Research Policy xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Research Policy

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

Decision-makers' underestimation of user innovation

Philip Bradonjic[a], Nikolaus Franke[a,*], Christian Lüthje[b]

[a] Institute for Entrepreneurship and Innovation, Vienna University of Economics and Business, Austria
[b] Institute of Innovation Marketing, Hamburg University of Technology, Germany

ARTICLE INFO

Keywords:
User innovation
Sources of innovation
Theory practice gap
Decision-makers
Biases

ABSTRACT

In the past few decades, much research has documented the importance of users as sources of innovations. Over the last 10 years, *Research Policy* alone has published 56 research articles investigating this phenomenon. We ask to what degree the findings of users as innovators have been absorbed by decision-makers responsible for new product development (managers) and by those who shape the contextual conditions for innovation (policy makers and public administration). A realistic perception of the sources of innovation is important as it constitutes the basis for a rational allocation of resources and thus indirectly impacts the innovation performance of companies and societies at large.

In a large-scale survey of n = 1500 decision-makers, we found support for a substantial underestimation of users as a source of innovation: While the true proportion of user innovation among the most valuable 1678 innovations in nine industries is 54.4% (as established in existing research articles), decision-makers estimate it to be 21.7%. A content analysis of transfer media (450 academic textbooks, popular innovation books, and business articles) underscores this theory-practice gap: Of 3469 text paragraphs dealing with the sources of innovation, only 2.7% mention users as innovators. We develop six propositions on the reasons for and consequences of this underestimation that may serve as a starting point for future research and practical consequences.

1. Introduction

As early as 1978, Eric von Hippel (von Hippel, 1978) published a first review of studies indicating that users are often the originators of major inventions in various industries. Since then, a growing research strand investigating the role of users as a source of innovation has emerged, with von Hippel's (1988, 2005, and 2017) books as undisputed milestones. Today, "user innovation" is one of the hot topics in innovation research (e.g. Bogers et al., 2010; von Hippel, 2017). In *Research Policy* alone, 56 articles have been published on this phenomenon over the last 10 years. Together with the many articles in other journals, as well as books, research reports, working papers, and contributions in conference proceedings like those of the Open and User Innovation Conference, these studies provide overwhelming empirical evidence for the importance of user innovation (de Jong, 2016). It is not only a common phenomenon, both among consumers (Franke et al., 2016; von Hippel et al., 2012) and industrial users (de Jong and von Hippel, 2009; Hienerth et al., 2014; Oliveira and von Hippel, 2011). User innovations have also been found to be particularly valuable (von Hippel, 2017). They are therefore of major importance for the competitive position of producer firms (Chatterji and Fabrizio, 2012; Cohen et al., 2002; Schweisfurth, 2017), for the development of industries (Hienerth et al., 2014; Shah, 2000), and for the welfare of societies as a whole (Henkel and von Hippel, 2004; Kim, 2015; Schaan and Uhrbach, 2009; von Hippel et al., 2012). What is more, technological developments suggest that the importance of user innovation is likely to increase (Baldwin and von Hippel, 2011): The internet has enabled the establishment of online communities and made it easier to exchange ideas, access the complementary skills of others, and diffuse reliable solutions (von Hippel, 2017). 3D printing and other flexible manufacturing technologies put users in the position to manufacture individual products directly from digital models at comparatively low costs (Rayna et al., 2015; Weller et al., 2015) and "big data" analysis tools make it easier to identify them (Kaulartz and von Hippel, 2018).

In this article, we investigate the extent to which decision-makers are aware of users as sources of innovation. *Ex ante*, it is not clear how far scholarly evidence has been absorbed by practitioners. On the one hand, there is much research showing that the diffusion of research knowledge into practice does not work well (van de Ven and Johnson, 2006). Academic silos have strong walls, and some studies even suggest that the gulf between academic business research and practice is widening (Rynes et al., 2001). However, research has also found that

* Corresponding author.
E-mail address: nikolaus.franke@wu.ac.at (N. Franke).

https://doi.org/10.1016/j.respol.2019.01.020
Received 6 July 2018; Received in revised form 11 January 2019; Accepted 28 January 2019

transfer is more likely when (1) findings are concrete, (2) the amount of evidence is high, (3) statistical methods are easy to understand, and (4) there are clear practical implications (Bartunek et al., 2006; Johnson and Duberley, 2000; Mohrman et al., 2001; Shapiro et al., 2007). Arguably, all these conditions apply to existing research on users as a source of innovation: The rich empirical evidence on user innovation is neither theoretically abstract nor statistically complex, and its practical implications are straightforward.

Our research question is thus *whether and, if so, to what degree decision-makers in practice underestimate users as sources of innovation.* Its relevance results from the practical implications of possible underestimation.

For, if *managers* underestimate the importance of user innovations, companies are unlikely to exploit the full potential of this crucial innovation source's (Hienerth et al., 2014; Li et al., 2013; Fuchs and Schreier, 2011; Yadav et al., 2007). That, in turn, causes considerable opportunity costs as research has consistently found that integrating contributions from users by methods such as lead user studies, crowdsourcing, user communities, and user innovation toolkits (for an overview, see von Hippel, 2005) strengthens internal innovation processes and increases company performance (Bock et al., 2016; Chatterji and Fabrizio, 2014; Lilien et al., 2002; Schweisfurth, 2017). One potential consequence of an underestimation is thus a competitive disadvantage suffered by product and service companies (Gambardella et al., 2017). Furthermore, such an error can translate into disadvantages for customers and society as many valuable (user) innovations will not become available on the market (Gambardella et al., 2017).

Public administrators and policy-makers control the allocation of innovation-related resources intended to enhance public welfare (Barker and Mueller, 2002; Gonzales and Pazo, 2008; Kuusisto et al., 2013; von Hippel and Jin, 2009). If they underestimate users as innovators, it will thus have negative consequences. First, in most countries, government authorities and public research agencies constitute a major source of R&D funding in the form of grants and subsidies. As a result, significant underestimation could lead to systematic underfunding of user innovation projects. Second, Gambardella et al. (2017) show that concentrating innovation policy on public support for producers can have welfare-reducing effects. Firms are incentivized to engage in R&D that substitutes for user innovations and, in turn, become even less open to innovation by users. Underestimation of user innovation may also prompt governments and their institutions to underinvest in infrastructure that supports user innovation such as online platforms (Koch et al., 2013) or maker-spaces (Halbinger, 2018; Svensson and Hartman, 2018). Third, legislative bodies determine whether the legal environment is more or less supportive of user innovation activities. For instance, copyright acts constrain users in accessing or re-using existing solutions, and patent law may impose high risks on incorporating prior inventions into user-generated designs and revealing them to other users (Torrance and von Hippel, 2016). Even well-meant regulations can inflict collateral damage on user innovation by increasing the cost to users of testing their inventions in a public space (e.g. testing new car prototypes on public roads or drones in the air; Torrance and von Hippel, 2015; von Hippel, 2017). Again, the underestimation of users' value as a source of innovation may translate into welfare losses (Gambardella et al., 2017; Henkel and von Hippel, 2004).

