

The Role of Rapid Reviews in Supporting Decision-Making in Software Engineering Practice

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ABSTRACT

Context: Recent work on Evidence Based Software Engineering (EBSE) suggests that systematic reviews lack connection with Software Engineering (SE) practice. In Evidence Based Medicine there is a growing initiative to address this kind of problem, in particular through what has been named as Rapid Reviews (RRs). They are adaptations of regular systematic reviews made to fit practitioners constraints.

Goal: Evaluate the perceptions from SE practitioners on the use of Rapid Reviews to support decision-making in SE practice.

Method: We conducted an Action Research to evaluate RRs insertion in a real-world software development project.

Results: Our results show that practitioners are rater positive about Rapid Reviews. They reported to have learned new concepts, reduced time and cost of decision-making, improved their understanding about the problem their facing, among other benefits. Additionally, two months after the introduction of the Rapid Review, in a follow up visit, we perceived that the practitioners have indeed adopted the evidence provided.

Conclusions: Based on the positive results we obtained with this study, and the experiences reported in medicine, we believe RRs could play an important role towards knowledge transfer and decision-making support in SE practice.

CCS CONCEPTS

• General and reference → Empirical studies;

KEYWORDS

Rapid Reviews; Systematic Reviews; Support Decision-Making; Evidence Based Software Engineering

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1 INTRODUCTION

More than ten years have passed since Kitchenham *et al.* introduced the concept of Evidence Based Software Engineering (EBSE), inspired by the promising results of Evidence Based Medicine (EBM) [44]. According to them, the main goal of EBSE is “to provide the means by which current best evidence from research can be integrated with practical experience” [44]. However, recent evidence suggest a lack of connection between the evidence produced by systematic reviews and the needs of Software Engineering (SE) practice [14, 36, 62]. The EBM community also faced similar problems in its early days and it is still facing in some extent [10, 68, 70]. One of the most successful initiatives to mitigate that problem in EBM is what was called as *Rapid Reviews* (RRs) [68]. Rapid Reviews are aimed to deliver evidence in a timely manner with lower costs. To achieve this goal, Rapid Reviews should emerge from a practical problem, report the results through mediums more appealing to practitioners, and omit/simplify some steps of Full Systematic Reviews (FSRs)¹. For instance, Rapid Reviews limit the literature search, use just one person to screen studies, do not conduct quality appraisal, or present results with no formal synthesis [68]. As a shortcoming, it lowers the validity of the results. More details about Rapid Reviews can be found in Section 2. It is important to note that, by any means, Rapid Reviews were not conceived to replace Full Systematic Reviews. Instead, both can and should coexist. While Full Systematic Reviews are important to provide in-depth insights, Rapid Reviews are important to easily and quickly transfer established knowledge to practice.

In spite of the increasing interest on the adoption of RRs on health-related fields[68–70], there is no single report on the usage of RRs in the context of SE practice. This is unfortunate for at least two important reasons: 1) software engineers are not used to consume software engineering research, in general [48], and systematic reviews, in particular [15], and, as a consequence, 2) software engineers still rely on expert opinion when making decisions [59]. Therefore, RRs can play a pivotal role on the adoption of research evidence into SE practice, as we recently shown when proposing a knowledge transfer model [1]. More specifically, the question we are trying to answer with this research is:

RQ: What are practitioners’ perception on using Rapid Reviews to support informed decision-making in software engineering practice?

¹For the purposes of this study, we consider any kind of secondary study (e.g., mapping studies, meta-analysis, or even the traditional systematic literature reviews) as full systematic reviews

This paper. This paper reports the first introduction of a Rapid Review in a Software Engineering setting. We conducted a Rapid Review in a software company based in Recife, Brazil. To assess the role that the Rapid Review played, we conducted an Action Research [66] in close collaboration with practitioners. Action research is an empirical method that should take place in close connection with practice aiming to address a research problem in an organization [23, 25]. We conducted several interviews during the course of the Action Research. In the first interview with the company's representatives, we observed that the main problem they were facing was to find a way to deal with low customer collaboration in one of their projects. Thus, we proposed as action the conduction of a Rapid Review on this topic. After selecting 17 primary studies, we summarized and presented the findings in a workshop, and printed as an Evidence Briefing [15]. During the workshop, we conducted our second interview, which was aimed at understanding the practitioners perception about the Rapid Review. Practitioners perceive many benefits regarding the Rapid Review, such as the novelty of the approach, the applicability to their problem, and the reliability of the content. As a shortcoming, they found that some findings were not clear in the printed form — although they became clearer after discussing with researchers during the workshop. Finally, two months after the introduction of the Rapid Review, we conducted the third interview to assess whether practitioners employed some of the evidence presented with the Rapid Review. Fortunately, practitioners adopted some of the findings in their daily work habits, although some findings that were initially thought as useful were not implemented in practice.

In summary, the main **contributions** of this research are:

- We **proposed** Rapid Reviews as a way to transfer knowledge from research to SE practice, contributing towards EBSE's main goal;
- We **evaluated** the applicability and practitioners' perceptions on Rapid Reviews through an action research in a real-world environment;
- We **discussed** results and implications of this study for researchers and practitioners.

2 BACKGROUND ON RAPID REVIEWS

Although RRs are not well-known in SE, they are facing a growing interest in health-related fields. Tricco et al. [68] mapped 100 RRs published between 1997 and 2013, and observed that 56% of them were published on the last five years of investigation. Additionally, major medicine venues, such as the prestigious Systematic Reviews journal, are officially recognizing RRs as one Evidence Based Practice (EBP) method [55]. Moreover, Cochrane — a global renowned group of researchers and practitioners specialized in evidence diffusion in health-care — announced in 2016 a group² to play a leading role guiding the production of RRs [31]. Even the World Health Organization (WHO) has recently published a guide presenting the importance of RRs [70].

