Feedback Gathering from an Industrial Point of View

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Feedback Gathering from an Industrial Point of View

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Abstract—**Feedback communication channels allow end-users to express their needs, which can be considered in software development and evolution. Although feedback gathering and analysis have been identified as an important topic and several researchers have started their investigation, information is scarce on how software companies currently elicit end-user feedback. In this study, we explore the experiences of software companies with respect to feedback gathering. The results of a case study and online survey indicate two sides of the same coin: on the one hand, most software companies are aware of the relevance of end-user feedback for software evolution and provide feedback channels, which allow end-users to communicate their needs and problems. On the other hand, the quantity and quality of the feedback received varies. We conclude that software companies still do not fully exploit the potential of end-user feedback for software development and evolution.**

Index Terms—**Software evolution, software development, software maintenance, end-user feedback, requirements elicitation, user involvement, case study, survey, experience report.**

I. INTRODUCTION

User involvement can positively affect system success and user satisfaction [1]. Research has shown that early user involvement is associated with better requirements quality [2]. Involving end-users is important for software development and evolution [3] because it is challenging to anticipate fully all end-user needs and application contexts in advance. Thus, if software companies do not give their end-users a voice, they would miss the opportunity to increase their knowledge of real software usage and end-users' ideas for improvement [4]. To overcome this condition, software companies can either ask for feedback (pull) or allow the end-user to trigger the feedback communication (push) [5].

End-user feedback can be a valuable source for requirements as feedback communication channels allow end-users to report on feature requests and shortcomings, which can result in requirements for a software system (e.g., [6][7][8][9]), or allow them to provide satisfaction rates for quality requirements elicitation (e.g., [10]). Using these feedback channels, end-users can communicate feedback in linguistic (e.g., text) or non-linguistic (e.g., star rating) format [11].

During the last few years, the research on tool-supported end-user feedback gathering for software development and evolution has increased and it covers end-users' motivation to provide feedback [12][13], their needs and preferences for communicating feedback [7][12][14], the value and use of social media and app stores as feedback communication channels [15][16], and an ontology of online end-user feedback [11]. In addition, researchers have already developed and investigated standalone [9][17][18], embedded [4][19][20], and cross-platform [21] feedback tools to give end-users a voice. Furthermore, there are numerous commercial service providers offering solutions for feedback gathering, such as Usabilla [22], UserVoice [23], Usersnap [24], and BugHerd [25].

However, there is a lack of knowledge on how software companies gather feedback from their end-users and what challenges these companies face when operating end-user feedback channels. Exploring software companies' strategies and needs can provide new insights and foster the improvement of feedback communication channels.

To gain insight into software companies' experiences, we conducted a case study and an online survey with software companies who currently gather end-user feedback.

The paper is organized as follows. In Section II, we describe the study design in terms of scope and research questions, research methods, and sampling. Section III presents the case study and online survey results. In Section IV, we discuss our findings, threats to validity, and related work. Finally, we draw the conclusion by showing the next steps in Section V.

II. STUDY DESIGN

A. Scope and Research Questions

The goal of this study is to investigate software companies' experiences when gathering feedback. We particularly aim at answering the following two research questions (RQ):

- *RQ1: How do software companies gather feedback from their end-users?* We aim to determine which communication channels end-users can use to provide feedback and what challenges exist for end-users to provide feedback.
- *RQ2: What is the quantity and quality of feedback that software companies receive?* We want to know the amount of feedback the companies receive, the distri-

bution of feedback among the feedback communication channels, and how satisfied the software companies are with the quantity, quality, and relevance of the feedback they receive.

B. Research Methodology and Sampling

We aimed to answer our research questions by conducting a case study and an online survey in which we asked software companies about their feedback gathering process. With the case study, we wanted to obtain a detailed view of the software company's experiences when gathering feedback and to understand the challenges, problems, and success they encounter.

To quantify and validate the case study results, we formulated a set of questions and answer categories for an online survey conducted with additional software companies, following the case study.

Our research methodology (Fig. 1) consists of four phases that we describe in the following section.

Preparation of the Case Study. The case study was realized with the software company SEnerCon with the aim of analyzing and reflecting on the weaknesses and strengths of their feedback gathering process. The CTO, who is responsible for the development process and is a co-author of this paper, was interested in discussing possibilities to improve the current feedback gathering process.

