How do Practitioners Perceive the Relevance of Requirements Engineering Research? An Ongoing Study

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***Abstract*— The relevance of Requirements Engineering (RE) research to practitioners is a prerequisite for problem-driven research in the area and key for a long-term dissemination of research results to everyday practice. To understand better how industry practitioners perceive the practical relevance of RE research, we have initiated the RE-Pract project, an international collaboration conducting an empirical study. This project opts for a replication of previous work done in two different domains and relies on survey research. To this end, we have designed a survey to be sent to several hundred industry practitioners at various companies around the world and ask them to rate their perceived practical relevance of the research described in a sample of 418 RE papers published between 2010 and 2015 at the RE, ICSE, FSE, ESEC/FSE, ESEM and REFSQ conferences. In this paper, we summarize our research protocol and present the current status of our study and the planned future steps.**

***Index Terms*—Requirements Engineering, Empirical Study, Survey, Online Questionnaire.**

I. Introduction

High-quality Requirements Engineering (RE) directly contributes to appropriateness and cost-effectiveness in the development of a system [6] whereby RE is a determinant of productivity and (product) quality [7]. Yet, RE remains inherently complex due to the various influences in industrial environments rendering the choice of adequate processes, methods, and tools dependent on the needs and particularities of the practical contexts as in no other software engineering discipline. This makes it impossible to standardize RE via holistic and universal solutions.

Over the last years, we have observed an active research community arise and propose a plethora of promising contributions to RE. However, we still know very little about the practical impact of those contributions or whether they are in tune with the practical problems they intend to address [8]. In fact, there still seems to be often a gap between research and current practice [3]. It was, to our knowledge, first discussed in 2000 at panels during the 12th International Conference on Advanced Information Systems Engineering (CAiSE) and the 4th International Conference on Requirements Engineering (ICRE), and then later summarized by Kaindl et al. [9]. Recent panels at the International Requirements Engineering Conference on obstacles for technology transfer into practice as well as ongoing debates (as recent as in the last edition of the Working Conference on Requirements Engineering: Foundations for Software Quality –REFSQ 2017, following the keynote by Lionel Briand) on the extent to which RE research and practice are detached from each other highlight the need for a radical change in the community [10] and indicate, at least, to its still existing perception in academia. Without any prejudice, this raises the following questions: is academic research in RE perceived as relevant to practitioners, and how can scholars make RE research (even more) relevant?

Motivated by a similar line of thoughts, Lo et al. [1] performed a study to assess how practitioners at Microsoft perceive the relevance of software engineering papers published at ICSE, ESEC/FSE and FSE from 2009 to 2014. This study was then replicated by Carver et al. [2], based on a broader population of practitioners at various companies, to understand the relevance of research published at ESEM to practitioners covering the ESEM papers published between 2011- 2015. In this joint work, we now plan to conduct the second replication for the RE community to understand whether research in RE and practitioners' needs are disconnected.

In this paper, we summarize our research protocol and present the status of our study and the planned future steps. The rest of the paper is organized as follows. In Section II, we state the objective of the study and then elaborate our research questions. In Section III, we introduce the context of the study. In Section IV, we elaborate on the study plan and discuss the threats to validity in Section V, before concluding the paper in Section VI.

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II. Objective of the Study

The primary goal of our RE-Pract project is to investigate the overall practitioners' perception of the practical relevance of currently published research in the RE field. To achieve this goal, we define five research questions (RQs). The first four ones are in tune with the previous studies by Lo et al. [1] and Carver at al. [2], which form the basis for our replication. The last RQ is a new one emerging from the particularities of RE as an interconnected discipline.

The first RQ forms the central one opting for understanding the general perception of the practical relevance as perceived by practitioners from industry.

RQ1: What is the relevance of RE research to practitioners in the industry?

This first RQ builds the core of our investigation, yet we naturally aim at gathering further details that help us provide a broader and more detailed picture of practitioners' perceptions. To this end, we add further RQs. Beyond others, we expect that the practitioners' perception of the importance of research is also influenced by the topics addressed rather than based on the particularities of the individual papers only. Therefore, the next RQ is:

RQ2: What are the most highly rated research ideas?

As our assumption is that there is often a gap between the focus of academic research and the needs of practitioners, the third research question seeks to bridge this gap:

RQ3: What research problems do practitioners think are most important to be focused on by the RE research community?

Next, we are interested to know if direct links to papers to the industry have an influence on such perception. These links may have two non-exclusive manifestations: (i) one or more authors of the paper pertain to industry (often through the research arm of an organization); (ii) the paper has been submitted to an industry track (when the conference has such):

RQ4: Do papers with explicit ties to industry have higher practical relevance than other papers?