The emerging character of RRs can be explained in terms of its benefits. For instance, a study observed that RRs saved approximately \$ 3 millions when implemented in a hospital [51]. Moreover, survey exploring the use of 15 RRs revealed that 53% were used

to directly apply their results to support decision-making in practice [33]. Additionally, Lawani et al. reported that RRs enabled the development of clinical tools more rapidly than with FSRs [46]. Taylor-Phillips et al. reported to have read 2,176 fewer title/abstracts and 129 fewer full texts when performing a RR [67]. Other studies have also demonstrated positive impact of RRs in practice [7, 34, 68, 75].

2.1 Characteristics

RRs are lightweight secondary studies focused on delivering evidence to practitioners in a timely manner [35, 68]. Some steps of FSRs are deliberately omitted or simplified in RRs to achieve their proposed goal. Rapid Reviews have core characteristics [68]:

- It reduces the costs of heavyweight methods (§ 2.2);
- It delivers evidence in a timely manner (§ 2.2);
- It operates in a close collaboration with practitioners (§ 2.3);
- It reports results through appealing mediums (§ 2.4).

Furthermore, one should not confuse RRs with informal literature reviews [57]. RRs follow systematic protocols, although some methodological decisions aiming to deliver evidence in less time might introduce bias. The informal literature reviews, on the other side, do not have even a systematic protocol, being conducted ad-hoc. Moreover, RRs is strongly oriented to practice, which is not necessarily the case with informal literature reviews.

2.2 Timely Evidence and Reduced costs

Many strategies have been used, in health-related fields, to reduce costs and time, such as: (1) limiting search strategy by date of publication and/or search source; (2) using just one person to screen studies; (3) do not conduct quality appraisal of primary studies; (4) or presenting results with no formal synthesis [68, 69]. We discuss our lightweight method in details at Section 4.

2.3 Collaboration with practitioners

The argument to have more lightweight secondary studies like RRs holds only if time and costs are hard constraints. This kind of scenario is typically observed in the practice of many fields. Therefore, RRs are only conceived to be conducted bounded by a practical problem, inside a practical context. As a consequence, practitioners should be willing to devote part of their busy schedule to the implementation of the Rapid Review.

Examples of that intrinsic characteristic can be observed in RRs on Health-related fields. They are conducted with a practical problem as premise. For instance, the work of Best et al. that described their experience conducting 63 RRs for decision-making through the Development and Evaluation Committee in the UK [10]. Or the Bamba's et al. study, that described their experience conducting nine RRs for the Secretary of State for Health [5]. Or even the research of Jahangirian et al., that discusses the experience of conducting five RRs for the Research into Global Healthcare Tools consortium [38]. As we shall see in Section 3.2, practitioners collaboration is crucial to RR thrive.

²<http://methods.cochrane.org/rapidreviews/>

2.4 Appealing Mediums

One important aspect of RRs is the way they are reported. Many authors argue that alternative mediums should be used, instead of traditional research papers format [8, 15, 32]. To substantiate this claim, Tricco [68] observed that, although RRs present several variations on their methods and terminologies, 78% of them present results as a narrative summary reported in mediums that better fit practitioners' needs. Examples of alternative mediums include: the Contextual Summaries of Young et al. [73], that limits the report to a one-page document; the Briefings presented by Chambers and Wilson [17], that summarize the main findings of a systematic review in one section; or even the Evidence Summaries by Khangura et al. [42], which use an informative box separated from the main text to highlight the audience and nature of the report.

In the context of software engineering, there are few studies proposing alternative mediums. Cartaxo's et al. proposes and evaluates the use of one page-documents to report FSRs [15]. Storey et al. proposed Visual Abstracts to increase practitioners appealing toward scientific evidence [65]. In our work, Evidence Briefings are used to report the results of our RR, as we shall discuss in Section 4.7.

3 ACTION RESEARCH PROTOCOL

Action research is a flexible research method well-suitable to support evidence-based practices [11, 20, 26] and knowledge transfer initiatives [28]. We decided to conduct an action research to evaluate the applicability of Rapid Reviews because, differently from case studies [6] or ethnography studies [64], we were not observing an environment without disturbing it. In fact, we introduced a RR to deliberately change the way practitioners used to make decisions. Together with them, we provided evidence that could support practitioners towards solutions to the problem they are facing. Case studies, however, are usually concerned to augment scientific knowledge, but not necessarily with a direct impact in practice [6]. Consultancy activities, on the other hand, tends to diagnose or solve practitioners problem with few preoccupation to contribute with scientific knowledge [6].

3.1 Research Context

Here we present the context where the action research was conducted, thought the following elements:

The company: We conducted this study with an applied-research institute in Brazil. The mission of the institute is to “increase Brazilian industry competitiveness” providing services such as software development, applied research, and consultancy. The institute was founded in 2013, and currently has 16 innovation projects under development. The institute has 21 employees.

The project: We first contacted the projects coordinator, who is responsible for coordinating all project managers. After presenting the goal of this research, a project manager joined us and discussed problems regarding low customer collaboration that he was facing in one of his projects. Besides the project manager, this project has three software developers and one designer. The project started in August 2016 aiming to develop a system that monitors reusable packages during the entire production chain — from suppliers to factories — of the automotive industry. In this context, there are

packages more expensive than the object they carry. Eventually, one of those packages get lost, which provokes high monetary losses. Hereafter, we refer this project as “Project X”.