SEnerCon is a small and medium-sized enterprise (SME) with 25 years of experience in engineering and consultancy in the domain of energy efficiency management. SEnerCon is located in Berlin, Germany, and has fifteen employees: A manager, a helpdesk agent, a CTO, and twelve software developers and engineers, who focus on software development and energy consulting.

SEnerCon's web application "interactive Energy Saving Account" (iESA) enables more than a hundred thousand end-users to monitor and analyze their energy consumption.

We aimed to conduct an on-site workshop to have access to SEnerCon's relevant stakeholders and to interview them in their working environment. The academic authors developed a semi-structured interview guideline (goo.gl/j0pvjy) considering the research questions. We also discussed which of the stakeholders could potentially answer which question.

Realization of the Case Study. The on-site workshop lasted one and a half days and it was moderated by two of the academic authors. Four stakeholders participated in the on-site workshop: (i) one end-user, who is using an energy saving account and has already provided feedback, (ii) the CTO, (iii) the helpdesk agent who receives the feedback, and (iv) the manager.

In the workshop, the two academic authors had a separate meeting with the end-user. The CTO participated in the sessions with the helpdesk agent and the manager.

During the workshop, the stakeholders demonstrated and walked through different parts of the energy saving account application and available feedback channels while highlighting the aspects they considered important. This included limitations and benefits of the current feedback channels as well as needs and ideas for improvement.

The workshop was audio recorded and workshop outputs (e.g., notes on boards, computer screens) were photo-documented.

Analysis of the Case Study Results. Two of the academic authors analyzed the collected data. They transcribed the audio data and wrote short descriptions of demonstrated artefacts (e.g., an end-user's main interaction steps with the iESA). They linked relevant paraphrases to the initial interview questions and wrote question-related summaries. In addition, they documented the similarities and differences between the stakeholders' experiences in providing and gathering feedback.

SEnerCon reviewed the results and made notes in the online document on statements where they did not agree. Incorrect paraphrases and summaries were corrected by SEnerCon and for other points under discussion, the academic authors provided a more detailed explanation to SEnerCon, which allowed them to agree.

Online Survey. To validate the findings from the case study, we performed an online survey with additional companies in German-speaking countries.

We adapted the questions from our interview guideline and developed a set of quantitative, closed questions (goo.gl/HQ1Ekl). We inquired about the availability and utilization of feedback channels, frequency of communicated feedback as well as the company's opinion on the feedback gathering process.
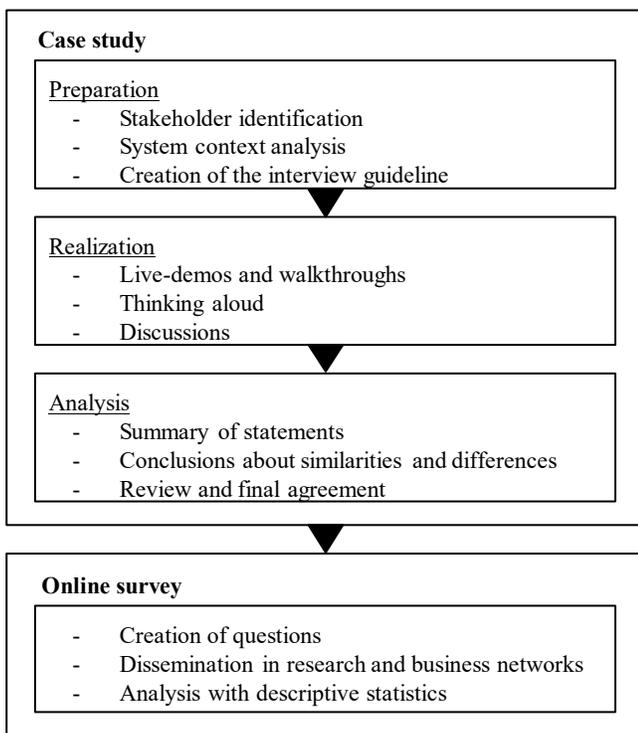

Case study

Preparation
- Stakeholder identification
- System context analysis
- Creation of the interview guideline

Realization
- Live-demos and walkthroughs
- Thinking aloud
- Discussions

Analysis
- Summary of statements
- Conclusions about similarities and differences
- Review and final agreement

Online survey
- Creation of questions
- Dissemination in research and business networks
- Analysis with descriptive statistics

Fig. 1. Research methodology.

