

Towards a model to transfer knowledge from software engineering research to practice

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ABSTRACT

Context: Many researchers argue that Software Engineering (SE) research lacks connection with practice.

Objective: We propose a model aimed at supporting researchers to transfer knowledge to SE practice.

Method: This model is built upon the foundation of Rapid Reviews and Evidence Briefings. These two key elements have been proven effective in other domains, such as medicine, and initial results suggest that they can play a prominent role in SE as well.

Results: We discuss how to apply the model as well as possible challenges that might hinder its adoption.

Conclusion: We believe that both SE practitioners and researchers could benefit from the proposed model. We expect replications and instantiations of the model in the future.

1. Introduction

Over the last years, a myriad of Software Engineering (SE) empirical studies have been conducted on a steady pace. Such advances made Evidence Based Software Engineering (EBSE) one of the pillars of the software engineering research. However, practitioners still discount empirical evidence in favor of expert opinion [1]. Although expert opinion is important, its prevalence is a challenge, since practitioners might lack evidence to back up their claims.

In order to favor evidence rather than opinion, EBSE community has recently recognized the importance of proper ways to transfer knowledge to practice [2]. In particular, EBSE researchers advocate in favor of Systematic Reviews (SR), which synthesizes the best research evidence and make it available to practitioners and researchers [3]. Unfortunately, recent studies revealed a lack of connection between what is studied in the Systematic Reviews and what is needed by software engineering practice [3], which hinders the knowledge transfer process.

In this paper, we argue that evidence from SE research should benefit, and better transferred to, SE practitioners. To bridge this gap, this paper proposes a knowledge transfer model applied to SE field. The model is an instantiation of a generic knowledge transfer model proposed by Bozeman [4] and built upon two emergent concepts in Evidence Based Medicine (that are not present on Bozeman's model), namely: Rapid Reviews [5] and Evidence Briefings [6]. The former —

Rapid Review — is a kind of lightweight secondary study (details at Section 4). It focus on (1) understanding the problems that practitioners face in practice and (2) delivering evidence in a timely manner. The latter concept — Evidence Briefing — is an one-page document that summarizes the main findings of any empirical study. Its short form is crucial to provide evidence in a more straightforward and appealing manner to practitioners (details at Section 5).

2. Related work

Gorschek et al. [7] developed a model to transfer technology to practice. Although similar, their model is focused on identifying practitioners' issues and propose a direct solution, while our model intends to identify practitioners' issues and synthesize empirical evidence to support decision-making. The former approach demands much more effort and commitment from researchers and practitioners, which might hinder cooperation between research and practice. Our proposed model, nevertheless, demands less effort and commitment, as well as stimulate practitioners to consume empirical evidence, which can foster a culture of informed decision-making.

As regarding the kinds of mediums, Grigoleit et al. [2] reported that such mediums can be “artifacts”, like publications and documents, or “human-intensive”, like conferences and workshops. To make SE research more relevant to practice, Beecham et al. [8] stated the

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importance of writing shorter evidence-based reports. However, this is the first work proposing a model to transfer knowledge strongly based on the evidence produced by a Rapid Review process and presenting the results through alternative mediums like Evidence Briefings.

3. The model

The knowledge transfer model is an instantiation of the influential model proposed by Bozeman [4]. It has five key elements:

- **Transfer Agent:** Institution or organization seeking to transfer knowledge. Government agency, university, or a private firm;
- **Transfer Medium:** Vehicle, formal or informal, which the knowledge is transferred through. License, copyright, person-to-person, or a formal literature;
- **Transfer Object:** Content and form of what is transferred; the transfer entity. Scientific knowledge, technological device, process, or know-how;
- **Transfer Recipient:** Organization or institution receiving the transfer object. Firm, agency, organization, consumer, or an informal group;
- **Demand Environment:** The characteristics of the environment the Recipient Agent is immersed in.

In our instantiation, software development companies (**Demand Environment**) are the sources used to identify the issues that practitioners face. Once an issue is detected, it motivates researchers (**Transfer Agents**) to conduct a Rapid Review along with practitioners to identify evidence (**Transfer Object**) that could help practitioners (**Transfer Recipient**) to address the issue. The evidence is presented to practitioners through Evidence Briefings (**Transfer Medium**). Fig. 1 presents the model instantiated.