The participants: The projects coordinator has about 15 years of experience in software development and holds a master degree in computer science. The project manager has about 2.5 years managing software development projects and also holds a master degree in computer science. Hereafter, we refer to them as “the participants”. The researcher who conducted this study together with the practitioners is a PhD candidate. Two professors supervised the entire study giving suggestions and feedbacks.

3.2 Research Steps

We followed the guidelines to conduct an action research [22], which encompass five main steps, namely: diagnosis, planning, intervention, evaluation, and reflection.

3.2.1 Diagnosis: This step intends to explore and define the problem the participants are facing in their environment [22]. To identify the participants' problem, we conducted a semi-structured face-to-face interview. The interview was divided in four parts:

- (1) We explained the purpose of this study;
- (2) We asked questions regarding Project X's background (e.g., an overview of the project and the characteristics of the development team);
- (3) We asked questions regarding the challenges faced according to each SE area, as defined by SWEBOK;
- (4) We ended the interview asking whether the participant had additional comments that were not covered by the previous questions.

The complete interview script is available online³. The interview was recorded and lasted ~1h15min. Audio was transcribed. The development team reported problems regarding customer collaboration. During the interview, the project manager stated that “*this [low customer collaboration] is the most critical issue of that project*”. The participants also affirm that “*emails requesting clarification about requirements take one or two weeks for customer to reply*”. The team uses agile methodologies, which consider customer collaboration as crucial. Based on the interview, and together with the participants, we defined that the practical problem that would guiding the action research should be: *find evidence about strategies to improve customer collaboration* so the participants can use it to support their decision-making.

3.2.2 Planning: During this step, we decided to conduct a RR to provide empirical evidence to the participants. Therefore, we built the RR's protocol in close collaboration with the participants (see Section 4 for details). We also agreed with a deadline to finish the RR and present the findings to the participants in a workshop. RR's execution was planned to last one week with one researcher dedicated full-time. Each aspect of RR's protocol was discussed with the participants (e.g. research questions to guide the RR, primary studies' inclusion/exclusion criteria, etc). Online channels such as Skype and e-mail were frequently used during this step.

³The diagnosis interview script can be found at <http://bit.ly/2swjoKH>

3.2.3 Intervention: This step performs the planning phase. We also executed the RR's protocol in close collaboration with the participants through online channels (e.g., during the selection procedure we showed to practitioners the title and abstract of primary studies that we were in doubt whether to include or not). After conclude the RR, we had a face-to-face workshop with the participants to present the entire RR process⁴. We discussed the evidence found, as well as how they can take advantage of that evidence on their job. The RR lasted six days, considering it started on the diagnosis interview, and ended on the workshop to present the results.

3.2.4 Evaluation: To evaluate the participants' perceptions about the RR, we conducted and transcribed two semi-structured interviews. The first⁵, during the workshop that reported the results of the Rapid Review. It lasted ~45 minutes. The results are presented in Section 5. The second interview⁶ was conducted about two months after we introduced the RR. It enabled us to evaluate whether the knowledge introduced with the RR was in fact adopted by the participants. The second interview was also recorded and transcribed. It lasted ~21 minutes. The results are presented in Section 6.

3.2.5 Reflection: According to Santos and Travassos, the reflection step involves the dissemination of acquired knowledge among participants and other organizations [22]. Our reflections and reasoning about the experience of conducting this first RR in SE can be found in Sections 7 and 7.3.

3.3 Limitations and Threats to Validity

Stringer [66] suggests that to establish valid action research, it is important to assess the following attributes of the study:

Credibility: The participants' commitment can only be reached if they trust in the integrity of the research process. During this study we maintained close connection with practitioners, discussing every aspect of the study with them, which stimulate their engagement.

Transferability: Unlike experimental studies, action research results cannot be fully generalized to contexts out of the research. It does not mean that this study cannot be applied in a different setting. We detailed each method step and provided access to all materials we have used. This could encourage researchers and practitioners alike to conduct/replicate similar investigations.

Confirmability: Researchers must be able to confirm that the procedures described actually took place. We provided the scripts of all face-to-face interviews, as well as spreadsheets with all the material we have used to conduct the RR. This exposes our study to full scrutiny by other researchers judgment.

An important limitation on the results of the action research we conducted is that we evaluated the perceptions of the participants, but not the effects of using RRs directly. This means if they affirm that the RR's finding solved or attenuated their problem, it is their perceptions, but not necessarily the truth. However, the focus of this research is on the perceptions of practitioners, not in direct observations, because RRs are new in SE research community, and measuring the perceptions of the stakeholders are important to discover the probability of adoption of such new approach. According

to Rogers [61], the perception of individuals about an initiative is one of the main predictors of its adoption. In addition, the interviews were conducted with all participants together, which might be a threat to validity. We could not interview each participant separated due to the limited time they have conceded.

4 RAPID REVIEW PROTOCOL

This section presents the Rapid Review's protocol defined together with the participants. The threats to validity and limitations provoked by the strategies we used to reduce the time to conduct this Rapid review are discussed in Section 4.8.

4.1 The Practitioners' Problem

Previous studies revealed that about 75% of FSRs' authors in SE were motivated by academic purposes only [62]. Thus, few FSRs are in fact motivated by an actual problem faced in practice, or under practitioners restrictions. This RR is an exception to this trend. Practitioners reported problems related to *low customer collaboration*. They would like to have access to evidence that could improve their relationship with the customer and, consequently, mitigate this problem.