TABLE I. CHARACTERISTICS OF SENERCON'S FEEDBACK COMMUNICATION CHANNELS

Channel	Trigger [5]	Feedback Format Supported [11]	Feedback Visible for other End-users
Hotline	Push	Linguistic (text spoken)	No
Email	Push	Linguistic (text written) + non-linguistic (screenshot or file upload)	No
Contact form	Push	Linguistic (text written)	No
Forum	Push/pull	Linguistic (text written, forum topic chosen) + non-linguistic (screenshot)	Yes
Social network: Facebook	Push	Linguistic (text written) + non-linguistic (images)	Yes
Social network: Twitter	Push	Linguistic (text written) + non-linguistic (images)	Yes

We had the opportunity to ask our questions for validation as part of a larger online questionnaire that aims to collect quantitative data from practitioners on requirements engineering in the industry. An invitation to participate in the survey was sent through mailing lists and business and research networks. In particular, requirements engineers or employees with knowledge of the company's requirements engineering activities were asked to fill out the questionnaire.

All questions and answer categories are translated from German. The survey results were analyzed by using descriptive statistics.

III. RESULTS

A. How do Software Companies Gather Feedback from their End-users? (RQ1)

1) Feedback Channels

SEnerCon's end-users can provide feedback through five communication channels: Hotline, email, contact form, website forum, and social networks.

SEnerCon's hotline is available from 10 am to 5 pm on workdays and the phone number is prominently promoted on the website. End-users can contact the helpdesk agent by email or reply to the email newsletter by reporting problems and requests. In addition, end-users can use the contact form "to ask questions or to provide suggestions," but they are advised to check if their question has already been answered in the help pages or forum. The latter is used by end-users to receive and discuss energy-saving tips. End-users' forum entries are always public and visible to unregistered users. SEnerCon has initiated diverse forum threads and sections to motivate end-users to provide feedback, for example, "report an error," and has sometimes asked for specific feedback, for example, after the implementation of a new feature. The social networks Twitter and Facebook are also available to send requests.

Table I summarizes the characteristics of SEnerCon's feedback communication channels. This includes whether the end-user (push) or SEnerCon (pull) starts the feedback communication [5], the feedback is communicated in natural language (linguistic) or not [11], and the feedback is visible to other end-users.

In total, 18 software companies that gather feedback from their end-users provided complete answers in the *survey*.

These software companies are in Germany (n = 15), Switzerland (n = 2), and Austria (n = 1). The domains spread across IT and software industry (n = 9), financial service, banking and insurance (n = 7), and public service and administration (n = 2). The eighteen companies vary also in their size: Four companies have less than ten employees, one company with ten to 99 employees, two companies with 100 to 249 employees, three with 250 to 999 employees, six with 1,000 to 9,999 employees, and two with 10,000 to 100,000 employees.

Table II shows that all companies (n = 18) provide a hotline and email as feedback communication channels, followed by the company's meeting at the customer site (n = 17) and contact form (n = 15). Furthermore, more than half of the software companies surveyed provide meeting at fairs (n = 13), survey (n = 12), ticket system (n = 11), forum (n = 11), and social network (n = 10) as channel. Approximately a third of the companies use embedded feedback tool (n = 7), chat (n = 6), and app store (n = 5) to gather feedback from their end-users. Two companies had one (or more) further feedback communication channel, but they did not state what these channels are.

Regarding the absolute number of feedback communication channels, software companies provide their end-users three feedback communication channels at the minimum and up to 13 channels (or more) at the maximum.

2) Potential Challenges for End-users to Provide Feedback

SEnerCon's helpdesk agent, who is working on end-users' requests, has the impression that end-users sometimes put a lot of effort into writing a feedback. This is in line with a statement of the interviewed end-user who stated that he is willing to invest up to ten minutes to provide a feedback.