To sum up, inappropriate cognitive representations of the user-innovation phenomenon among decision-makers may have severe consequences for firms' competitiveness, for countries' innovation dynamics, and for social welfare (Gambardella et al., 2017; Helfat and Peteraf, 2015; Rosenbloom, 2000; Tripsas and Gavetti, 2000). It is thus crucial to establish whether the importance of user innovation is incorrectly estimated.

2. Study 1: Do decision-makers underestimate user innovation?

2.1. Measurement

We seek to assess how (in)accurately decision-makers estimate the importance of user innovation. In order to do so, we had to develop our own test instrument given the absence of prior attempts at empirical assessment.

Measuring estimation errors requires the availability of a true value to which estimates can be compared (e.g. Fischhoff et al., 2010; Lichtenstein et al., 1978; Viscusi, 1990). We therefore sought out all studies that analyze the *source of the major innovations* in a given field and selected those that report figures for the share of innovations within a product or service field originating from users. This process identified nine innovation sets drawn from eight studies (see DeMonaco et al., 2005; Goeldner and Herstatt, 2016; Hienerth et al., 2014; Oliveira and von Hippel, 2011; Preissner and Raasch, 2016; Riggs and von Hippel, 1994; Shah, 2000; van der Boor et al., 2014; see Technical Appendix A for a more detailed description of the selection process).

Typically, the authors of these studies compile a complete sample of the most important innovations introduced in a given field within a certain time span. Next, they identify the individuals who created the first functioning prototype in each case and assign them to one of the different sources of innovation (e.g. producers, users, research intuitions). As a result, the studies report the percentage of innovations originally developed by users and other inventor groups. These "true" shares of user innovation in samples of particularly important innovations served as reference values for our own study.

To elicit decision-makers' estimates of the share of user innovations in the nine innovation sets, we used an online questionnaire. In it, we provided an illustrative picture and a short explanation of each of the product or service categories covered by the samples. We took care to avoid demand effects, that is, distortions resulting from cues to what constitutes an appropriate answer (Orne, 1962). Had we asked only about the share of user innovations, we would have revealed the focus of the study and might have prompted distorted assessments. So, instead, we asked respondents to estimate the shares of *all* potential sources of innovations: (a) users, (b) producer/service firms, (c) universities and research institutions, and (d) other innovators (in randomized order). (*Who do you think developed…? Please estimate the share of innovations that each of the following groups developed*). Respondents gave their estimates of the percentage share of each of the four potential innovator categories via scroll bars (see Technical Appendix B). We measured the estimation error as the difference between the estimated percentages of user innovations and our reference values taken from the research studies (e.g. Viscusi, 1990). Readers who want to test their ability to estimate the share of user innovation (or that of colleagues, students, or employees) are invited to do so by following the link to the original questionnaire: https://bit.ly/2BXlF66.

We took steps to control and reduce various potential types of bias. To avoid order effects, we randomized the order of the nine innovation samples in the individual questionnaires. An additional test for systematic differences between the first and the last estimates given in the survey provided no indication of remaining order effects (t-test, $p = 0.81$). Similarly, we checked whether the order in which the four innovation sources were presented to respondents had an effect. Again, an ANOVA test provided no indication of order effects ($p = 0.44$). We also took measures to monitor and reduce the risk of distortions caused by a salience effect, file-drawer effects, framing bias, lack of attention, or socially desired response behavior (see Technical Appendices C1 to C5 for more information).

2.2. Samples and data collection

Our respondents were drawn from six independent samples of decision-makers (see Table 1).

Table 1
Samples.

Samples	*Contacted*	*Complete responses*	*Response rate*
Top managers of innovative SMEs	827	159	19%
Junior and mid-level managers	3964	1094	28%
Physicians and medical researchers	1000	60	6%
Economic policy-makers	1590	133	8%
Employees of the Chamber of Industry and Commerce	987	106	11%
Management scholars	1000	206	21%
Total sample	*9368*	1758	*19%*

2.2.1. Top managers of innovative SMEs

Senior executives can influence how intensively their organizations utilize users as a source of innovation. Our sample consisted of 827 executive directors of firms that have successfully participated in the annual TOP 100 competition (www.top100.de), in which companies apply to be considered among Germany's most innovative SMEs.

2.2.2. Junior and mid-level managers

For our sample, we identified 1094 managers working in industries ranging from high-tech products to service. They were employed by both small and large organizations at junior or middle management level, in organizational areas such as R&D, production, sales, and finance. To construct the sample, we enlisted the help of a renowned panel provider of proven high quality in the recruitment and treatment of panel participants (Certificate of Access Panel Norm ISO 26,362).

2.2.3. Physicians and medical researchers

We wanted to test decision-makers' estimations in a field characterized by fairly high user innovation levels. The medical field meets these conditions particularly well (DeMonaco et al., 2005; Goeldner and Herstatt, 2016; Oliveira et al., 2015). We drew a random sample of 1000 physicians at university hospitals in Germany.

2.2.4. Economic policy-makers

We included economic policy-makers since their decisions determine the legal and regulatory environment in which user-innovators develop new products and services. Our sample consisted of politicians serving on economic committees and of public service managers in ministries of economics at both state and federal levels in Germany. We collected all email addresses that were available online, giving a total of 1590 politicians and public administrators.

2.2.5. Employees of the Chamber of Industry and Commerce

We included employees of the German Chamber of Industry and Commerce (IHK) because it represents the interests of most businesses in Germany and acts as a key agent in diffusing economic and innovation-related information. The entire population of IHK employees in Germany is almost 7000. We drew a random sample by contacting every seventh person on the list, a total of 987 employees.

2.2.6. Management scholars

We included management professors because they are important distributors of knowledge in innovation management via teaching, publications, and consulting. We drew a random sample of 1000 professors from the German Academic Association for Business Research (VHB).

Of the 1758 responses to our questionnaire (response rate 19%), we filtered out 258 participants who failed our attention test (Oppenheimer et al., 2009; see Technical Appendix C4), thus arriving at a net sample of n = 1500. We checked the reliability of respondents' estimations across the nine innovation fields and found a sufficient Cronbach's alpha of 0.68. We also tested for a non-response bias and found no difference between early, middle and late respondents (Armstrong and Overton, 1977).