4.2 Research Questions

Together with the participants, we formulated the following research questions to guide the RR:

- RQ1:** What are the benefits of customer collaboration in software development practice?
- RQ2:** What are the problems caused by low customer collaboration in the software development practice?
- RQ3:** What are the challenges to establish customer collaboration in software development practice?
- RQ4:** What are the strategies to improve customer collaboration in software development practice?

The first two RQs are intended to provide evidence about the benefits of adequate customer collaboration. As a consequence, the participants can have better arguments to convince their customer to increase collaboration. RQ3 seeks for a better understanding of the challenges that hinder customer collaboration in order to mitigate this problem. Finally, RQ4 is intended to provide evidence about strategies to mitigate low customer collaboration.

4.3 Search Strategy

To abbreviate the search for primary studies, and conduct the RR under the agreed time frame, we used only Scopus⁷ search engine. It searches in many of the most relevant SE digital libraries. We tested many different versions of the search string until we found a set that returned relevant papers. Before conducting the search, we present the possible search string to practitioners, and through a feedback loop with them, we refined and defined the following search string:

⁴The workshop presentation can be found at <http://bit.ly/2s1exh5>

⁵The first evaluation interview script can be found at <http://bit.ly/2t10XhX>

⁶The second evaluation interview script can be found at <http://bit.ly/2DHaXDm>

⁷<https://www.scopus.com>

(customer OR “product owner” OR stakeholder) AND (collaborat* OR participat* OR cooperat* OR relation* OR involvement OR engagement) AND (“software development” OR “software engineering” OR “software project”)

4.4 Selection Procedure

After discussing with the participants, the selection procedure was based on the following criteria:

- (1) The study must be in the context of software engineering;
- (2) The study must be a primary study (i.e. we do not consider secondary);
- (3) The study must present evidence based on scientific empirical methods (e.g., interviews, surveys, case studies, etc). Propositional or anecdotal studies were not considered;
- (4) The study must provide answers to at least one of the rapid review’s research questions.

Regarding the criterion (2), we decided to exclude secondary studies aiming to produce a pure RR, based only in primary evidence. This enables a comparison between this RR and FSRs in the future. Otherwise, our RR results would include findings extracted and synthesized using FSRs methods, which would be certainly an unfair comparison.

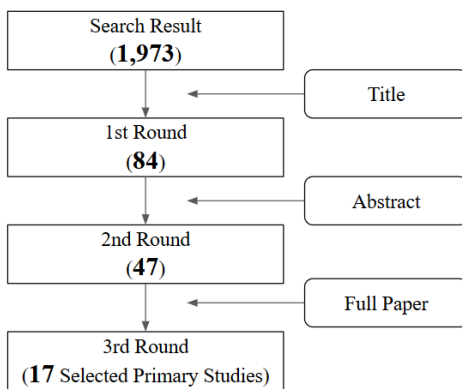


Figure 1: Selection Procedure Results

Figure 1 depicts the selection procedure results. The search in Scopus returned 1,973 studies. In the first round, a solo researcher analyzed the studies’ titles and excluded those that clearly did not meet the criteria, resulting in 84 studies. Although the wild-cards used in the search string might provoked high number of false-positives, we kept them to have a more comprehensive search. In the second round, a solo researcher analyzed the studies’ abstract, reducing the number of studies to 47. In the third round, a solo researcher analyzed the entire papers content and excluded those that could not answer any of the research questions. Thus, we ended up with 17 selected primary studies, as shown in Table 1. The selection procedure is available online⁸.

Selection in pairs was not considered due the participants’ time and resource constraints. The selection procedure was also conducted in close collaboration with the participants. For instance,

⁸The selection procedure is available at <http://bit.ly/2su8xC8>

Table 1: Selected Primary Studies.

REF.	PAPER TITLE
[63]	Towards Customer-Centric Software Development: A Multiple-Case Study
[12]	How Stakeholders’ Commitment May Affect the Success of Requirements Elicitation
[39]	The connection of the stakeholder cooperation intensity and team agility in software development
[50]	A competency model for customer representatives in agile software development projects
[19]	Customer involvement in service production, delivery and quality: the challenges and opportunities
[4]	A comparative case study on clients participation in a ‘traditional’ and in an Agile software company
[54]	Engaging stakeholders with agent-oriented requirements modelling
[45]	A case study of customer communication in globally distributed software product development
[60]	Collaboration, communication and co-ordination in agile software development practice
[37]	Agile undercover: When customers don’t collaborate
[47]	A prototype tool to support extended team collaboration in agile project feature management
[49]	Relationship Research Between Communication Activities and Success Indexes in Small and Medium Software Projects
[40]	Customer involvement in requirements management: lessons from mass market software development
[3]	Mutual development: A case study in customer-initiated software product development
[58]	The impact of agile practices on communication in software development
[56]	The relationship between customer collaboration and software project overruns
[41]	Customer-developer links in software development

we showed to practitioners the title and abstract of primary studies that we were in doubt whether to include or not.

4.5 Extraction Procedure

In this step, we extracted all relevant findings that could help to answer any of the research questions. The extraction was also conducted by a solo researcher, as was the selection procedure.

4.6 Synthesis Procedure

Usually, RRs perform just a narrative summary to synthesize evidence aiming to reduce time/effort. However, we decided to conduct a formal *Thematic Analysis* because the number of selected primary studies was not high. We followed the phases of thematic analysis, as presented by Fereday and Cochrane [27].

- (1) **Familiarization with data:** At this phase, we analyzed each selected primary study. When a study introduced new concepts, we searched on the literature to better familiarize with them.