TABLE II. Availability and Estimated Utilization of Feedback Communication Channels (Answer Categories: A1 = very often, A2 = often, A3 = sometimes, A4 = rarely, A5 = never although available)

Channel	Availability		Utilization by End-users				
	Absolute	*Relative*	*A1*	*A2*	*A3*	*A4*	*A5*
Hotline/Phone	18*	100%	3	9	6	-	-
Email	18	100%	2	6	8	2	-
Contact form	15	83%	-	2	5	3	5
Ticket system	11	61%	4	6	-	1	-
Embedded feedback tool in the company's software	7	39%	-	1	1	1	4
Forum	11	61%	-	1	-	7	3
App store (e.g., Google Play)	4	22%	1	-	-	-	3
Social network (e.g., Facebook)	10	56%	-	1	-	3	6
(Online) Survey	12	67%	-	2	6	-	4
(Live)Chat	6	33%	-	-	3	-	3
Meeting at fairs	13	72%	-	2	7	3	1
Company's meeting at the customer site	17	94%	3	9	4	-	1

*Number of software companies (survey sample n = 18).

The helpdesk agent, the CTO, and the end-user believe that end-users are motivated to provide feedback. However, the end-user is only willing to invest time if he can be assured that SEnerCon is really interested in his feedback. Moreover, he wants to know with whom he is communicating. He is skeptical about email as a communication channel for feedback because he is unsure if SEnerCon reads and takes the feedback seriously. Thus, he would expect an immediate answer from SEnerCon confirming that his message was received. In addition, he would like to know if and when SEnerCon starts to work on his feedback. This is in line with the opinion of the helpdesk agent: He believes that end-users would be interested in the status of their feedback.

The end-user and helpdesk agent see a trade-off regarding published feedback, e.g., in social networks or in the forum: On the one hand, end-users want to make their feedback public to win allies and exert pressure on SEnerCon. On the other hand, they might want to protect their privacy, especially when they upload screenshots. Moreover, the end-user and the helpdesk agent emphasized that end-users have different needs when providing feedback. The current context and device of the end-user will influence if and how the end-users will provide feedback.
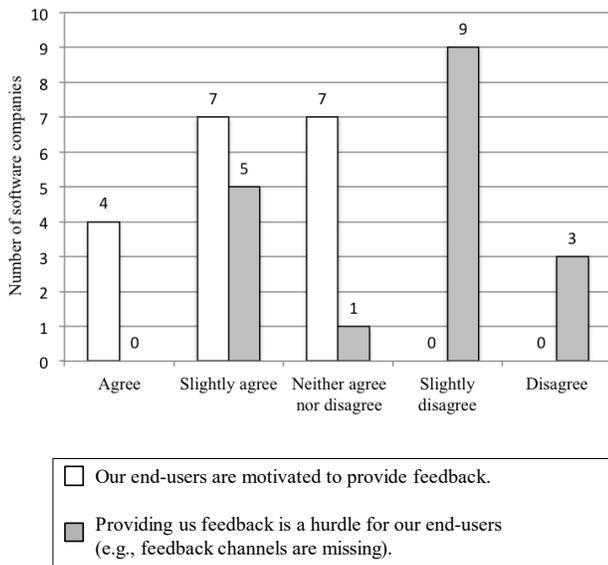
The *survey* results on end-users' motivation and hurdles to provide feedback are in line with the workshop results.

Two thirds of the companies (slightly) agreed that their end-users are motivated to provide feedback, whereas one third neither agreed nor disagreed (see Fig. 2).

Again, two-thirds of the companies (slightly) disagreed that their end-users have hurdles in providing feedback, for example, due to missing feedback channels. However, five companies slightly agreed that there might be hurdles.

Fig. 2. Software companies' opinion on end-users' motivation and hurdles to provide feedback; survey sample n = 18.

B. What is the Quantity and Quality of Feedback that Software Companies Receive? (RQ2)

1) Quantity of Feedback Received

In 2015, *SEnerCon* received 1,120 end-user requests (see Table III). Two-thirds are support requests, one-third of the requests is about feedback, such as bug reports (e.g., "Every time I try to save a new meter reading, the system shows me

TABLE III. NUMBER OF END-USER REQUESTS ON SENERCON'S ENERGY SAVING ACCOUNT IN 2015, GROUPED BY COMMUNICATION CHANNEL AND REQUEST TYPE

Communication Channel	Support Requests	Feedback	Sum
Hotline	163	31	194
Email	349	154	503
Contact form	147	67	214
Forum	129	80	209
Social network: Twitter	0	0	0
Social network: Facebook*	-	-	-
Sum	788	332	1120

*SEnerCon did not document end-user requests via Facebook.

the error message 'saving did not work'."), but also feature shortcomings, feature strengths, feature requests, and general praise and critique.