2.3. Findings

Our data show a clear underestimation of user innovation, with virtually all decision-makers underestimating its value. Of the 1500 respondents, only eight (0.5%) estimated the proportion of user innovations correctly or overestimated it. On average, across all product and service areas, decision-makers estimated users to account for 21.7% of the most important innovations (Table 2, last line), the correct value being 54.4%. The difference, 32.7 percentage points, is highly significant ($p < 0.0001$). This means that, of the given set of extremely important user innovations, decision-makers identified less than half as such; in fact, they saw only 39.9% of the true value of this innovation source (21.7/54.4%). This pattern is consistent across different product and service areas (Table 2), and across different groups of decision-makers (Table 3). Finally, management scholars also gave estimates clearly lower than the values reported by empirical studies.

3. Study 2: Is this underestimation reflected in transfer media?

In this second study, we investigate the picture transmitted by transfer media of the extent and value of user innovation. On the one hand, this media analysis may validate our survey results using a completely different method, namely content analysis. For, if we find

Table 2
Decision-makers' Underestimation by Innovation Field.

	True share of user innovations (as found in focal study)	Decision-makers' estimate	Standard deviation	Extent of underestimation (true share minus estimate)	P
Disruptive innovations[a]	44.3%	20.7%	14.5%	23.6%	.000
Financial services					
Corporate banking services[b]	67.5%	18.2%	15.8%	49.3%	.000
Mobile banking services[c]	52.5%	15.9%	14.7%	36.6%	.000
Retail banking services[d]	44.0%	16.8%	14.8%	27.2%	.000
Medicine and science					
Medical apps[e]	46.3%	21.5%	16.3%	24.8%	.000
Off-label drug therapies[f]	59.0%	18.4%	17.4%	40.6%	.000
Scientific instruments[g]	43.8%	16.3%	14.2%	27.5%	.000
Sports					
Kayaking equipment[h]	87.0%	34.2%	18.3%	52.8%	.000
Windsurfing equipment[i]	45.5%	33.6%	20.0%	11.9%	.000
Total	*54.4%*	*21.7%*	*16.2%*	*32.7%*	*.000*

[a]Preissner and Raasch, 2016; [b]Oliveira and von Hippel, 2011; [c]van der Boor et al., 2014; [d]Oliveira and von Hippel, 2011; [e]Goeldner and Herstatt, 2016; [f]DeMonaco et al., 2005; [g] Riggs and von Hippel, 1994; [h] Hienerth et al., 2014; [i] Shah, 2000.

Table 3
Underestimation by Category of Decision-maker.

	Decision-makers' estimate	Standard deviation	Extent of underestimation (true share – estimate)	P
Decision-maker category				
Top managers of innovative SMEs (n = 149)	21.7%	7.6%	32.7%	.000
Junior and mid-level managers (n = 879)	22.1%	8.6%	32.3%	.000
Physicians and medical researchers (n = 57)	21.0%	6.5%	33.4%	.000
Economic policy-makers (n = 127)	22.5%	6.7%	31.9%	.000
Employees of the Chamber of Industry and Commerce (n = 94)	20.5%	9.7%	33.9%	.000
Management scholars (n = 194)	20.0%	10.3%	34.4%	.000

Table 4
Examples of Text Paragraphs.

Examples of user innovation	Examples of other innovation sources
"Craig Newmark (…) wanted a way to exchange information with friends about cool events happening around his hometown. At first he used email, but soon there was enough traffic that an email list was needed so people could post and reply without annoying each other. (…) In 1997, Craig formalized the noncommercial nature of the list. (…) It wasn't until 1999 that Craig decided to make Cragislist.org the focus of his working life."[a]	"Canon spends heavily on R&D (8 per cent of sales revenues) to maintain its leadership in the laser printer market by fast introduction of innovations such as colour improvements and to develop new products such as LED TVs, which can produce the wide viewing angle and deep colours of a cathode-ray TV but are as thin as a liquid-crystal or plasma screen."[d]
"Not wanting to carry the mat along with her instrument on trips, Martha Aarons invented gloves and slippers with a gripping substance."[b]	"One solution, developed by one of the Fraunhofer Institutes in Germany, is a standard based on the Motion Picture Experts Group (MPEG) level 3 protocol – MP3."[e]
"One day, Louis Plante, a sufferer from cystic fibrosis, had to leave a concert because of excessive coughing while sitting in proximity to a large speaker. Using his skills as an electronics technician, Louis developed a device that could generate the low frequency vibrations. His primary goal was to develop a treatment he would benefit from"[c]	"Invented by Bill Moggridge, design thinker extraordinaire and one of the pioneers of Sillicon Valley design, the butterfly test is a thoroughly unscientific but amazingly effective process for extracting a few key insights from a mass of data."[f]

[a]Berkun (2007, p. 48); [b]Hisrich et al. (2008, p. 150); [c]Bessant and Tidd (2015, p.54); [d]Jobber and Ellis-Chadwick (2013, p. 451); [e]Tidd (2001, p.24); [f]Brown (2009, p.83).

that transfer media underreport users as source of innovation, we can interpret this as underestimation by the authors of these publications. On the other hand, content analysis may also point to a potential reason for the underestimation reported in Study 1 (see discussion), decision-makers being frequent consumers of transfer media.

3.1. Sample of transfer media

We collected data from three categories of transfer media.

(1) The first category comprises academic textbooks, which not only constitute one of the key information sources in higher education but are consulted more often by practitioners than research papers in academic journals. We examined textbooks in four subject areas: general management, marketing, entrepreneurship, and innovation management. For each subject, we compiled a list of the most-cited books according to Google Scholar and checked the syllabi of courses offered by the management departments of 60 German universities for recommended books. By combining these two search results, we selected the 10 most-cited and most frequently used textbooks in each field (for a list of the books analyzed, see Technical Appendix D).
(2) The second publication group consisted of popular innovation books targeting mainly practitioners. As such books are advertised to a broader audience, they are more likely to be read by decision-makers in industry and policy. We selected the top 10 all-time most popular books according to the world's largest site for readers and books, goodreads.com (for a list of the ten books analyzed, see Technical Appendix E).
(3) The third publication type was business press articles. We selected two media outlets in Germany: the leading business newspaper, handelsblatt.com (Statista, 2018), and the most popular general news outlet, spiegel.de (Newman et al., 2016). For each, we identified 200 articles covering innovation in the 12 months before the launch of our survey by searching for the keyword *innovation* in each platform's online archive.