- (2) **Creating initial codes:** Here we gave a code for each finding of the primary studies. These codes summarize the core of each finding. For instance, the finding “[...] participants expressed their frustration over not being able to choose the customer reps [...] It is not enough to have a customer rep for the project, it is also important for that rep to be effective in providing requirements and feedback to the team”, from the study of Hoda et al. [37] was coded as *Ineffective customer representative*.
- (3) **Searching for themes:** In this step, we already had a list of initial themes (e.g., *Lack of commitment*, as a challenge to establish customer collaboration), but we begin to focus on broader patterns in the data, combining coded data with proposed themes.
- (4) **Reviewing themes:** Here we have a potential set of themes. We then searched for data that supports or refutes our themes. For instance, we initially themed the finding “*the role of customer is rarely taken by the ideal individual, and the individual circumstances of that person affects the nature of collaboration and communication. For example, how much authority the customer has in making decisions; how much knowledge of the domain the customer has [...]*” from the study of Robinson et al. [60] as “*The customer representative is rarely ideal*”. However, we later realized that this finding would fit as “*Ineffective customer representative*”, so we merged the two themes.
- (5) **Producing the final report:** This process leads to the themes that composed the final report of the RR.

4.7 Rapid Review Report

To make the RR more appealing to practitioners, we reported its result through an Evidence Briefing [15]. It is an one-page document that presents only the main findings of a research. Figure 2 shows the Evidence Briefing we created to report the RR. The Evidence Briefing document is also available online at <https://bit.ly/2ImwxP1>.

4.8 Limitations and Threats to Validity

RRs usually present more threats to validity than FSRs due to its lightweight methodology. Some of the threats and limitations of this RR include: (1) Only one search engine was used, which may limited the number of primary studies found; (2) The entire selection procedure was conducted by a solo researcher, which may introduce selection bias; (3) We did not conduct quality assessment on the selected primary studies. This might limit the reliability on the evidence we have found; (4) the selection of papers by title consists in another threat; (5) The RR was presented to practitioners through an Evidence Briefing. Because it is an one-page document focused only on the findings, no information about RR’s method was presented; (6) The participants have master degree in computer science, and work in an applied-research institute. So they may consume more scientific evidence than practitioners working in a regular development company. This may make the participants more positive about the RR we conducted. Finally, due to its method variability, one might argue that RRs might introduce biased results. Although conflicting results have been reported [71], different authors found similar results when comparing RRs and



Figure 2: Evidence Briefing reporting the findings of the Rapid Review.

FSRs [10, 18, 67]. Moreover, RRs should be seen as a complementary method, which are more suitable to be performed in practice, and not a substitute for FSRs.

5 ACTION RESEARCH RESULTS: INTRODUCING THE RAPID REVIEW

In this section, we present the participants’ perception regarding the introduction of the RR. Their perceptions were obtained through an interview (Section 3.2.4). It was conducted in Portuguese, thus all quotes are free translations. Since the results of the RR are not the main goal of this research, we decided to omit them in this paper and make it more concise. Nevertheless, the Evidence Briefing we created to report the results of the RR is available online, as we already mentioned in Section 4.7.

5.1 Benefits of the Rapid Review

Applicable to software engineering practice: The participants considered that the rapid review is applicable to software engineering practice. To illustrate, the project manager mentioned that “[rapid review] is very applicable, specially to institutes that conduct applied research in collaboration with industry [...] but I [the project manager] find it [rapid review] useful even for software factories”. The

projects coordinator believes they can apply *“Just Demos, Change Priority, and Story Owner [strategies to improve customer collaboration identified with the rapid review] to our project [Project X]”*. The projects coordinator also mentioned that *“the main benefit is the lighter protocol [of rapid reviews] [...] you can do it [rapid review] in one week. This is a good timing for us.”*

Novel approach to support decision-making: The participants mentioned they have never heard about such approach to support decision-making. For example, the project manager told us that he *“never heard about nothing similar [to rapid reviews]”*. While the projects coordinator mentioned that they *“usually conduct research [in informal sources] to support decision-making, but never with the systematic you [the interviewer] have shown us [the participants]”*.

Fostered the learning of new concepts: The participants affirm to have learned new concepts with the findings of the Rapid Review. For example, the projects coordinator told us that he has never heard about *“Story Owner, or Just Demos [strategies to improve customer collaboration identified by the RR].”*

Offer reliable content: The participants considered the evidence provided by the RR is more reliable than the information they used to consume. For instance, the projects coordinator mentioned that *“it is [rapid review] an optimized way to find rich content, because usually scientific papers are rigorously analyzed to be published, which increases the confidence, [...] and avoid you to find false answers [on informal sources] [...] so, it is really useful”*. The participants also affirmed that the Evidence Briefing transmits confidence. The projects coordinator told us that *“it transmits confidence since there are links to the primary studies.”*

Problem-oriented: The participants reported that the RR was problem oriented, since it supported decision-making for a specific problem they are facing. For instance, the project manager mentioned that *“the information is condensed based on the problem we are trying to solve”*. The projects coordinator also mentioned that *“it is [rapid review] interesting, specially because the problem is well defined, so you can adopt the systematic process you have described in a very pragmatic way.”*

Improve problem comprehension: The participants noted that the RR process helped them to better comprehend and structure the problem they were facing. For instance, the project manager told us that *“it [the RR] helps to organize the ideas, what you want to search for”*. Also, the projects coordinator mentioned that *“it [the RR] makes you more confident to stratify the ideas that will help you to solve your problem, instead of conduct a blind search.”*