The helpdesk agent performs the categorization of support requests and feedback manually and creates a report at the end of each month. Although this report creation is very time consuming, the helpdesk agent emphasized that this "monthly clean-up" helps him to structure his thoughts. The report itself is an important artefact and triggers the team to have a monthly review. Nevertheless, the helpdesk agent would appreciate a tool supporting him in the categorization of end-user support requests and feedback, including the identification of duplicates.

SEnerCon receives on average 65 support requests and 26 feedbacks per month. However, the frequency depends on the season and SEnerCon's media presence, which can affect when new end-users register for the energy saving account and then request for support. During the cold season (usually October to March) SEnerCon receives 100 to 150 requests per month, mostly support requests. The helpdesk agent points out that especially in months with increased frequency of requests, he would appreciate a tool solution that sends him alerts when end-users communicate urgent or important feedback so that he can react immediately, for example, bug reports.

Table III shows that most requests arrive via email (n = 503). For communicating feedback, in half of the cases, end-users use email (n = 154), followed by forum (n = 80), and contact form (n = 67); the hotline was only used in ten percent of the cases (n = 31). SEnerCon's end-users do not use Twitter to provide feedback and Facebook is rarely used by end-users to provide feedback. Thus, SEnerCon decided to neither document nor categorize requests sent via social networks.

In the *survey*, software companies were asked about the quantity of feedback received ("How much feedback do your end-users provide on average per month?"). Most companies chose the category "0-10" (n = 5) or "10-50" (n = 8). Two companies chose "50-100" and three companies "100-500." No company received more than 500 feedback issues per month.

In Table IV, the number of end-users is crossed with the es-

timated number of feedback received per month. All companies with less than one thousand end-users and four of the nine companies with more than one thousand end-users received a maximum of fifty feedback issues per month.

Next, companies were asked how often end-users use a feedback communication channel to provide feedback. Table II shows the estimated feedback channel utilization.

Hotline and email, which are available in all companies, are very often or often used, similar to the results from the case study. Furthermore, similar to SEnerCon's contact form, end-users of the surveyed companies do not often use the contact form to communicate feedback. In contrast, a ticket system is available for end-users in 61% of the companies and is very often or often used by end-users (n = 10). Embedded feedback tool, chat, and forum tend to be used rarely or never by end-users to provide feedback. A few companies have app stores and social networks as feedback communication channel, which are also used rarely or never. In companies that are conducting surveys (n = 12) or are available for meetings at fairs (n = 13), end-users tend to occasionally use these channels (n = 6, n = 7). In contrast, end-users use often or very often (n = 14) the company's meeting at the customer site. The two companies who have further feedback channels (but did not state which) receive only sometimes or rarely feedback through these channels.

A third of the companies (slightly) agreed that they are satisfied with the quantity of the feedback they receive (see Fig. 3). Nine companies neither agreed nor disagreed, whereas three companies slightly disagreed.

2) Quality of Feedback Received

SEnerCon estimates that 70 to 80 percent of the feedback has a high quality and is relevant to software evolution. For example, the feedback (translated from German) "I registered once with my Facebook account that I want to delete now. So I need the possibility to decouple my Facebook account from my iESA account," was communicated by different end-users and

TABLE IV. ESTIMATED NUMBER OF FEEDBACK RECEIVED PER MONTH GROUPED BY SOFTWARE COMPANIES' NUMBER OF END-USERS

Number of End-users	Feedback per Month				
	0-10	*10-50*	*50-100*	*100-500*	*>500*
1-10	-	-	-	-	-
10-50	2*	-	-	-	-
50-100	-	1	-	-	-
100-500	2	1	-	-	-
500-1,000	1	2	-	-	-
1,000-10,000	-	2	-	1	-
10,000-100,000	-	-	1	2	-
100,000-1,000,000	-	2	-	-	-
>1,000,000	-	-	1	-	-

*Number of software companies (survey sample n = 18).