3.2. Data collection

In order to analyze our sample of transfer media, we used a total of 10 raters none of whom was aware of the study objective. We randomly assigned raters to the reading material in a way that each text document was read by two raters. In a first stage, the raters scanned all text in their reading package to identify individual paragraphs reporting on the sources of innovations. Typically, the information in such paragraphs fell into one of two categories: (1) General remarks on the roles of potential innovation sources and (2) illustrations of specific innovation examples with some information about the originating party. Next, each selected paragraph was coded independently by the two raters into one of the four innovator categories used in Study 1. Specifically, raters were trained to code text paragraphs to the user innovator category if the innovation was explicitly stated to originate from users, customers, or buyers, and/or the unit explicitly indicated that the focal innovation was developed for innovators' own use. Inter-rater reliability (Krippendorff's alpha) was 0.94. Table 4 provides examples of paragraphs coded to the user-innovator category (left column) and the non-user categories (right column).

3.3. Findings

The results reported in Table 5 show that users as a source of innovation play hardly any role in transfer media. Only in 2.7% of the 3469 paragraphs on the sources of innovations were users mentioned as originators. A comparison of this share with the average proportion of user innovations in the academic studies on this topic (54.4%) points to a clear case of underreporting.

Indeed, only in academic textbooks on innovation management do users figure to any significant extent as innovators (6.6% of paragraphs

Table 5
Mentions of Users as Innovators by Type of Transfer Media.

Information source	Units of analysis	No. of text paragraphs referring to innovation sources	No. of text paragraphs explicitly referring to user innovations	Share of text paragraphs explicitly referring to user-innovators
Academic textbooks				
General business textbooks	10 books	372	5	1.3%
Marketing textbooks	10 books	340	8	2.4%
Entrepreneurship textbooks	10 books	203	3	1.5%
Innovation textbooks	10 books	1080	71	6.6%
Popular innovation books	10 books	1116	8	0.7%
News magazines				
General news magazine	200 articles	122	0	0.0%
Business news magazine	200 articles	236	0	0.0%
Total		3469	*95*	*2.7%*

on the sources of innovation). Other textbooks on general management (1.3% of paragraphs), marketing (2.4%), and entrepreneurship (1.5%) give the merest glimpse of users' true importance. Moreover, outside academic literature, it appears almost impossible to find information about users as innovators. Popular innovation books are virtually silent about users when describing innovation sources (0.7% of paragraphs), and in business press articles that refer to innovators, users do not figure at all (0.0%), clearly validating Study 1.

4. Discussion

Our research has a clear finding: Decision-makers across various subgroups clearly underestimate the importance of user innovation. This prompts us to seek out the reasons for such perceptual bias, highlights the need to investigate its consequences, and calls for measures to reduce the estimation error. In what follows, we try to structure the root causes and consequences into a set of propositions to be investigated by further empirical research and which may provide a starting point for concrete countermeasures (Fig. 1).

4.1. Causes and consequences of underestimation

First of all, innovation by users is, by its nature, an "invisible" phenomenon. Most users innovate in order to solve a concrete problem of their very own and because they consider the innovation process itself to be self-rewarding (Stock, 2015; von Hippel, 2005). Only a small fraction of users plan to commercialize or sell their innovations on markets (Shah and Tripsas, 2007; von Hippel, 2017). So, although user-innovators are in principle willing to share their innovations with other users, and to reveal them to anyone interested (Harhoff et al., 2003), they lack an *incentive* to promote them actively and diffuse them widely (de Jong et al., 2015; von Hippel, 2017). In addition, it is hard and/or costly for user-innovators to popularize their achievements as they lack both direct marketing links and access to broader communication channels (von Hippel et al., 2017). Finally, many may simply lack proficiency in promoting their innovations to information agents, producers, or other users. All this makes it likely that most user innovations are known only to the user-innovators themselves, or at best to the user community they belong to, which is why the diffusion of user innovation has been identified as a case of market failure (de Jong et al., 2015; von Hippel, 2005). Only rarely do "outsiders" come into direct contact with the phenomenon of user innovation.

Proposition 1. Decision-makers underestimate user innovation because they lack direct contact with users-innovators and their innovations.

Yet, even in cases when user innovations are picked up by producers and become the basis of commercial products (as in the cases of the mountain bike, the heart-lung machine, and the zip fastener), the role of the user-innovator usually remains hidden. As claiming the role of innovator in product announcements or advertising campaigns entails clear reputational benefits (Henard and Dacin, 2010),[1] producers have no incentive to reveal the original innovation source. Moreover, knowledge about the true origin of innovations tends to get blurred when producers further develop a user invention into a commercially viable product or service (von Hippel, 1988). User innovation prototypes are 'raw and rude' and require considerable investment in order to turn them into marketable products or services. Consequently, producers' representatives may arrive at the conclusion that they are the 'real' innovators. As a result, also in cases where decision-makers have producer-mediated indirect contacts to user innovations, the activities of users will most likely go unnoticed.

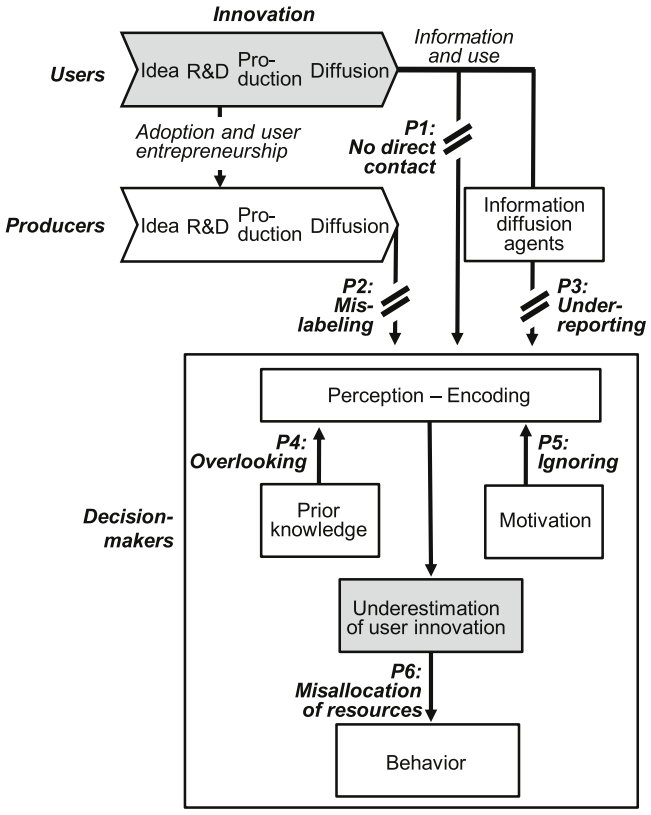

Fig. 1. Reasons for and consequences of decision-makers' underestimation of user innovation: Six propositions (P1-6).

[1] It was shown recently that, under specific circumstances, stressing users' role may also have positive effects for the producer (see Nishikawa et al., 2017; Dahl et al., 2014). Again, it is questionable whether this finding has made its way into practice.