Finally, to get a more differentiated view on the overall perception, we are interested in the practitioners' views regarding the dependence on their roles in the company. We believe this is important to RE given that the discipline (and its outcome) is centered on various potentially differing needs and expectations of the different stakeholders involved and, thus, want to know:

RQ5: Do practitioners' perceptions and views differ in dependence on their roles?

III. Context of the Study

A. Background

The RE-Pract project was a joint initiative of the first two authors of this paper (Franch and Méndez Fernández) after attending a keynote given by the last author (Zimmermann) at the 9th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM 2015) held in Sept. 2015 in Beijing, China. As part of the keynote, Zimmermann reported the study published in ESEC/FSE 2015 [1] and conducted by Lo (Singapore Management University), Nagappan and himself (Microsoft Research) to understand practitioners' perception of the relevance of software engineering research in general. The study was based on rating a random sample of the research published in 571 papers at the ICSE, ESEC/FSE, and FSE conferences in the period of 2010-2014. Overall, they gathered 17,913 ratings by 512 practitioners from Microsoft. Findings were organized around three research questions: 1) how do (Microsoft) practitioners view software engineering research as a whole?, 2) what research ideas do (Microsoft) practitioners consider to be most important? and 3) why do (Microsoft) practitioners view some research ideas as unwise? A high number of the respondents, 71%, provided overall positive ratings.

This ESEM 2015 keynote rose a high interest in the audience and formed the seed for so far two independent follow-up studies. The first study was conducted by Carver et al. [2] and focused on the empirical software engineering community. The main drivers of the replication were two further authors of the paper at hands (Carver and Dieste) in collaboration with a third author from industry (Kraft from ABB Corporate Research) and other two authors of the initial study (Lo and Zimmermann). The resulting study was published at ESEM 2016 [2] and gathered 9,941 ratings by 437 practitioners from a random sample of overall 156 papers published at the ESEM conference between 2011 and 2015. The overall percentage of positive ratings was close to the former one, namely 67%.

The second replication is the current paper at hands. Shortly after ESEM 2015, the first configuration of the team (seven first authors plus last author of this paper) was completed and started working shortly after. When getting awareness of the first replication [2], its first two authors, Carver and Dieste, were invited to join the team, leading to the final team of authors.

B. Issues, Pitfalls, and Mitigations

The first two authors have initiated international collaborations around RE topics involving various contributors from various countries before. One to be named is the NFR4MDD initiative (Non-Functional Requirements for Model-Driven Development[1] [4]) initiated by the first author to investigate the adoption of non-functional requirements in the context of model-driven development in industrial settings. The second to be named is the NaPiRE initiative (Naming the Pain in Requirements Engineering[2]) initiated by the second author forming a collaboration with currently more than 50 researchers worldwide and including a bi-yearly replicated family of distributed surveys investigating the current state of RE practices and problems encountered therein. Both projects are different in the topics addressed and the research methods applied, but they are comparable to each other and to the study at hand from the perspective of potential issues and pitfalls. In addition, the inclusion in the team of authors of the former baseline studies [1][2] should help to anticipate and mitigate

[1]http://www.essi.upc.edu/~gessi/NFR4MDD/index.html

[2]http://www.re-survey.org

possible barriers. Anyhow, we remain aware that we may very well expect further ones to come up with later stages of the study execution, e.g. coming with changes of affiliations.

As it can be expected from a paper with authors coming from eight different affiliations, one first basic issue concerns the overall coordination and decision-making. In our case, the first two authors proposing this initiative are the ones to have taken over the organizational set-up of the project and related organizational tasks (e.g. time schedule proposals, coordination of the communication, or proposals of workload distributions). The first two authors also coordinate any decisions on issues related to the scope and design of the project itself and taken jointly in the team on a majority basis.

Another basic but not minor important issue concerns the establishment of a commonly shared infrastructure. Here, we made a pragmatic decision and set up a shared space in Google Drive to support collaborative editing of documents with good traceability features, and to share the several documents (previous studies, study protocols, etc.) which are needed.

Team members' communication is another challenge in such a project. The time difference between the easternmost and westernmost partners is nine hours, rendering it difficult to set up live team meetings. We created a mailing list as the main communication channel in the project. Together with the shared space, this simple yet effective solution is the primary team communication channel.

Author order is another common issue for larger research teams. We jointly decided in advance to make decisions on a case-by-case basis following the classification of contributing roles for authorship as proposed by Brand et al. [12] and previously adopted in the context of NaPiRE [11]. For this paper, we had three main categories of authors: main contributors driving the overall project and building the core team for the writing, members involved in the preparation of the data collection, i.e. creators of paper summaries for this study (see also the next section), and advisors with experience in the two previous studies and their design. We sorted each category alphabetically. Besides, each paper will describe the responsibilities and work undertaken by each author.