Increase team confidence: The participants mentioned that some RR's evidence gave them confidence about decisions they have taken or thought in the past. For instance, the projects manager said that *“this Change Priority [a strategy to improve customer collaboration identified with the rapid review] is something I have wondered before [but was not confident]. So, you realize that it worked [the strategy] and other people have used in practice, you see it would be the best solution.”*

Reduce time and cost to conduct decision-making process: The participants mentioned that the RR avoided the cost to define a solution from scratch and also enlarge the set of possible solutions. For example, the project manager told us that *“it is better to search*

for a solution that someone else already proposed and validated in a paper [...] than reinvent the wheel”. The projects coordinator mentioned that *“you normally have your set of solutions [for a specific problem] and this [the RR] enlarges your set of solutions”*. He also told us *“why not apply a solution used by other people? You gain time. It [the RR] helps you to optimize it [the decision-making process].”*

Fast and easy way to find information: The participants mentioned the time gained reading the Evidence Briefing, when compared to a traditional research paper is high. For example, the project manager affirmed that he *“read it [the Evidence Briefing] in 15 minutes, everything condensed in just one page [...] It would take hours and hours of reading if we would read it direct from the papers [the primary studies]. Impressive the time we saved.”* The participants declared that it is easy to find information in the Evidence Briefing: *“the information is very clear, in topics, and the topics that need further information present that information.”*

Avoid reading multiple sources: The participants considered that rapid reviews are more suitable to acquire knowledge than primary studies. The former aggregate evidence from various studies preventing them to take time reading multiple primary studies. This could be observed when the projects coordinator mentioned that *“it [the RR] is more straight-forward and captures the important information of the researches more objectively.”*

Flexible knowledge transfer medium: The participants suggested other possible contexts to use the Rapid Review. The projects coordinator told us that he *“wants to buy the idea and use them [Evidence Briefings] to build technical clippings.”* We then asked *“like internal and external communication? for instance if you want to diffuse good programming practices to enhance technical level of your teams, you can use the briefings to guide a discussion, is this it?”*. The project manager confirmed this intuition. Still, the project manager stated that *“it [the RR] is really good to transfer knowledge.”*

Non-applicable evidence can support other problems: The participants also suggested that even evidence that are not direct applicable to their problem, can support the decision-making of other problems they are facing in different projects. The projects coordinator mentioned that *“some information are not applicable [to Project X] but almost all evidences could be applied [in different contexts].”*

Interest to receive briefings regularly: When we asked the participants if they would be interested in receive Evidence Briefings like the one we presented about various SE topics, they answered positively. To illustrate, the projects coordinator suggested to do it *“like a newsletter.”*

Recommend Rapid Reviews to other practitioners: When asked whether they recommend their peers to adopt rapid reviews to better understand and mitigate a real problem that they are facing, both participants answered positively.

5.2 Improvements to the Rapid Review

Discussing the findings of the RR is needed: The participants mentioned that some the findings of the RR only became clearer after the discussion during the workshop. For instance, the project manager declared that *“things I found difficult to assimilate [only reading the Evidence Briefing], I assimilated during the discussion*

[the workshop]”. Therefore, delivering only the Evidence Briefing without discussions with the practitioners is not sufficient.

Present the primary studies’ context near their findings: The participants suggested that primary studies’ context should come near their findings, instead of grouped together with the context of all other primary studies on the first paragraph of the RR report, as we did. For instance, the projects coordinator mentioned that *“the first paragraph is very bureaucratic. I think that maybe there are better ways to present the domain [context of the primary studies] which findings came from”*. When we asked what do they think if we have a paragraph briefly describing the context of a study, and immediately after, the findings related to that study, the projects coordinator answered *“Yes, that is it, the context should come near to the findings”*.

Avoid printing the RR report in black-and-white: The participants affirmed that some information was not highlighted as it should be, because the Evidence Briefing was printed in black-and-white. The projects coordinator thought *“there were no links to contact you [the research group that created the Evidence Briefing] but then I saw the link on the right-side box, it is not much visible”*. Then the interviewer (researcher) asked if *“you [the projects coordinator] believe it is because the Evidence Briefing was printed in black-and-white and the right-side box that is highlight in gradient blue lost its highlight?”* The projects coordinator agreed.

Graphical information is needed: The participants suggested that charts/figures would make the RR report even more appealing. For instance, the projects coordinator mentioned that *“if you could represent that evidence in a graphic way it would be even better.”*

6 ACTION RESEARCH RESULTS: ADOPTING RAPID REVIEW’S EVIDENCE

To evaluate whether the knowledge introduced with the RR was applied, we conducted an interview with the participants (Section 3.2.4), two months after the introduction of the RR. The interview was in Portuguese, thus all quotes are free translations.

6.1 What Worked Well

The participants mentioned that the RR was positive when it comes to mitigating their main problem. The participants affirmed to **use the Evidence Briefing as a reference material** many times throughout the weeks after the introduction of the RR. To illustrate, the project manager said that he *“analyzed it [the Evidence Briefing] after our discussion [the one during the workshop to introduce the RR] and we started to test some strategies.”* They also **used the Evidence Briefing to discuss with team members** how to properly deal with their problem. More importantly, the participants applied the knowledge provided by the rapid review. Among the strategies employed, they highlighted that *Story Owner*, *Change Priority*, and *Risk Assessment Up Front* were introduced in their work habits. In particular, the participants said that they introduced the *Story Owner* as an additional role for one member of the development team. This member was then in charge to deal with the customer, which alleviated the burden on the projects coordinator. When asked whether Rapid Reviews could be applied in other projects inside the company, the participants shared a positive enthusiasm. For instance, the project manager said that *“the customer background*

varies a lot, but the problems with collaboration and communication are recurrent”. As a positive side effect, the participants mentioned that the RR **motivated them to seek additional knowledge** that would help to cover corner cases not covered. Despite the low customer collaboration — the participants mentioned that *“emails requesting clarification about requirements take one or two weeks for customer to reply”* — the customer used to demand prompt attention when the communication started from them. For instance, before the Rapid Review introduction, the participants often had endless/non-focused meetings with customers. Nonetheless, after the RR, they blocked an one hour meeting, and the meetings became more straight to the point. In summary, the participants mentioned that the Rapid Review was useful to decrease the tension between company and customer. They also mentioned that *“in the end, the customer was satisfied with the system we developed [...] he is thinking in contract us again in the future, for the next phases of the project.”*