Proposition 2. Decision-makers underestimate user innovation because user innovations commercialized by producers are rarely labeled as such.

If there is little direct contact to user-innovators, and little indirect information is provided by producers, the role of transfer media is crucial. Most practitioners do not read scholarly articles (Bartunek, 2007; Rynes et al., 2007), which means that media such as academic textbooks and business press articles offer the best opportunity to learn – albeit indirectly – about user innovation. In Study 2 we found, however, that transfer media rarely report on the extent and value of user innovation. This could be due to one or, more probably, both of two factors. Authors and journalists (like decision-makers) may underestimate the frequency and import of this source of innovation – or they may think that this information is of no interest to their readers. In any case, the net result is that decision-makers are inadequately informed about the importance of user innovation and therefore inevitably underestimate it.

Proposition 3. Decision-makers underestimate user innovation because transfer media underreport on it.

Propositions 1 to 3 suggest that most information on user innovation is not actively promoted and is therefore filtered out. However, we maintain also that information which does reach decision-makers will not necessarily be correctly perceived and interpreted – with negative effects on the assessment of the user-innovation phenomenon – for different reasons.

First, prior knowledge about the origins of innovations may play a role. For long, the dominant paradigm was that of producer innovation (Baldwin and von Hippel, 2011; Gambardella et al., 2017). On this view, users are merely buyers with needs that producers identify and meet by appropriate products and services (Brown, 2009; von Hippel, 2005). Users are denied the role of innovators, partly because they are not believed to have insight into their unmet needs, and partly because their ability and incentive to innovate is disputed (Bogers et al., 2010; Ulwick, 2002). As a result, users have no place in the mental framework within which decision-makers' conceptualize the sources of innovation (van de Ven, 1986). And information that does not clearly relate to categories in individual's mental frameworks tends to go unnoticed (Bazerman and Moore, 2013); it fails to overcome their attention barrier and is thus unintentionally lost (Beyer et al., 1997; Felin et al., 2017; Shane, 2000).

Proposition 4. Decision-makers overlook information on user innovation because prior knowledge blinds their attention.

Second, decision-makers may also show a tendency towards active filtering and downplaying of information about user innovation. Individuals' mental schemata represent their belief structure (e.g. 'user innovations rarely happen'). Such beliefs become the basis of fixed attitudes toward users and their innovations (e.g. 'user innovation threatens me'). Like an ideology, the set of beliefs about, and attitudes towards user innovations skews perception and distorts reasoning (e.g. Kahneman, 2011). Moreover, since information about the prevalence of user-innovators questions key beliefs and attitudes, it poses a challenge to the producer-centric perspective. It may therefore elicit a confirmation bias to uphold familiar cognitive patterns, leading to a tendency to question, downplay, and deny this sort of information (Hart et al., 2009; Oswald und Grosjean, 2012; Walsh, 1988). The self-protective nature of the confirmation bias is apparent in the 'not-invented-here' syndrome (NIH), which has often been seen as shaping attention to, as well as interpretation and recall of external innovation stimuli (Katz and Allen, 1982). The NIH refers to the belief among internal players (mostly R&D personnel) that they possess a monopoly of relevant knowledge on innovation. User innovations threaten the decision makers' position and devalue their capabilities. Seen as a self-supporting bias, the NIH is therefore very likely to influence their assessment of user innovations (Antons and Piller, 2015).

Proposition 5. Decision-makers will subconsciously and/or intentionally ignore and misinterpret information on user innovation in order to protect their own interests.

Turning to the consequences of underestimation, we suspect that negative consequences are very likely and probably very substantial. As outlined in the introduction, significant misperception of user innovation by managers, policy makers and management scholars may well mean that it is insufficiently exploited and supported. Generally, rational decisions require a view of reality that is objective. If it is systematically biased, almost inevitably the result will be a suboptimal decision (Tversky and Kahneman, 1974). In 2016, for example, nearly $2 trillion in public and private funds were spent on R&D (Industrial Research Institute, 2016); a misallocation of even a small fraction of this sum will have led to considerable welfare losses. Not only that: Users have shown that they can develop new and better solutions to existing problems. If underestimation of their importance translates into disregard of, or even contempt for their work, many welfare-enhancing innovations will be delayed at significant cost – or not implemented at all (Gambardella et al., 2017; Helfat and Peteraf, 2015; Rosenbloom, 2000; Tripsas and Gavetti, 2000). However, although extremely plausible, we have to note that the consequence of inefficient resource allocation due to a bias regarding the sources of innovation has not yet been empirically shown.

Proposition 6. Decision-makers' underestimation of user innovation leads to misallocation of innovation-relevant resources.

4.2. Further research

We have not tested our propositions on the reasons for the underestimation of user innovation nor have we measured its consequences. As a result, the descriptive results of our study point to several research opportunities. It would also be helpful to establish whether our results can be confirmed using different empirical methods and metrics. Any measurement comes with limitations, and the approach selected for this study is no exception. Another avenue for future research would thus be to try to replicate our findings.

Future replications could also be used to see if underestimation of user innovation decreases *over time*. Every new idea has to run through a process of gradual adoption before being accepted by most members of a social system (Rogers, 2003), and it has been shown that it takes time for knowledge to cross the gap between academia and practice (Cohen et al., 2002; Shapiro et al., 2007). Furthermore, diffusion of knowledge is even slower if the adoption of new knowledge requires dominant paradigms to be expanded or existing ones complemented with new ones (Kuhn, 1970; Thagard, 1993; Qiu et al., 2012). In our particular case, the idea of user innovation is relatively new, its importance has received attention mainly from researchers, and its broader diffusion requires the paradigm of producer-dominated innovation to be refined and complemented (Baldwin and von Hippel, 2011; Gambardella et al., 2017). Our results may reflect the fact that the process of diffusing knowledge about user innovation is still in its infancy, in which case underestimation should decline in the future.

In a similar vein, it would be interesting to measure underestimation of user innovation in other *geographical areas*. Our study is limited to decision-makers in Germany. As has been shown repeatedly for the diffusion of new technology, new research findings may be diffused at different rates in different countries (Leidner and Kayworth, 2006; Takada and Jain, 1991). Perhaps assessment of the user innovation phenomenon would be different among a sample of US, Asian, or African decision-makers. Differences regarding the estimation error may derive from differences in cultural norms (e.g. collectivism), widely shared orientations (e.g. willingness to cooperate) or patterns of social interaction (e.g. level of communication between research

scholars and practitioners). Testing for such international differences constitutes a promising research opportunity.

In the spirit of openness that pervades the field of user innovation research, we invite anyone interested in taking it, or any of the other opportunities identified, up to use our measurement tool in order to examine the estimation error over time and across different regions of the world (see https://bit.ly/2E9Lf9K for tools and instructions).

