Identification of SLR tool needs – results of a community workshop

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ABSTRACT

Context: With the increasing popularity of the Systematic Literature Review (SLR) process, there is also an increasing need for tool support. **Objective:** The goal of this work was to consult the software engineering researchers who conduct SLRs to identify and prioritize the necessary SLR tool features. **Method:** To gather information required to address this goal, we invited SLR authors to participate in an interactive 2 h workshop structured around the Nominal Group Technique. **Results:** The workshop outcomes indicated that Search & Selection and Collaboration are the two highest priority tool features. The results also showed that most of the high-priority features are not well-supported in current tools. **Conclusion:** These results support and extend the results of prior work. SLR tool authors can use these findings to guide future development efforts.

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1. Introduction

The Systematic Literature Review (SLR) process is a formal, repeatable, documented process for identifying, evaluating, and analyzing the literature relevant to a specific topic or question [1]. With the increase in frequency of various type of empirical studies in software engineering (SE), SLRs are becoming increasingly important as a method to systematically gather and analyze the results from these studies. A 2013 mapping study identified 174 SLRs published in the SE literature [2] between 2005 and 2011. SLRs are valuable to researchers, by providing guidance about areas in need of further research, and to practitioners, by providing information that can be used in deciding whether or not to adopt a practice within the organization.

Despite these benefits, SLRs are difficult and time consuming to conduct. In most cases, the research team must perform the formal process manually (without adequate tool support). Previously, we conducted a community workshop to identify the key barriers in the SLR process. Participants in that workshop identified the following crucial barriers: (1) lack of tool support for data extraction, (2) low quality of the articles, (3) lack of methods for synthesizing data, (4) inadequate search engines, (5) difficulty in analyzing and presenting qualitative data, and (6) ensuring the SLR topics are relevant to industry [3]. Our belief is that at least four of these six items (i.e. data extraction, data synthesis, inadequate search engines, and analysis/presentation of qualitative data) can be addressed by tool support.

Inadequate tool support increases the effort required for researchers that conduct SLRs and adds barriers for new researchers wishing to perform SLRs. To begin to address these problems, researchers have developed tools to support various aspects of the SLR process. A recent mapping study identified eleven SLR tools in the SE literature [4]. Eight of these tools focus on only one or two aspects of the SLR process: study identification [5], study selection [6–9], data extraction [8,10,11], or data synthesis [10,12–14]. The remaining three tools target the entire SLR process [14–16]. Unfortunately, only two of these tools have been evaluated independently [11]. The lack of integration of tools across the SLR process along with the general lack of external validation suggest the need for additional research to identify the SLR tool features most in need by the community.

Therefore, the goal of this work is to **identify and prioritize tool features that would be beneficial when conducting an SLR in software engineering**. The results of this work will provide important information to researchers who develop SLR support tools. To address this goal, we enumerate four research questions:

RQ1: **Which SLR tool features do SLR authors desire?** This basic question is geared towards enumerating all of the important features necessary to address the barriers that SLR authors currently face.

RQ2: **What is the development priority for each identified feature?** The answer to RQ1 could result in an overwhelming number of desired features. Therefore, to help focus development efforts of tool builders, it is important to prioritize those features.

RQ3: **Does the experience level of the SLR author affect the development priority of the features?** While RQ2 examines the overall priority, it is quite likely that novice SLR authors will

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have different needs than more experienced SLR authors. This question will help identify those differences and provide additional insight to tool builders about the different audiences.

RQ4: **How well do the existing SLR tools support the identified features?** Finally, it is important to understand how well the existing SLR tools support these features. If all features are well-supported, then the answer to this question will provide a mapping between requirements and tools. If features are not well-supported, then the answer to this question will provide a roadmap for tool builders about where to focus their efforts to have the most impact.

To answer these questions, an interactive forum like a workshop is preferable to a survey because it allows authors to spend time thinking and discussing these ideas to arrive at the final results. We used the Nominal Group Technique [17] to organize a workshop to elicit the information required to answer the research questions. We conducted this community workshop just prior to the *18th International Conference on Evaluation and Assessment in Software Engineering (EASE'14)*. We chose this venue because the prevalence of SLRs typically presented at the conference suggested that many SLR authors would already be in attendance.