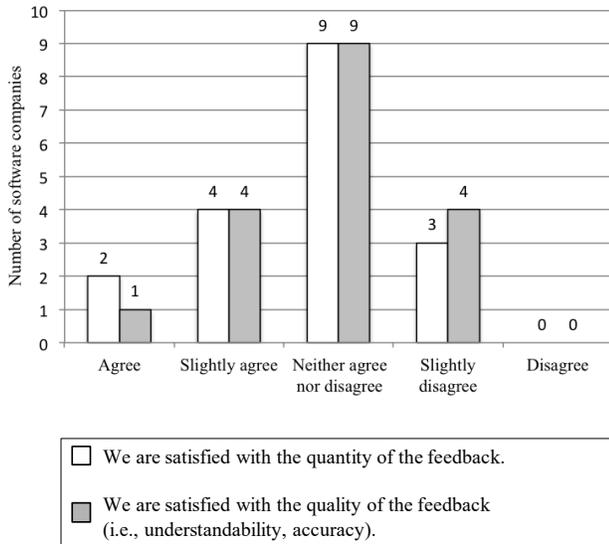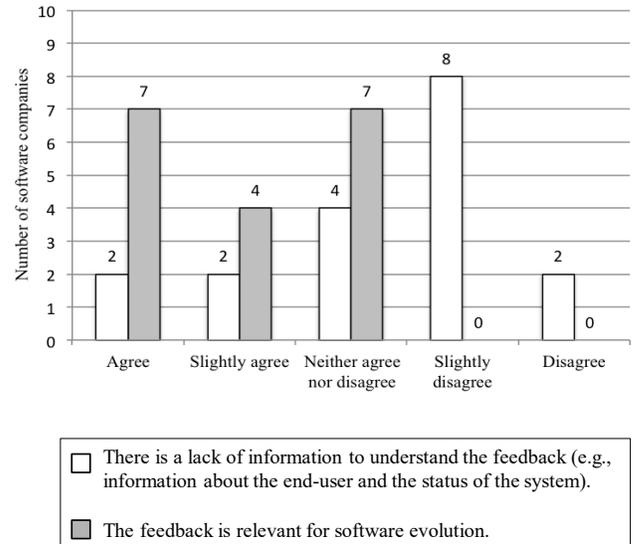Fig. 3.   Software companies' opinion on quantity and quality; survey sample n = 18.

Fig. 4.   Software companies' opinion on missing information to understand feedback and feedback relevance; survey sample n = 18.

SEnerCon decided to implement the feature requested.

However, SEnerCon's management is less satisfied with the feedback quantity and quality, and would like to receive more specific feedback, for example, suggestions for improvement. Thus, the manager stated: "We get enough feedback, but sometimes not the feedback we want."

Although SEnerCon is satisfied with the current feedback communication channels, SEnerCon sees improvement potential. Sometimes, it is time-consuming to extract the relevant information as end-users provide feedback in natural language and in an unstructured way. SEnerCon expects that some guidance for the end-users, for example, several text fields or categories to be selected, might not only reduce end-users' effort to provide feedback but also help SEnerCon to understand the feedback faster.

Furthermore, SEnerCon appreciates receiving enriched feedback. This could include further media, for example, annotated screenshots, as well as metadata such as end-user's ID, URL, and browser data. If an end-user currently posts a feedback in the forum, SEnerCon knows at least the username and the helpdesk agent can check the end-user's account to get more information about this end-user. In case the end-user calls the helpdesk agent, he must ask the end-user for her iESA username and further context information, for example, what is the currently visible page. However, if an end-user sends feedback via email, the helpdesk agent must find the user ID manually by assigning the email address to the iESA end-user list. If the end-user has sent feedback from an email address not registered in this list, the helpdesk agent must ask for the user ID in a reply to the email. This is time-consuming and could also be frustrating for end-users because questions need to be asked for clarification. Regarding the identification of an end-user, the CTO concluded: "Email is the 'worst' feedback channel we can think of!"

Although SEnerCon is aware that solutions exist for an au-

tomated feedback analysis, SEnerCon is skeptical and has doubts regarding the quality of the automated feedback analysis. For example, they question how bugs with individual root causes could be automatically analyzed. Thus, in the future, SEnerCon would like to test a software solution that supports manual and automated analysis.

In the *survey*, we found that software companies also vary in their judgment on the quality of feedback, for example, how understandable and accurate the feedback is (see Fig. 3). Five companies (slightly) agreed that they are satisfied with the feedback quality, while four slightly disagreed. Most companies (n = 9) neither agreed nor disagreed.