Finally and as mentioned above, further issues might raise along the project execution. At the end of the next section, we briefly discuss currently open issues at this point after introducing the overall study design (planning).

IV. Planning of the Study

The overall goal of the RE-Pract project is to investigate practitioners' perceptions of the practical relevance of today's academic research in RE. Structuring it more precisely and following the Goal Definition Template [5], we want to

- **Analyze** RE academic contributions (research ideas, tools, approaches, methods, and techniques)
- **in order to** characterize
- **with respect to** the perceived practical relevance
- **from the point of view** of Software Engineering practitioners (requirements engineers, architects, testers, etc.) dealing with requirements
- **in the context of** full (published) research papers

The subjective views of practitioners on our research outcomes are dominated by their everyday practice, experiences, beliefs, and personal taste. Therefore, we design our project as a qualitative study relying on survey research. To address a broad population, we opt for online survey research designed as an anonymous survey to lower potential barriers to participation.

The main audience of our research are practitioners working in industrial settings in one form or the other with requirements (ranging from requirements engineers to testers). Their key motivation to participate in our study is, similarly as in the mentioned NaPiRE project, their contribution to increasing the awareness of topics considered important by them. The main audience of our research outcomes is the overall RE research community. Our hope is that the results support ongoing reflections on the practical relevance chosen research topics might have (without any prejudice to the individual judgment of the researcher herself and without judgment about papers where the practical relevance is not and should be not the primary quality attribute).

In the following, we briefly introduce the overall study planning covering subsequent stages:

1. Paper selection and summarization.
2. Participant selection (selection of subject population).
3. Feedback elicitation where we approach practitioners via survey research to let them rate a random sample of paper summaries from the pool gathered in Step 1.
4. Data analysis with respect to the research questions.

In the following, we will elaborate on details while we focus on the first three items.

A. Paper Selection and Summarisation

The first step into the data collection is the selection and preparation of the papers to be rated by practitioners. To this end, we extracted a pool of 418 papers published between 2010 and 2015 at the RE, ICSE, ESEC/FSE (including FSE when held alone), ESEM and REFSQ conferences. As we are aware that early stage solution proposals, such as visionary papers, might not attract the interest of practitioners despite their potential value in the future, we intentionally decided to concentrate on full papers only to not distort the results. We included all full papers for research and industry tracks, even if, for some conferences, industry track papers are required to be shorter compared to research track papers. We thus excluded short, vision, or ongoing research papers regardless of research or industry track. For each paper, we created a short summary of the scope in one sentence. In contrast to the baseline studies [1][2] where the authors of the selected papers provided the paper summaries themselves, we used the original abstracts (and in cases of doubts the paper's body) and created the summaries on our own. The main reason was to control a certain consistency among the provided summaries, to reduce potential influences by the authors' ability to write appealing summaries, and for pragmatic reasons as we deemed it impossible to reach out to all involved authors given the broad spectrum of venues involved. We created our summaries in pairs of researchers. After the summary creation, another pair of researchers then validated the overall outcome.

Each summary has put the main contribution of the paper and potential research type facets [13], such as "solution proposals" or "evaluation" in scope. For instance, for a paper proposing and evaluating a specific requirements elicitation technique, we formulated the summary in the form "An evaluated requirements elicitation technique that [details of the technique]". The summaries for RE and REFSQ were crafted from scratch. For the papers published at ICSE, ESEC/FSE, FSE and ESEM, we excluded from the original pool of papers those not related to RE, then extended the remaining set to cover all RE-related papers published from 2010 to 2015, merged them into one holistic spreadsheet, and revised the summaries to fit the intended structure. Finally, for each paper, we documented (besides the authors' names and abstracts), the venue and year, the authors' ties to industry based on their affiliation (*academic* in case all authors were from academic institutions, *industry* in case all authors were from industry, or *mixed*), and whether it was an industry track submission or not.

