (i.e., solution knowledge) (Audia and Goncalo, 2007; Fleming, 2001; Lettl et al., 2009) but does not investigate how combining different types of knowledge, i.e. need knowledge and solution knowledge, facilitates innovation (cf. Franke et al., 2013; von Hippel, 1994). We contribute to filling this gap by showing that ideas from employees who take advantage of their location inside the organization to access solution knowledge combined with complementary need knowledge, are more creative than employees who lack need knowledge (i.e. ordinary employees). We highlight that location within the organization (compared to being outside the organizational boundaries) provides the individual with organization-specific schemas including organizational limitations which dampen idea quality. This mirrors Magnusson, 2009 finding outside the organization that external users who receive training on the possibilities and limitations of a technical system have less original ideas than users who do not have this knowledge.

### 5.3. Limitations and further research

One limitation is rooted in the idea generation setting we chose for a focus. First, in reality, ideas are often generated by teams. We would not expect that groups of users or employees would come up with better ideas than individual users or employees per se (Girotra et al., 2010). However, ideation carried out in teams of external lead users and internal lead users would likely generate higher quality ideas due to the complementary knowledge types brought by each group. Investigating this conjecture would combine high external validity with managerial relevance.

Other limitations are related to our sample. We cannot be completely sure that our subsamples are representative of either the home appliance user population or the population from the organization. We have argued that this was the case and conducted statistical checks but future work should investigate these issues using symmetric designs (Franke et al., 2013).

Even if the samples would be fully representative, our findings do not account for the fact that lead user integration is often carried out in workshops. For such workshops, firms can select from an almost endless number of external users or even use pyramiding search to identify lead users with solution knowledge from analogous markets (Franke et al., 2013; Stockstrom et al., 2016). However, the number of internals which could be integrated into idea generation remains limited. Thus, our findings can be regarded as conservative because we focus on an average consumer population, whereas firms may select only external users with very high lead userness for integration into new product development.

Also, our study was conducted in an industry in which use expertise is rather ubiquitous and needs are rather homogenous. First, all employees of firms in such industries are users of home appliances in the sense that they will likely have used an appliance at least once and thus can be considered internal users. Second, since the home appliances sector is a mature industry, most needs are likely to be similar across users, and also across employees and users. Thus, our findings are directly generalizable to similar industries such as the automotive industry. However, the role of need knowledge may be even more pronounced in industries with idiosyncratic and heterogenous user needs. In such industries, we would expect the effect of lead userness on idea quality to be stronger for employees than in the home appliances industry due to the large gap in user need understanding between internal lead users and non-user employees. Also, in our study, employees can also be users of the firm's products at the same time. This is different in industries such as the medical devices industry, in which users of medical devices, i.e. surgeons, cease to be active users once they join a medical device firm (Chatterji and Fabrizio, 2012). Even if such physician employees have been shown to be idea contributors (Wadell et al., 2013), we would expect that their lead userness decreases with organizational tenure. Future research should investigate how such individuals can keep up their creativity rooted in use experience over time, e.g. by going back to the field occasionally.

### 5.4. Implications for practice

Our findings have implications for managers looking for valuable innovation ideas. External user ideas are known to be more valuable with respect to originality and user value but internal ideas are easier to access and to realize. It might be expected that taking ideas from internal lead users could be the solution to this dilemma. However, our findings present a more differentiated picture:

Internal lead users produce ideas which are more valuable than those of ordinary employees and ordinary users. This is good news for firms because identifying creative users outside organizational boundaries can be extremely costly (Poetz and Prügl, 2010; von Hippel et al., 2009). As opposed to externals, identifying employees who are lead users is less challenging and their ideas are more easily realizable within the organization. Thus, drawing on internal lead users is a convenient way to source and implement new ideas.

However, this is not to say that internal lead users can replace external lead users in the innovation process; the ideas incorporating the maximum novelty, user value, and market potential come from external lead users.

## Acknowledgements

My sincerest thanks go to Christina Raasch, Christoph Stockstrom, Cornelius Herstatt, Joachim Henkel, Thorsten Pieper, Michael Zaggl, Luis Roberto Trujillo, and the participants of the International Open and User Innovation Meeting in Lisbon 2015 for

Please cite this article in press as: Schweisfurth, T.G., Comparing internal and external lead users as sources of innovation. Res. Policy (2016), http://dx.doi.org/10.1016/j.respol.2016.11.002

their valuable comments on this paper. I also thank the participating firm, participating students, and all raters. I am very grateful for the thoughtful comments of three anonymous reviewers and the editor Ben Martin.

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Please cite this article in press as: Schweisfurth, T.G., Comparing internal and external lead users as sources of innovation. Res. Policy (2016), http://dx.doi.org/10.1016/j.respol.2016.11.002

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