On the statement that information is missing to understand the feedback, only four companies (slightly) agreed, whereas the half (slightly) disagreed (n = 10) (see Fig. 4). Four companies neither agreed nor disagreed.

Two thirds of the companies (slightly) agreed that the feedback is relevant for software evolution, while seven companies were undecided; no company disagreed.

IV. DISCUSSION

In this section, we discuss the findings from our case study and online survey, present limitations of our research methodology, and refer to related literature.

A. Findings

It comes as little surprise that the feedback gathered by different companies varies from a handful per month up to a hundred or more, given that the companies vary in terms of the number of end-users. However, we could *not* identify a clear trend as the higher the number of end-users, the higher the number of feedback gathered.

The latter might be influenced by the number and type of feedback communication channels provided by the software companies. Interestingly, the number of feedback communica-

tion channels provided varies between companies: from three channels at the minimum up to 13 or even more.

However, only certain feedback communication channels are often used, including those allowing for a direct and live communication between the feedback sender and the receiver: phone calls and a company's on-site meetings with customers. It is surprising that feedback communication channels, which allow a publication of feedback (e.g., social networks, forum) or prevent a context change (e.g., embedded feedback tool, contact form) are rarely or never used by end-users.

This result is linked to our case study finding that end-users have different needs when providing feedback. For example, one end-user would like to discuss her feedback in a forum, while another end-user prefers to protect her privacy and therefore does not want to publish her feedback online (see also [12][14]). Furthermore, excessive effort to communicate the feedback or missing reactions to a feedback could be potential obstacles that we have derived from the case study. The survey results also showed that in several cases, end-users are not motivated to provide feedback and that sometimes, hurdles exist for end-users to communicate their feedback. This might influence the preference of end-users to some channels or even in their decision not to provide a feedback.

In several cases, feedback communication channels also do not fit the needs of the software company. This is indicated by our case study and survey results showing that companies are not always satisfied with the quantity and quality of the feedback received. One reason for this, as stated by SEnerCon and supported by literature [26], is that end-users communicate their feedback mostly in natural language without following a structured form. Beyond that, we found in our case study and survey that sometimes, further information is missing to understand the feedback (see also [20]). In the case of SEnerCon, the software company provides feedback channels that support a two-way communication allowing SEnerCon to ask questions for clarification. However, this could be time-consuming for the end-user as well. Nevertheless, in most software companies that we have investigated, the feedback received from end-users is relevant for software evolution.

B. Limitations

Threats to construct validity. The first threat refers to the fact that we did not run pilot tests with the questions used in the interview guideline and online survey. However, the interview questions were carefully developed in several discussion rounds with SEnerCon. From our experiences in the workshop, we can claim that all stakeholders understood the questions and gave reasonable answers. As the survey was prepared based on the interview guideline and workshop results, we are confident that survey participants understood the questions.

To ensure that we measured what we intended to measure, we asked the workshop participants to show artefacts and engaged them to be as concrete as possible, for example, by asking about critical incidents. This is also true for the survey questions as we tried to be aligned as much as possible with the current practice, for example, asking for agreement toward statements derived from the workshops.

We cannot exclude that the list of feedback channels we presented in the online survey was incomplete. However, only two of 18 companies stated that they provide other feedback communication channels.

Moreover, due to restrictions regarding number and format of questions in the questionnaire, we were not able to ask many detailed or even open format questions.

Threats to internal validity. The first threat to internal validity could be that SEnerCon's helpdesk agent, CTO, and manager gave incorrect or incomplete answers given that other team members were present. We tried to limit this threat by asking for concrete examples of their daily working life.

A second threat is related to the survey sample. Our questions were asked in a larger questionnaire, where previously asked questions on requirements engineering might have affected the response to our feedback gathering questions. We limited this threat by placing the feedback related questions at the top third of the questionnaire.

Third, we must assume that the assessment of the quality and relevance of feedback received is highly subjective based on workshop participants' and companies' judgments. For example, SEnerCon documents the quantity, but not the quality of feedback. Thus, we cannot exclude, that this judgment is influenced by a single feedback that was received in the recent past and had a very high or low quality.