Since Demand Environment, Transfer Agent, and Transfer Recipient are straightforward to understand, at this moment, we focus on two elements that deserve more attention: the *Transfer object* and the *Transfer medium*. We operationalize the latter in terms of Evidence Briefings [9] and the former in terms of Rapid Reviews [10].

4. Rapid reviews' evidence: The transfer object

Rapid Reviews are lightweight secondary studies focused on delivering evidence in a timely manner to practitioners. To conduct Rapid Reviews, researchers deliberately omit or simplify steps of full systematic reviews. For instance, they can limit literature search, they can use just one person to screen studies, or they can skip quality appraisal of primary studies [5].

It is important to highlight that Rapid Reviews are not conceived to replace full systematic reviews. Instead, both can coexist. While full systematic reviews are important to provide in-depth, high-reliable evidence, Rapid Reviews are important to quickly transfer knowledge to practice. As expected, rapid reviews have obvious limitations. To cite a few: paper coverage is limited to few search sources; there might be selection bias if only one person screens papers.

In spite of the limitations inherently to the relaxed method, the interest in rapid reviews is growing in health-care fields [5]. To illustrate, the prestigious Systematic Reviews journal published an editorial¹ recognizing rapid reviews as one of the foundations of Evidence Based Practice. Additionally, Cochrane — a global renowned group specialized in evidence diffusion — announced a group² to guide the production of rapid reviews in medicine.

Following the promising results in medicine, we conducted a rapid review in a SE context [10]. The rapid review was aimed to (1)

understand the problem that the company had and to (2) provide evidence that could support the decision-making of company's representatives towards fixing the problem. The problem reported was **low customer collaboration**. We then (1) created a search string to search for relevant literature (limited to Scopus search engine only); (2) conducted a selection procedure to filter out papers (17 selected studies), screened by only one researcher; (3) synthesized the findings, and finally (4) reported the results to practitioners using Evidence Briefings. Throughout this process, practitioners worked on close collaboration with researchers. The entire process took six days, and the first author was full-time dedicated. Although the company's representatives were unfamiliar with this approach, they considered that the rapid review was **applicable to software engineering practice**, specially due to its short duration. They reported that rapid review is **more reliable than the approach they use to seek information** (e.g., informal sources and expert opinion). Additionally, they mentioned that rapid review process **helped them to better comprehend and structure the problem** they were facing. These initial results suggest that rapid reviews might play the role of **Transfer Object** in SE.

5. Evidence briefings: The transfer medium

Researchers in medicine argue that systematic reviews often neglect practitioners' needs [5], avoiding them to consume that kind of content. This led to alternative mediums to transfer knowledge that better fit practitioners' needs rather than traditional research paper format.

Following initial findings from medicine peers [5], we recently introduced the concept of *Evidence Briefings* [9] in SE. The Evidence Briefings' template is based on information design best practices. Both the template and its guidelines can be found at <http://cin.ufpe.br/eseg/evidence-briefings>.

Fig. 2 shows an Evidence Briefing. It has six main parts: (1) title; (2) a short paragraph presenting briefings' goal; (3) the main section, presenting the findings of the study; (4) an informative box outlining the intended audience and explaining the nature of the briefings' content; (5) references to primary studies; and (6) an area for logos of research groups, universities, or companies involved in the study [9].

Both format and content of Evidence Briefings were positively evaluated with a group of SE practitioners [9]. Respondents perceived that **information was easy to find and the format was clear, understandable, and reliable**. Due to these characteristics, we believe that Evidence Briefings are a proper **Transfer Medium**.

6. Discussion

The proposed knowledge transfer model, or parts of it, can be applied in many contexts. For instance, a Rapid Review could synthesize challenges and strategies to introduce agile practices in a distributed team. Regulatory agencies and/or companies departments that need to define its software improvement process can invite researchers to conduct rapid reviews *in situ*. Still, Evidence Briefings can be used to guide technical discussions inside companies, or even to serve as internal dissemination mediums.

However, some challenges might hinder the adoption of the proposed model. For instance, some companies may oppose to conduct rapid reviews arguing difficulties to allocate employees' **effort** on that kind of initiative. To overcome this challenge, researchers can argue that the benefits of rapid reviews overcome the efforts on the long run [5]. Likewise, researchers can take most of the effort, as they already do with traditional systematic reviews. Moreover, companies may claim that the model might introduce **delays** on the projects' schedules. One possible mitigation plan is to avoid problems on the critical path of a project's schedule.