4.3. Practical implications

Assuming that our finding is correct and our set of propositions valid, it is appropriate to ask how the underestimation problem can be addressed, and by whom. The key to answering these questions lies in one finding of research on paradigm shifts in science: that the likelihood of new or complementary perspectives being widely accepted increases with the amount of evidence that violates established expectations (Johnson and Duberley, 2000; Kuhn, 1970). This means that empirical evidence about users as sources of innovation needs to be disseminated more widely. In particular, innovation management scholars must actively popularize their findings on the sources of innovation. Moreover, information agents (e.g. media) and other influencers should be addressed, so that they can integrate the findings in their publications and messages. Hopefully, the results of the present study will also stimulate curriculum managers and teachers on innovation programs to present existing empirical evidence on the importance of user-innovators. This evidence should be embedded in a broader debate about studies investigating models of open innovation and processes of distributed innovation. The result of such efforts would be a basis for students to question the validity of traditional innovation paradigms that widely ignore the high and rising levels of user innovations in many product and service fields.

In addition, information campaigns, subsidies, and public support programs seem promising ways to improve the dissemination of evidence, as is already happening in Denmark, Finland, the UK, and Austria (Kuusisto et al., 2013).

User innovations are often ignored merely because they are rarely commercialized as products or services sold at market prices (Gault, 2012; von Hippel, 2017). For their true potential to be revealed, they need to be integrated into publicly financed international innovation surveys. Such integration is of utmost importance since individual ad-hoc studies may alleviate the underrepresentation of user innovation in accessible information sources, but are hardly likely to eliminate it. What is needed is a broad, and panel-like collection of data on user innovations at regular intervals (von Hippel, 2017). This would allow tracking of the level, and possibly also the impact, of user innovations in many industries over time, while helping to relate the results to contextual factors or political interventions. Such findings would be significantly more likely to draw the attention of decisions-makers in firms, public administration and higher education than the results of occasional and isolated studies.

It is therefore very helpful that the definition of innovation in the Oslo Manual (Oslo Manual, 2005) has recently been extended to cover innovations from all sectors of the economy, thus also including private households as a source. Furthermore, the new definition does not require inventions to be introduced into a market in order for them to be categorized as innovations. Instead, any means of making a new process or product available to potential users qualifies as the implementation of an invention. Consequently, most user innovations will now fall under the official definition of the Oslo Manual (Gault, 2018).

We declare that the manuscript “Decision-makers’ Underestimation of User Innovation” and the underlying research is free of any conflict of interest.

Acknowledgments

The authors wish to thank Valentin Bauer, Viktoria Braun, Christoph Dvorak, Zeno Jecel, Janine Kasparek, Dmytro Kharchenko, Markus Kneisz, Valentin Priesner, Lukas Rennefeld, Ivana Savic, Martin Schwarz, and Jakob Spiess for their help in collecting the data and Chris Ross for proof-reading the article. In addition, we are grateful for the valuable comments provided by two anonymous referees who helped us to improve this paper significantly. An earlier version of the paper was presented at Open and User Innovation Conference 2017 in Innsbruck, Austria.

This research was not funded by any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.respol.2019.01.020.

References

Antons, D., Piller, F.T., 2015. Opening the black box of “not invented here”: attitudes, decision biases, and behavioral consequences. Acad. Manag. Perspect. 29 (2), 193–217.
Armstrong, J.S., Overton, T.S., 1977. Estimating nonresponse bias in mail surveys. J. Mark. Res. 14 (3), 396–402.
Baldwin, C., von Hippel, E., 2011. Modeling a paradigm shift: from producer innovation to user and open collaborative innovation. Organ. Sci. 22 (6), 1399–1417.
Barker, V.L., Mueller, G.C., 2002. CEO characteristics and firm R&D spending. Manage. Sci. 48 (6), 782–801.
Bartunek, J.M., 2007. Academic-practitioner collaboration need not require joint or relevant research: toward a relational scholarship of integration. Acad. Manag. J. 50 (6), 1323–1333.
Bartunek, J.M., Rynes, S.L., Ireland, R.D., 2006. What makes management research interesting, and why does it matter? Acad. Manag. J. 49 (1), 9–15.
Bazerman, M.H., Moore, D.A., 2013. Judgment in Managerial Decision Making, 8th ed.). John Wiley & Sons, New Jersey.
Berkun, S., 2007. The Myths of Innovation. O’Reilly Media, Sebastopol.
Bessant, J., Tidd, J., 2015. Innovation and Entrepreneurship. John Wiley & Sons, New Jersey.
Beyer, J.M., Chattopadhyay, P., George, E., Glick, W.H., Ogilvie, D.T., Pugliese, D., 1997. The selective perception of manager revisited. Acad. Manag. J. 40 (3), 716–737.
Bock, J.H., Henkel, J., Schweisfurth, T.G., Stiegler, A., 2016. Commercializing user innovations by vertical diversification: the user–manufacturer innovator. Res. Policy 45 (1), 244–259.
Bogers, M., Afuah, A., Bastian, B., 2010. Users as innovators: a review, critique, and future research directions. J. Manage. 36 (4), 857–875.
Brown, T., 2009. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. HarperBusiness, New York.
Chatterji, A.K., Fabrizio, K.R., 2012. How do product users influence corporate invention? Organ. Sci. 23 (4), 971–987.
Chatterji, A.K., Fabrizio, K.R., 2014. Using users: when does external knowledge enhance corporate product innovation? Strateg. Manage. J. 35 (10), 1427–1445.
Cohen, W.M., Nelson, R.R., Walsh, J.P., 2002. Links and impacts: the influence of public research on industrial R&D. Manage. Sci. 48 (1), 1–23.
Dahl, D.W., Fuchs, C., Schreier, M., 2014. Why and when consumers prefer products of user-driven firms: a social identification account. Manage. Sci. 61 (8), 1978–1988.
de Jong, J.P.J., 2016. The empirical scope of user innovation. In: Harhoff, D., Lakhani, K.R. (Eds.), Revolutionizing Innovation: Users, Communities, and Open Innovation. MIT Press, Cambridge, pp. 67–87.
de Jong, J.P.J., von Hippel, E., 2009. Transfers of user process innovations to process equipment producers: a study of Dutch high-tech firms. Res. Policy 38 (7), 1181–1191.
de Jong, J.P.J., von Hippel, E., Gault, F., Kuusisto, J., Raasch, C., 2015. Market failure in the diffusion of consumer-developed innovations: patterns in Finland. Res. Policy 44 (10), 1856–1865.
DeMonaco, H.J., Ali, A., von Hippel, E., 2005. The Major Role of Clinicians in the Discovery of Off-label Drug Therapies. MIT Sloan Working Paper No. 4552-05.
Felin, T., Lakhani, K.R., Tushman, M.L., 2017. Firms, crowds, and innovation. Strateg. Organ. 15 (2), 119–140.
Fischhoff, B., Bruine De Bruin, W., Parker, A.M., Millstein, S.G., Halpern-Felsher, B.L., 2010. Adolescents’ perceived risk of dying. J. Adolesc. Health 46 (3), 265–269.
Franke, N., Schirg, F., Reinsberger, K., 2016. The frequency of end-user innovation: a re-estimation of extant findings. Res. Policy 45 (8), 1684–1689.
Fuchs, C., Schreier, M., 2011. Customer empowerment in new product development. J. Prod. Innov. Manage. 28 (1), 17–32.
Gambardella, A., Raasch, C., von Hippel, E., 2017. The user innovation paradigm: impacts on markets and welfare. Manage. Sci. 63 (5), 1450–1468.
Gault, F., 2012. User innovation and the market. Sci. Public Policy 39, 118–128.
Gault, F., 2018. Defining and measuring innovation in all sectors of the economy. Res. Policy 47 (3), 617–622.
Goeldner, M., Herstatt, C., 2016. Are Patients and Relatives the Better Innovators? The Case of Medical Smartphone Applications. Hamburg University of Technology: Working Paper No. 91.