B. Participant Selection

As for the participant selection, we chose individual practitioners as the unit of analysis. Those practitioners need to have clear ties to RE in their everyday practice, i.e. their roles and responsibilities include both creating and managing requirements, or working with them in a broader sense (e.g. architects or testers). To select the participants, each of the authors created a list of personal contacts to industry. We followed the same strategy as in the NaPiRE project and opted for an invitation-based survey where we approach individually known practitioners rather than distribution the survey randomly based on, for instance, mailing lists or social media channels for mainly two reasons. First, relying on a list of known contacts gives us the possibility to ensure that the respondents have the necessary background to provide useful answers. Second, inviting known respondents gives us the chance to control the responses and the response rates. Even if the actual responses remain anonymous to lower for potential barriers that might hinder respondents to reveal their real opinions, we believe that an invitation of known practitioners supports us in equally distributing the survey among various companies. That is, we are interested in the views of the individuals free of company-specific valences, which are why we need to distribute equally the survey among various practitioners from multiple companies rather than risking having various practitioners from single companies. The downside we are very aware of is that this might yield lower numbers of participants as in the previous studies [1][2].

C. Feedback Elicitation

Following the design of the baseline studies [1][2], we plan to use an online survey. We will design the survey such that participants require as little effort as possible to complete it; for instance, it will be self-contained and will include all relevant information. We will limit the response types to numerical, Likert-scale, and short free-form answers. As part of the questionnaire, we will elicit feedback in three categories while staying as close as possible with the questions as used in the baseline studies:

Demographics: Collecting this basic information about the participants allows us to break down the results by, e.g., roles (such as developers or testers) or domains.

Ratings of research ideas: We will present a subset of randomly selected paper summaries to each participant (in random order). For each summary, the respondent must rate the research idea following the question "In your opinion, how important are the following pieces of research?". We will provide the same rating categories as used in the baseline studies, i.e. participants can label a research idea as "Essential", "Worthwhile", "Unimportant", "Unwise" or "I Don't Understand". The last category was included to address the diverse background of participants—not all participants will understand all technologies.

Qualitative Feedback: We will additionally ask for two types of qualitative feedback. First, to understand the rationale behind the ratings, we will randomly select two of the summaries the participant rated and ask them to "provide a brief explanation for why you found it either relevant or not to your work." Second, we will give the participants an opportunity to provide guidance to the research community about topics of interest. We will ask them "Suppose that you could provide guidance to a team of RE researchers, what problems should they focus on first?".

D. Current Stage

At the stage of writing this paper, the selection and summarization are completed. The following table illustrates the distribution of the final pool of papers and the ratio of papers with ties to industry have (i.e. papers with at least one co-author having ties to industry and / or industry track papers). As probably anticipated, RE and REFSQ greatly dominate due to their topic.

Venues	Number of papers	Industry ratio
RE	212	32,5%
REFSQ	144	18%
ICSE & ESEC/ FSE	43	23%
ESEM	19	52%

A detailed summary of the papers will be published once the whole data analysis is completed. Currently, we are finalizing the list of individual contacts from industry and the questionnaire. Once the questionnaire is completed, we will implement it as a web application using the *Enterprise Feedback Suite* and pilot it with practitioners.

E. Open Issues

In these initial steps of the study, some issues are currently raising interesting discussions. Most prominently, we are discussing the concept of *industry papers*, which comes with a non-trivial question: When does a paper qualify as an industry paper? So far, we rely on a (not mutually exclusive)

classification via authorship and the track in which papers were presented. In the case of authorship, we classified whether at least one or all authors of papers have industry affiliations, i.e. affiliations to companies or related research units. This, however, is itself a non-trivial decision as many researchers have nowadays multiple affiliations, e.g. researchers working at both a university and a company. Further, the notion of "industry" is fuzzy itself as it is not often clear as what to classify research and transfer institutes bridging the gap between classic companies and, for example, universities (such as Fraunhofer institutes). For the moment, we are therefore collecting the data as separate as possible and with the maximum of information available to us to decide how to aggregate the information at the end and leave options open.

A further open question, which formed an idea discussed in previous baseline studies, yet eventually not realized, is that once practitioners provided feedback, we show them pointers to the papers that they rated highly in the survey site. This could form one additional step in strengthening the ties between researchers and industry participants.

Finally, one still open issue comes along the population source for the industry contacts. We deliberately decided to rely on personal contacts only and not to spread the survey invitation anonymously using available channels (e.g. mailing lists). It also means not to include the contacts at Microsoft as this potentially high number of responses from one company alone might be in strong contrast to the otherwise diverse but smaller number of responses from our contacts lists. However, we are still discussing how to increase the population sample within the limits of our existing constraints.

V. Threats to Validity

As any other empirical study, this project is facing some threats to validity. Some of them are already known, while others may appear later as the study progresses. We briefly report them together with associated mitigation actions, relying on the classification as proposed by Wohlin et al. [5].