Some companies may want to avoid **information disclosure** or even may be **afraid of admit their problems**. To mitigate, researchers might take advantage of Informed Consent Forms (or any similar

¹ Systematic Reviews Journal's Editorial <http://bit.ly/2boZTgv>.

² Cochrane Rapid Review Group - <http://bit.ly/2u77FUN>.

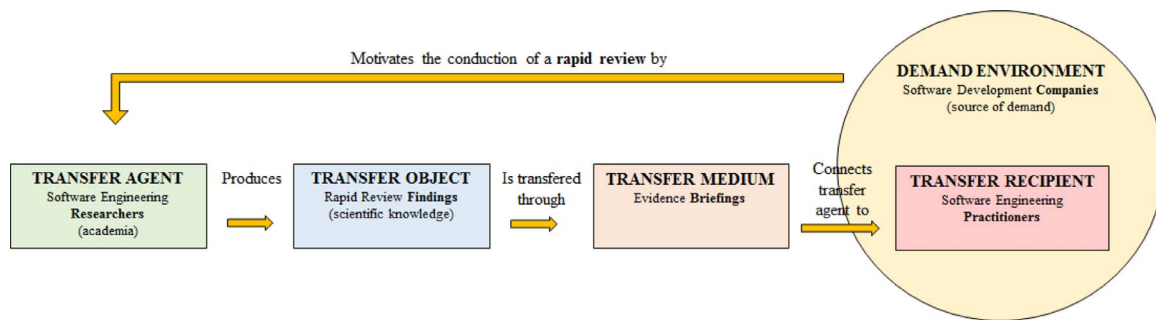


Fig. 1. Proposed knowledge transfer model.

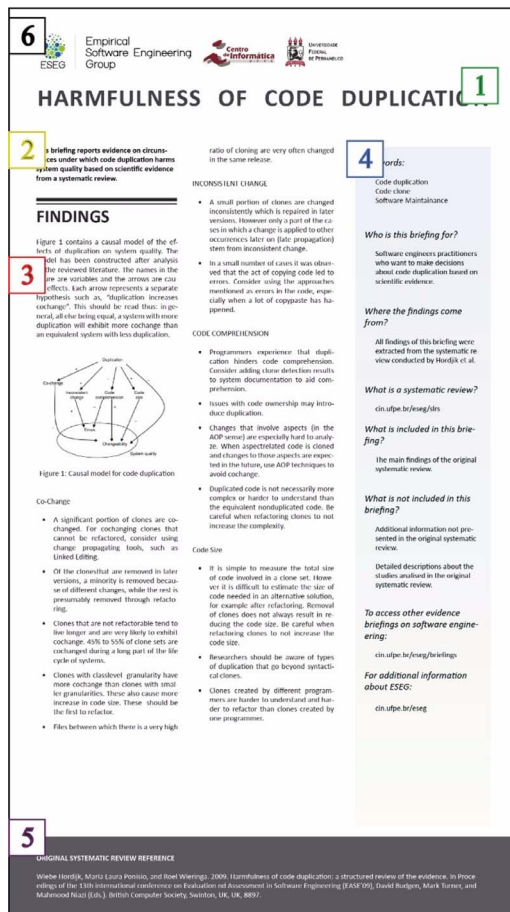


Fig. 2. Evidence Briefing Structure.

approach that guarantees data confidentiality, participants anonymity, and the right that participants have to withdraw from the research at any moment).

7. Conclusions

In this paper we propose a model to transfer knowledge from scientific evidence to SE practice based on Rapid Reviews and Evidence Briefings. Rapid reviews are lightweight secondary studies to deliver evidence in a timely manner and connected to practitioners' issues. Evidence Briefings synthesize any research in an one-page document, that practitioners could easily get acquainted with. This is the first paper exploring Rapid Reviews and Evidence Briefings in SE, which is a growing topic in more mature fields applying evidence based practice, such as health-care. We report some preliminary empirical results on the usage of Rapid Reviews and Evidence Briefings. Due to encouraging initial results, we believe that our model could be better explored in SE research. As future work, we are planning to conduct more rapid reviews in industry settings to assess the proposed model.

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