Gonzales, X., Pazo, C., 2008. Do public subsidies stimulate private R&D spending? Res. Policy 37 (3), 371–389.

Halbinger, M.A., 2018. The role of makerspaces in supporting consumer innovation and diffusion: an empirical analysis. Res. Policy 47 (10), 2028–2036.

Harhoff, D., Henkel, J., von Hippel, E., 2003. Profiting from voluntary information spillovers: how users benefit by freely revealing their innovations. Res. Policy 32 (10), 1753–1769.

Hart, W., Albarracin, D., Eagly, A.H., Brechan, I., Lindberg, M.J., Merrill, L., 2009. Feeling validated versus being correct: a meta-analysis of selective exposure to information. Psychol. Bull. 135 (4), 555–588.

Helfat, C.E., Peteraf, M.A., 2015. Managerial cognitive capabilities and the micro-foundations of dynamic capabilities. Strateg. Manage. J. 36 (6), 831–850.

Henard, D.H., Dacin, P.A., 2010. Reputation for product innovation: Its impact on consumers. J. Prod. Innov. Manage. 27 (3), 321–335.

Henkel, J., von Hippel, E., 2004. Welfare implications of user innovation. J. Technol. Transf. 30 (1-2), 73–87.

Hienerth, C., von Hippel, E., Jensen, M.B., 2014. User community vs. Producer innovation development efficiency: a first empirical study. Res. Policy 43 (1), 190–201.

Hisrich, R., Peters, M., Shepherd, D., 2008. Entrepreneurship. McGraw-Hill/Irwin, New York.

Industrial Research Institute, 2016. 2016 Global R&D Funding Forecast. Retrieved October 19, 2017, from. https://www.iriweb.org/sites/default/files/2016GlobalR&DFundingForecast_2.pdf.

Jobber, D., Ellis-Chadwick, F., 2013. Principles and Practice of Marketing. McGraw-Hill Higher Education, New York.

Johnson, P., Duberley, J., 2000. Understanding Management Research: An Introduction to Epistemology. SAGE publications, London.

Kahneman, D., 2011. Thinking, Fast and Slow. Penguin Books, London.

Katz, R., Allen, T.J., 1982. Investigating the not invented Here (NIH) syndrome: a look at the performance, tenure, and communication patterns of 50 R & D Project Groups. R&D Management 12 (1), 7–20.

Kaulartz, S., von Hippel, E., 2018. Lead User Innovation Identification: Rapid Semantic Analyses of User-Generated Content. Available at SSRN 3249162. .

Kim, Y., 2015. Consumer user innovation in Korea: an international comparison and policy implications. Asian J. Technol. Innov. 23 (1), 69–86.

Koch, G., Rapp, M., Kroeger, N., 2013. Harnessing the innovation potential of citizens: how open innovation can be used to co-develop political strategies. In: Pfeffermann, N., Minshall, T., Mortara, L. (Eds.), Strategy and Communication for Innovation. Springer, Heidelberg, pp. 63–83.

Kuhn, T.S., 1970. The Structure of Scientific Revolutions. University of Chicago Press, Chicago.

Kuusisto, J., de Jong, J.P.J., Gault, F., Raasch, C., von Hippel, E., 2013. Consumer innovation in Finland: incidence, diffusion and policy implications. Vaasa (Proceedings of the University of Vaasa, 189).

Leidner, D.E., Kayworth, T., 2006. A review of culture in information systems research: toward a theory of information technology culture conflict. Mis Q. 30 (2), 357–399.

Li, Q., Maggitti, P.G., Smith, K.G., Tesluk, P.E., Katila, R., 2013. Top management attention to innovation: The role of search selection and intensity in new product introductions. Acad. Manag. J. 56 (3), 893–916.

Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M., Combs, B., 1978. Judged frequency of lethal events. J. Exp. Psychol. Hum. Learn. 4 (6), 551–578.

Lilien, G., Morrison, P., Searls, K., Sonnack, M., von Hippel, E., 2002. Performance assessment of the lead user idea-generation process for new product development. Manage. Sci. 48 (8), 1042–1059.

Manual, Oslo, 2005. Oslo manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd ed. Statistical Office of the European Communities, Organisation for Economic Co-Operation and Development.

Mohrman, S.A., Gibson, C.B., Mohrman Jr., A.M., 2001. Doing research that is useful to practice a model and empirical exploration. Acad. Manag. J. 44 (2), 357–375.

Newman, N., Fletcher, R., Levy, D.A.L., Nielsen, R.K., 2016. Reuters Institute Digital News Report. Retrieved October 19, 2017, from:. . http://reutersinstitute.politics.ox.ac.uk/sites/default/files/Digital-News-Report-2016.pdf?utm_source=digitalnewsreport.org&utm_medium=referral.

Nishikawa, H., Schreier, M., Fuchs, C., Ogawa, S., 2017. The value of marketing crowdsourced new products as such: evidence from two randomized field experiments. J. Mark. Res. 54 (4), 525–539.

Oliveira, P., von Hippel, E., 2011. Users as service innovators: the case of banking services. Res. Policy 40 (6), 806–818.

Oliveira, P., Zejnilovic, L., Canhao, H., von Hippel, E., 2015. Patient innovation under rare diseases and chronic needs. Orphanet J. Rare Dis. 10 (1), 41.

Oppenheimer, D.M., Meyvis, T., Davidenko, N., 2009. Instructional manipulation checks: detecting satisficing to increase statistical power. J. Exp. Soc. Psychol. 45, 867–872.