A. Internal Validity

Abstract comprehension. We intentionally took the decision of not using the original paper abstracts but instead formulating our own short summary ourselves. Main motivations included avoiding the risk that interviewees found the summaries too long and then withdrawing the questionnaire, and to minimize the role that ill-designed abstracts could have on practitioners' perception. To mitigate this risk, we very precisely defined what such summary must describe, and we included a validation step to harmonize the summaries, which were created by different members of the team.

B. External Validity

Representativeness of papers. We selected a set of venues and a given period as the source of data for our study (2010-2015). We did not include 2016 because we started the work at mid-2016. Concerning venues, we believe that the selected conferences are the world-leading ones when it comes to RE (RE and REFSQ) and software engineering in general (ICSE, ESEC/FSE, FSE, and ESEM). Still, we are aware that including more venues could change our results. In addition, given the scope of conferences aiming at discussing more specific (digestible) results rather than broader research programs as it is more the case for journal papers, we intentionally concentrated on conferences and excluded journals.

Representativeness of respondents. Even though at the moment we do not know yet how many responses we will obtain, and to what extent some companies will be dominant (as it happened with Microsoft in the two previous studies [1][2]), we for sure will need to consider this threat. To mitigate it, we are planning to use as many additional practitioners' network as possible. In the field of RE, we have some resources that worth to consider: the NaPiRE database, the IREB magazine which is well-known by European RE practitioners, but over and above all our own networks (and some of the paper authors have ample networks), and we are plan to involve some RE practitioners who may be especially sensible to this issue (e.g., because they are usual attendees of the RE conference).

C. Conclusion Validity

The meaning of "perception". This study focuses on the *perception* of the relevance published research papers have from the perspective of practitioners. Please note that it is not our intention nor do we pretend, to over claim the observations gathered in the study. For instance, we will not claim that well-ranked papers or areas will be most likely adopted by practitioners, or will have a higher impact than others. Besides, we are aware that a relevant problem may not be addressed in a relevant way. In fact, we are very much aware of that the practical relevance can eventually only be judged after the fact based on the extent to which, e.g., technologies have been adopted or not. However, our position is that the results of the study can provide a good first indicator of such impact. Over and above all, it serves to foster discussions on important aspects in our field given the practical scope many contributions have.

Replicability. One major prerequisite for replicability (and more generally reproducibility) is the openness of the study design as well as the data obtained. Therefore, once the study is finalized, the protocol and all the related material used to perform this study will be made available under CC-BY license. Furthermore, we plan to disclose all data obtained to an open repository for other researchers to use. The open character of our project will support researchers and practitioners to replicate this study and, in the long run, to better generalize further from the results.

D. Construct Validity

Methodology robustness. The robustness of a methodology depends on many (non-trivial) factors, and many threats may arise already during the planning phase. For instance, the protocol may be incomplete; it may lack necessary details or even contain flaws with respect to the data analysis. Furthermore, the research questions may be incomplete or the questionnaire insufficient to answer the research questions. As a mitigation to this threat, we stay as close as possible to the original studies for which our study at hands builds the replication. Furthermore, the research protocol has been

discussed in advance among all authors of this paper, which also worked on the previous studies. For the sake of transparency and as a means of quality control, we will further disclose all the data including the detailed protocol, and we finally plan for a validation phase for the survey, which shall also include a pilot of the analysis methods planned. It shall allow to, at least, control and tackle the most severe issues in advance and the application of corrective measures before sending out the survey.

VI. Conclusions

In this paper, we have reported on the planning and current status of an ongoing empirical study to gauge the perception of practitioners about published research in the RE field. This study may benefit several stakeholders: for researchers looking for transferability of their results, it may indicate to areas of future research (or fine-tune the ones currently in their scope of investigation); for practitioners, it may help to discover lines of current research that could eventually be interesting to them, but it provides them also with the possibility to add their own views and flavours; for conference organisers, it may help to assess the topics that they offer to the community.

In the context of our study, this paper represents a milestone for us. First, we aligned the deadline with the finalization of an important activity, namely the completion of the abstract summaries. The paper became a motivating instrument to speed up in the finalization of this activity. Next, the organization of the team has improved given the need of collaborating to finalize this paper on time and in some sense, it has become a proof of concept for the way of working for the rest of the study. Last, we acquired relevant feedback from the paper reviewers for improving our protocol promptly. Once at the conference, the presentation itself would provide an excellent opportunity to share our first impressions on the ongoing analysis and raise awareness of the study.

As mentioned already, this is the third study of its kind with a very similar protocol. We plan to compare our results with these two studies and start to identify trends. Since the protocol will be disclosed to the public, we cordially encourage other researchers to replicate it for other areas (software architecture, testing, etc.) to get a deeper understanding of the (perceived) practical relevance of software engineering in general.

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