6.2 What Did Not Work Well

In contrast, some evidence were not useful to the participants. For instance, the strategy to leverage **e-collaboration tools** was not necessary since the participants already use those kind of tools. According to them *“[...] the problem lies on the quality of the communication [...] delays to answer the development team, and meetings that did not have focus and time limit”*. Similarly, although **Just Demos** was initially considered as an interesting strategy, turns out that the participants were not able to implement it. The customers did not accept meetings only to present a release and make demos. They demanded for more intermediary meetings.

7 DISCUSSION

The participants mentioned many positive points regarding the use of the Rapid Review. We found that it offered reliable content, which is crucial aspect, from a scientific point of view. Even though we acknowledge that RRs are not as reliable as FSRs, from the eyes of the participants, they are more reliable than expert opinion or informal sources, which they often use to support their decision-making. The participants also mentioned RRs are problem-oriented. This means that when the topic of the research is aligned to a practical problem, chances are that the results are more useful and aligned to practitioners’ needs. Our participants also affirmed to have fostered the learning of new concepts, particularly relevant to deal with the problem they were facing. This feedback might encourage other researchers to conduct additional RRs. The participants also mentioned that RRs reduce the time and cost related to decision-making activities, when compared to the informal way they execute those kinds of activities. This finding corroborates with the Evidence-Based Medicine literature, which state that rapid reviews deliver evidence in a timely manner.

Still, the participants mentioned that the RR helped them to improve their comprehension about the problem they were facing. The discussion of the problem between participants and researchers, as well as the formalization of the RR protocol through explicit research questions, have sharpened the problem. They also considered that RRs can be applicable in a practical setting and also that they would recommend rapid reviews to other practitioners as a source of information.

Despite the positive impressions, participants also highlighted the need to discuss the rapid reviews' findings with the researchers that conducted the RR. This close connection helped to clarify unclear items while reading the Evidence Briefing. This finding endorses the claims of Grigoleit et al. [32], which argues that it is important to use artifact mediums (e.g. Evidence Briefings) together with human-intensive mediums (e.g. face-to-face discussions) in order to effectively transfer knowledge.

Moreover, our participants considered positive the use of Evidence Briefings to report findings of the Rapid Review. Yet, the participants pointed that it was easy to find information in the Evidence Briefing, and also that, compared to traditional research papers, it takes considerably less time to read. They reported that about 15 minutes to read the Evidence Briefing. This finding is particularly relevant to SE practice since practitioners are often under time pressure and are not used to consume software engineering research. Despite the positive points, the participants also suggested some improvements to the report. For instance, they suggested that information about the context of each finding should come near the finding itself. This reveals the importance of contextual information about the primary studies — like the number of cases investigated, the characteristics of participants, the countries which the primary studies were conducted, etc. Much have been discussed about context characterization in primary studies [13, 24], but few studies have been conducted on how to present the context of evidence in secondary studies. This is particularly challenging since findings of secondary studies come from diverse primary studies. Additionally, the participants affirmed that Graphic information is needed. However, the challenge here is associated with the effort required to derive such graphical information, e.g., summarizing/synthesizing qualitative data from diverse primary studies in figures/charts.

Apart from the mostly positive participants' perception, we also observed that the participants, in fact, applied the knowledge acquired from the Rapid Review in practice. The usage of some findings of the Rapid Review led the practitioners to experience improvements on their problem. The participants also took advantage of the RR and used the Evidence Briefing as reference material. Similarly, they used the Evidence Briefing to discuss evidence with the team, which might suggest that the benefits of the Rapid Review are not restricted to the first impressions in the workshop. Finally, we believe that the Rapid Review motivated the team to seek additional knowledge to solve their problem. Since the findings of the Rapid Review were condensed in a single one-page document, when practitioners did not find the evidence they needed (e.g., to deal with corner cases not covered by the Rapid Review), they had to figure out for themselves. However, this only occurred because the Rapid Review helped them to learn some of the fundamentals. As a shortcoming, not all not all the strategies identified in the Rapid Review were useful to their project (although practitioners mentioned that they could apply some of the findings in other projects).

7.1 Asking the right questions

One of the most important characteristics of RRs is that they should offer useful knowledge to support decision-making for a practical problem. Therefore, in order to provide useful answers, one has to ask the right questions. Based on the reflections made in this first

report, we argue that Rapid Reviews should ask at least two kinds of research questions.