Orne, M.T., 1962. On the social psychology of the psychological experiment: with particular reference to demand characteristics and their implications. Am. Psychol. 17 (11), 776–783.

Oswald, M.E., Grosjean, S., 2012. Confirmation bias. In: Pohl, R.F. (Ed.), Cognitive Illusions A Handbook of Fallacies and Biases in Thinking, Judgement and Memory. Psychology Press, East Sussex, pp. 79–96.

Preissner, S., Raasch, C., 2016. Disruption by users? Analyzing the sources of historical breakthrough innovations. Paper Presented at Academy of Management Annual Meeting.

Qiu, J., Donaldson, L., Luo, B.N., 2012. The benefits of persisting with paradigms in organizational research. Acad. Manag. Perspect. 26 (1), 93–104.

Rayna, T., Striukova, L., Darlington, J., 2015. Co-creation and user innovation: the role of online 3D printing platforms. J. Eng. Technol. Manag. 37 (4), 90–102.

Riggs, W., von Hippel, E., 1994. Incentives to innovate and sources of innovation: the case of scientific instruments. Res. Policy 23 (4), 459–469.

Rogers, E.M., 2003. Diffusion of Innovations, 5th ed.). Free Press, New York.

Rosenbloom, R.S., 2000. Leadership, capabilities, and technological change: the transformation of NCR in the electronic era. Strateg. Manage. J. 21 (10/11), 1083–1103.

Rynes, S.L., Bartunek, J.M., Daft, R.L., 2001. Across the great divide: knowledge creation and transfer between practitioners and academics. Acad. Manag. J. 44 (2), 340–355.

Rynes, S.L., Giluk, T.L., Brown, K.G., 2007. The very separate worlds of academic and practitioner periodicals in human resource management: implications for evidence-based management. Acad. Manag. J. 50 (5), 987–1008.

Schaan, S., Uhrbach, M., 2009. Measuring User Innovation in Canadian Manufacturing. 2007. Statistics Canada, Ottawa.

Schweisfurth, T.G., 2017. Comparing internal and external lead users as sources of innovation. Res. Policy 46 (1), 238–248.

Shah, S.K., 2000. Sources and Patterns of Innovation in a Consumer Products Field: Innovations in Sporting Equipment. MIT Sloan Working Paper No. 4105.

Shah, S.K., Tripsas, M., 2007. The accidental entrepreneur: the emergent and collective process of user entrepreneurship. Strateg. Entrep. J. 1 (1-2), 123–140.

Shane, S., 2000. Prior knowledge and the discovery of entrepreneurial opportunities. Organ. Sci. 11 (4), 448–469.

Shapiro, D.L., Kirkman, B.L., Courtney, H.G., 2007. Perceived causes and solutions of the translation problem in management research. Acad. Manag. J. 50 (2), 249–266.

Statista, 2018. Circulation of the Business Press in Germany 2016. Retrieved May 26th 2018 from:. https://de.statista.com/statistik/daten/studie/74819/umfrage/kennzahlen-zur-auflage-der-wirtschaftspresse/.

Stock, R.M., 2015. Is boreout a threat to frontline employees' innovative work behavior? J. Prod. Innov. Manage. 32 (4), 574–592.

Svensson, P.O., Hartmann, R.K., 2018. Policies to promote user innovation: makerspaces and clinician innovation in Swedish hospitals. Res. Policy 47 (1), 277–288.

Takada, H., Jain, D., 1991. Cross-national analysis of diffusion of consumer durable goods in Pacific Rim countries. J. Mark. 55 (2), 48–54.

Thagard, P., 1993. Conceptual Revolutions. Princeton University Press, Princeton.

Tidd, J., 2001. Managing Innovation. John Wiley & Sons, New Jersey.

Torrance, A.W., von Hippel, E., 2015. The Right to Innovate. Mich. St. L. Rev. 793.

Torrance, A.W., von Hippel, E., 2016. Protecting the right to innovate: our innovation 'wetlands'. In: Hyysalo, S., Jensen, T.E., Oudshoorn, N. (Eds.), The New Production of Users: Changing Innovation Collectives and Involvement Strategies. Routlegde, New York, pp. 45–74.

Tripsas, M., Gavetti, G., 2000. Capabilities, cognition, and inertia: evidence from digital imaging. Strateg. Manage. J. 21 (10/11), 1147–1161.

Tversky, A., Kahneman, D., 1974. Judgment under uncertainty: heuristics and biases. Science 185 (4157), 1124–1131.

Ulwick, A., 2002. Turn customer input into innovation. Harv. Bus. Rev. 80 (1), 91–97.

van de Ven, A.H., 1986. Central problems in the management of innovation. Manage. Sci. 32 (5), 590–607.

van de Ven, A.H., Johnson, P.E., 2006. Knowledge for theory and practice. Acad. Manag. Rev. 31 (4), 802–821.

van der Boor, P., Oliveira, P., Veloso, F., 2014. Users as innovators in developing countries: the global sources of innovation and diffusion in mobile banking services. Res. Policy 43 (9), 1594–1607.

Viscusi, W.K., 1990. Do smokers underestimate risks? J. Polit. Econ. 98 (6), 1253–1269.

von Hippel, E., 1978. Successful industrial products from customer ideas. J. Mark. 42 (1), 39–49.

von Hippel, E., 1988. The Sources of Innovation. Oxford University Press, Oxford.

von Hippel, E., 2005. Democratizing Innovation. MIT Press, Cambridge.

von Hippel, E., 2017. Free Innovation. MIT Press, Cambridge.

von Hippel, E., Jin, C., 2009. The major shift towards user-centred innovation: implications for China's innovation policymaking. J. Knowl. Innov. China 1 (1), 16–27.

von Hippel, E., de Jong, J.P.J., Flowers, S., 2012. Comparing business and household sector innovation in consumer products: findings from a representative study in the United Kingdom. Manage. Sci. 58 (9), 1669–1681.

von Hippel, E., DeMonaco, H., de Jong, J.P.J., 2017. Market failure in the diffusion of clinician-developed innovations: the case of off-label drug discoveries. Sci. Public Policy 44 (1), 121–131.

Walsh, J.P., 1988. Selectivity and selective perception: an investigation of decision makers' belief structures and information processing. Acad. Manag. J. 31 (4), 873–896.

Weller, C., Kleer, R., Piller, F., 2015. Economic implications of 3D printing: market structure models in light of additive manufacturing revisited. Int. J. Prod. Econ. 164 (6), 43–56.

Yadav, M.S., Prabhu, J.C., Chandy, R.K., 2007. Managing the future: CEO attention and innovation outcomes. J. Mark. 71 (4), 84–101.