Fourth, we also must assume that some of the survey data on utilization of feedback channels and monthly amount of feedback received might be rather estimates of the survey participants than data from an in-depth data analysis of the software companies (as it is in the case study). However, we expect these estimates to be close enough to reality to allow us to draw a conclusion.

Threats to external validity. The main limit to the generalizability of our case study is that only one software company was involved. Meanwhile, we received an adequate amount of answers from the online survey, which increased the confidence in our case study results.

Moreover, SEnerCon, as well as the companies surveyed, span different domains and different organization characteristics. However, all companies are from German-speaking countries in Central Europe. Future studies should validate our results by formulating and testing the hypothesis with a more detailed questionnaire and a larger sample of software companies from different countries worldwide.

C. Related Work

There are many studies that are broadly related to the topic of feedback gathering, which will not be discussed in detail in the related work section. These studies include feedback analysis, where key publications are about the semi-automated analysis and classification of end-user feedback [8][27][28], and the prioritization and validation of feedback gathered with the help of the crowd [6][29].

The work closest to ours is by Pagano and Bruegge [26]. In 2012, they interviewed five software companies on their strate-

gies and experiences to involve end-users during software evolution. Our study confirms several findings of the authors: (i) software companies vary in number and type of feedback channels they provide, (ii) the feedback channel utilization frequency varies, and (iii) developers sometimes have difficulties in understanding the feedback received and require further context information.

Zimmermann and colleagues [30] investigated hurdles and problems developers and bug reporters have with bug tracking systems and derived four areas for improvement. For the tool-centric area, they recommend that users should use a tool that supports the users to provide information needed by the developers. This is in line with our findings that sometimes, developers need questions for clarification and further information to understand the feedback. For information-centric improvement, Zimmermann and colleagues recommended the provision of different interfaces to support different experience levels of users when documenting a bug. We believe that this is a good approach, given that the use of diverse channels by end-users could be interpreted that end-users have different needs. For the process-centric area, the authors recommended providing feedback on end-users' bug reports to keep them motivated. This recommendation is in line with the results of our case study. Finally, they recommended rewards and reputations as motivation factors for users reporting bugs (user-centric area). In our study, we did not explicitly ask for these motivation elements but also believe that these are promising mechanisms if they fit the end-users needs (see also [12]).

Heiskari and colleagues [31] conducted a case study to understand how software companies involve their end-users. A key finding was that more user information and even interactions with the end-users are needed. This finding is also supported by our case study and partly supported by our survey results.

Presently, only a few other studies have been exploring motivation factors [13][32][33], hurdles (e.g., privacy issues [12]), and end-users' different needs and preferences when providing feedback [12].

V. Conclusion and Next Steps

Research has shown that end-user feedback can be a valuable source for requirements engineering as feedback communication channels allow end-users to report on feature request and shortcomings (e.g., [6][7][8][9]).

However, there is a lack of knowledge of how software companies can set up an environment for feedback gathering in practice. To gain insight into software companies' challenges and needs when operating end-user's feedback communication channels, we conducted a case study with a German software company and an online survey with further 18 software companies from German-speaking countries.

We have shown that the number of feedback communication channels varies between software companies whereas only some feedback channels are often used by end-users; it seems that a bilateral communication with the software company is preferred compared to a public communication, for example, in social networks. Moreover, in some companies, end-users are not motivated to communicate feedback or hurdles to provide feedback might exist, for example, a time-consuming communication. Although most companies stated that the feedback they receive from their end-users is relevant for software evolution, in several cases, feedback communication channels do not fit the needs of the software company. This includes an adequate quality and quantity of feedback received as well as sufficient information to understand the feedback. Initial solution ideas include combining monitoring data with feedback and asking other end-users for support, e.g., prioritizing feedback [29].

Also considering related work [26][30][31], we conclude that in several cases, software companies still do not fully exploit the potential of feedback gathering for software development and evolution – although research and industry provide solution ideas for feedback gathering and analysis.

This calls for an in-depth analysis on which feedback communication channels provide the most valuable data for requirements engineering. How often does feedback influence requirements and does this depend on the feedback communication channel? For example, can companies derive more requirements from feedback communicated with a dedicated feedback tool versus a contact form? For this, the characteristics of the feedback channels should be varied to evaluate the effect on feedback quantity and quality. In addition, future work should continue to investigate the feedback sender perspective. It is still unclear how end-users could be best supported and motivated to communicate feedback.

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