The primary contributions of this work are:

- A prioritized list of SLR tool features derived from active SE SLR Authors.
- An understanding of the differences in tool feature requirements between novice and experienced SLR authors.
- An indication the participants' perceptions of which SLR tool features are not met in existing SLR tools.
- A comparison of our results to those of prior studies about SLR tool needs.

Section 2 describes more details about the participants and the workshop methodology. Section 3 reports the outcomes of the workshop along with some analysis of those outcomes. Section 4 discusses the outcomes in relation to extant literature and their implications. Section 5 lists the threats to validity of this study. Section 6 summarizes the paper and describes future work.

2. Workshop methodology

Consistent with the research questions enumerated in Section 1, the workshop discussion focused on:

- Identifying features that should be provided by SLR-support tools,
- Prioritizing those features, and
- Understanding how well current tools support those features.

Section 2.1 describes the workshop participants. Section 2.2 details the workshop activities.

2.1. Participants: SLR authors

To better understand the tool support desired by SLR authors, we needed to attract participants who were active in conducting SLRs and/or building SLR support tools. We searched the software engineering literature to identify papers reporting SLRs and papers describing SLR support tools. From these papers, we extracted a list of the authors as potential workshop participants. Approximately one month prior to the conference, we invited all of these authors, via email, to participate in the workshop. The invitation informed them that the goal of the workshop was to "gather and prioritize community needs and requirements regarding tool infrastructure to support the SLR process".

Sixteen participants from around the world attended the workshop, including ten SLR experienced authors (i.e. had completed at least three SLRs) and six novice SLR authors (i.e. had completed one
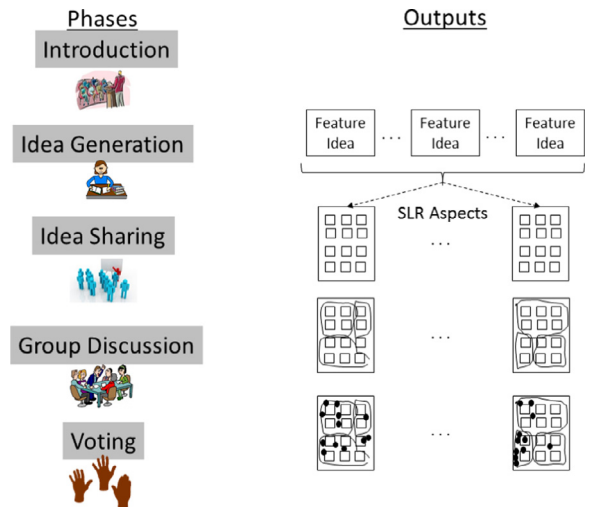

Fig. 1. Overview of methodology.

or two SLRs). All participants were interested in improving the SLR process by upgrading the available support infrastructure.

2.2. Workshop design

To help the workshop participants effectively interact with each other and to obtain the most accurate information, we used the *Nominal Group Technique* [17] to organize the workshop activities. The Nominal Group Technique is ideal for workshops with these characteristics [18]:

- Most participants are unfamiliar with each other (i.e. they do not generally work together);
- Some participants may be more vocal than others;
- Some participants think better in silence; and
- Lack of any topics that would be controversial or generate heated interactions.

These characteristics matched our workshop. Fig. 1 provides an overview of the five phases of the workshop methodology. The remainder of this section describes these Nominal Group Technique phases in more detail.

2.2.1. Phase 1: Introduction and Explanation
We began the workshop with a brief overview of the SLR protocol and process stages to ensure that everyone was using the same terminology and conceptual model. In our previous work [19], we illustrated Kitchenham's SLR process as follows:

- Planning stage
  - Motivation for conducting SLR
  - Research questions
  - Search strategy (databases and search strings)
  - Strategy for identification of primary studies (inclusion/exclusion criteria)
  - Quality assessment criteria
  - Data extraction strategy
  - Procedure for data synthesis
  - Project timeline
- Execution stage
  - Identification of relevant research using the search strategy
  - Selection of primary studies using inclusion/exclusion criteria
  - Evaluation of primary studies using quality assessment criteria
  - Data extraction
  - Data synthesis
- Documentation stage