Exploratory Questions: A certain type of question that we believe is crucial to a RR is the exploratory ones, in special aiming to identify *strategies* available in scientific literature that claims to solve or reduce practitioner's problem. We consider this kind of question as the cornerstone of Rapid Reviews, because the most important thing to practitioners under time constraints is to discovery strategies to solve their problems [74]. RQ4 (Section 4.2) in our RR is an example of such research question. Other arbitrary examples are: “*What are the strategies to improve software development team motivation?*”; or “*What are the strategies to introduce agile practices in a ad-hoc development team?*”

Motivational Questions: Questions that discuss why is important to solve one particular kind of problem. In the presence of skeptical stakeholders, these questions provide evidence that could convince them. RQ1 and RQ2 (Section 4.2) are example of such questions. In our RR, we asked questions to identify the benefits of solving practitioner's problem and the shortcomings for not solving it. However, one can define more specific questions depending on the stakeholder interest. For instance, “*What are the benefits of unit testing on software quality?*” would be useful, for example, to convince a Software Quality Analyst (SQA) about the importance of adopting unit tests. More specific questions are aligned to Ali's observation [2]. He identified that empirical SE research usually search for the benefits of proposed interventions. However, to support informed decision-making, we should comprise not just effectiveness, but also the evidence of cost-effectiveness. His claims consider only the cost dimension, but other dimensions can also be considered, such as quality, customer satisfaction, and system security.

7.2 Commissioning a Rapid Review

Rapid Reviews can be commissioned in different ways, depending on the context. Following there are some possible scenarios we envision:

Commissioned by practitioners: A RR can be commissioned by practitioners of a software development project aiming to support decision-making towards the solution of an issue. For instance, a RR synthesizing the challenges and strategies to establish agile practices in a distributed team, for a project team pondering whether go distributed is a good idea.

Commissioned by researchers: A RR can be commissioned by researchers who want to study a specific SE topic, but with strong relation with practitioners needs. For example, researchers wanting to investigate the problems related to acceptance testing can establish partnerships with companies facing that kind of problem and conduct a RR together.

Commissioned by policy makers: Regulatory agencies or companies who want to define policies can benefit from RRs. To illustrate, a company aiming to define its software improvement process to apply it institutionally can contact researchers to collaborate conducting RRs.

7.3 Implications

Research: Those interested in applied research can identify companies and projects facing problems related to their research topics and conduct rapid reviews together with practitioners. This might help researchers to identify what kind of issues practitioners are facing and better guiding their research. Moreover, researchers can promote rapid reviews tracks in software engineering conferences. Therefore, EBSE community as a whole can be benefited from regular rapid reviews, ultimately, approximating software engineering practice and research, establishing fruitful collaborations, and enacting a common agenda.

Practice: Practitioners can use Rapid Reviews to get a source of information based on evidence, beyond the informal ones they used to consume. If time and personnel are hard constrains, software companies can, for instance, commission researchers to conduct Rapid Reviews to guide the definition of institutional company policies, as suggested for Systematic Reviews [43]; or even to guide technical clippings for discussions within the company, as suggested by the participants of this Rapid Reviews.

8 RELATED WORK

Since software engineering is an applied discipline, there are many efforts reported aiming to connect research to practice. Here we gonna cite just few of them. In 2013, Begel *et al.* [9] released a technical report presenting 145 questions that 203 Microsoft software engineers would like to ask data scientists to investigate about software engineering. Additionally, they asked for a different set of Microsoft software engineers to rank the importance of each of the 145 questions. Another study with Microsoft software engineers was conducted in 2015 by Lo *et al.* [48]. In this study, the goal was to understand how practitioners perceive software engineering research relevance. They summarized 571 papers from five years of ICSE, ESEC/FSE and FSE conferences and asked practitioners to rate them according to their relevance. They received ratings from 512 practitioners, and their results suggest that practitioners are positive towards studies done by the software engineering research community since 71% of all ratings were essential or worthwhile. A similar study was conducted by Carver and colleagues [16], on the perception of ESEM research.

These studies reveals that the mismatch between SE research and practice are more related to the way we conduct and report research in SE, than the topics we investigate. Thus, we believe that initiatives to make empirical evidence more appealing to practitioners, like this research, and many others, are very important [8, 21, 28].

Recently, some advocates to use gray literature in Multivocal Literature Reviews (MLRs) [29, 30, 72]. The approach looks promising and is also strongly aligned to RRs's goal, which is to make research closer to practice. However, RRs aims to provide knowledge based on scientific evidence from peer-reviewed and rigorous primary studies only, as well as deliver evidence in a timely manner. MLRs, on the opposite side, applies systematic methods to synthesize not only primary studies, but also gray literature. MLRs also do not necessarily emerge from a practical problem inside a practical context, or is necessarily concerned about delivering evidence in a

timely manner to practitioner. Thus, RRs and MLRs are different approaches, although both can potentially contribute to approximate SE research to practice.

9 CONCLUSIONS

This paper reports the introduction of a Rapid Review (RR) in a Software Engineering (SE) setting. RRs aim to support decision-making in the SE practice. We conducted and evaluated the use of a RR in a software company in Brazil, using Action Research method. We found that the majority of practitioners' impressions were positive. They affirmed to have learned new concepts about the problem they were facing, as well as declared to trust in the findings provided in the RR. According to them, the RR helped to reduce time and costs related to decision-making. The practitioners also suggested some improvements to the Evidence Briefing, which is the document used to present the findings of the RR.

This paper is also aligned with a recent series of posts by Bertrand Meyer at Communications of ACM blog [52]. His vision points to a new era of SE, where empirical evidence and practice orientation are pivotal elements:

“As long as empirical software engineering was a young, fledgling discipline, it made good sense to start with problems that naturally landed themselves to empirical investigation. But now that the field has matured, it may be time to reverse the perspective and start from the consumer’s perspective: for practitioners of software engineering, what problems, not yet satisfactorily answered by software engineering theory, could benefit, in the search for answers, from empirical studies?” [52, 53]

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