Delft University of Technology
Software Engineering Research Group
Technical Report Series

Performing Systematic Literature Reviews with Researchr: Tool Demonstration

Eelco Visser

Report TUD-SERG-2010-010

TUD-SERG-2010-010

Published, produced and distributed by:

Software Engineering Research Group
Department of Software Technology
Faculty of Electrical Engineering, Mathematics and Computer Science
Delft University of Technology
Mekelweg 4
2628 CD Delft
The Netherlands

ISSN 1872-5392

Software Engineering Research Group Technical Reports:
http://www.se.ewi.tudelft.nl/techreports/

For more information about the Software Engineering Research Group:
http://www.se.ewi.tudelft.nl/

Performing Systematic Literature Reviews with Researchr: Tool Demonstration

Eelco Visser

Delft University of Technology
visser@acm.org

Abstract. This paper describes the workflow for performing systematic literature reviews with the researchr digital library environment.

1 Introduction

Conducting scientific research in a domain requires an up-to-date and complete overview of the scientific literature in that domain. A literature review gives an overview of the state of research in a domain, answering questions such as 'what are the problems being studied?', 'what are existing solutions and techniques?', and 'what is the quality and effectiveness of these techniques?'. A review is input for the formulation of new research questions and supports the argument about novelty of a research project. Since the body of scientific literature is large, the typical related work discussion in an individual research paper is often just a sample of the entire base of publications, without guarantees of completeness.

Inspired by the practices in evidence-based medicine, Kitchenham [5, 6] proposes performing *systematic* reviews in software engineering.

> A systematic literature review is a means of identifying, evaluating, and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest.

For example, Mendes [8] presents a systematic review of rigour in web engineering research investigating to what extent claims about methods and techniques in the field are validated, i.e. supported by emperical evidence. The conclusion in 2005 was that very few papers in the area provided evidence for claims made. In another example project, Cornelissen et al. [3] review the literature on program comprehension through dynamic analysis in the period 1999–2008, providing an overview of the field.

In order to achieve completeness and reproducibility, Kitchenham [5] outlines a formal process for conducting a systematic review, which includes

- Review protocol: specificies the research question that should be answered and the method that will be followed to answer it;
- Search strategy: specification of a 'mechanized' search for literature that is reproducible;
- Inclusion and exclusion criteria: criteria that specify how it is decided that publications found by the search strategy are included in the review;

– Quality criteria: specification of a taxonomy according to which publications are rated;
– Classification of selected publications according to the taxonomy;
– Interpretation and summary of the results.

Since the initial papers by Kitchenham [5, 6], a large number of systematic reviews have been performed and published[1] and several guidelines and evaluations of the approach have been published [4, 2, 1, 7], amounting to considerable experience in performing systematic reviews with a well developed methodology. However, these studies are very sparse with guidelines and evaluation of tools used in all stages of the reviewing process.

The main challenges in performing SLRs observed by the interviewees in Babar and Zhang's study [1] are time/effort and searching the literature. While these points are not further elaborated and finding and reviewing a large number of publications is intrinsically a lot of work, my hypothesis is that poor tool support plays a significant role; or rather, the poor integration of tools for managing review data. Searching of publications is done using digital libraries (ACM DL, IEEE Explore) and indexing services (Google Scholar, DBLP). Management of the resulting meta-data (BibTEX, RIS), is done using (online) bibliography tools such as Bibdesk, Bibsonomy, Citeulike, Mendeley. Spreadsheets and databases are used to administer the classification of publications.

In this paper, I describe the integrated workflow for performing systematic reviews with researchr[2] a web application for management of bibliographic data. Researchr semantically links publications to authors, journals, proceedings, and conferences, supporting reliable browsing. Publications can be classified using public (shared) tags. Researchr has over a million publication records, mainly in computer science. The core of the collection is based on the DBLP database (as provided via its XML export), but is extended with contributions from users. Researchr is open for contributions; users can contribute missing publications and can make corrections to publication records in the database and add missing information such as abstracts and citations. The quality of such modifications is guarded by a reputation system. Users can use researchr to provide a profile of their research with publications. More importantly, the site supports literature reviews, by creating bibiographies, collections of publications about a topic of choice. In this paper I describe the elements of the systematic reviewing workflow in researchr.

2 Systematic Reviews in Researchr

Performing a systematic review consists of creating a bibliography, defining and executing a search strategy, defining classification schemes, and reviewing and classifying papers.

[1] See the researchr bibliography at http://researchr.org/bibliography/systematic-review for a list of systematic review publications.
[2] http://researchr.org

2.1 Bibliography

The first step in the reviewing process is the creation of a *bibliography* for the collection of publications. A bibliography is maintained by a user group, which controls the access control settings of its bibliographies. An individual bibliography can be made accessible to the group, to researchr users, or the general public. These settings can be changed. Thus one can start with a closed bibliography, and disclose it after publication of the results of the review. Alternatively the reviewing process can be conducted in the open, inviting members of the community to inspect, comment, and even contribute. The description area of a bibliography can be used to document the review protocol, including the research question and search strategy.

2.2 Search Strategy

A bibliography is filled by searching for publications in the researchr database and adding them to the bibliography. Individual publications can be added by selecting the bibliography in the 'Bibliography' tab on the publications' page. Thus, a bibliography can be filled while browsing publications. Publications can also be added to a bibliography 'in bulk'. The results of a publication search can be copied to a bibliograpy. Similarly, all publications with a particular tag, published in the proceedings of a conference series, or in some journal can be copied to a bibliography. For all such bulk additions, the source is documented as part of the bibliography so that it can be reproduced, and so that the bibliography can be later updated to include new publications that match the original search criteria (Figure **??**).

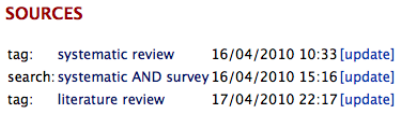

Fig. 1. Recording of sources in bibliography.

Further publications can be derived from the first search, e.g. by inspecting other publications of authors already in the bibliography or by following references. Adding the same publication to a bibliography via different searches, will not lead to duplicate entries; bibliographies are a *set* of publications. While the researchr database is large, it is not complete. Missing publications can be added by pasting bibtex entries obtained from other sources, or using a form.

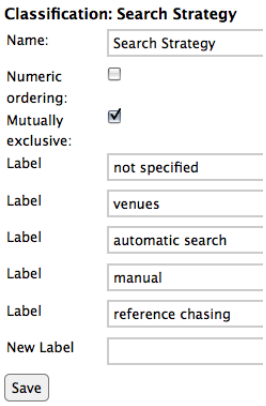

Fig. 2. Definition of a labeling classification scheme.

2.3 Classification Schemes

Given a collection of publications produced by the search strategy, the core task of the systematic review is the classify publications. A researchr bibliography automatically provides faceted search of the collection by year, tags, publication type, venu, and authors. To support classification for the purpose of the systematic review, a bibliography can be extended with *custom classification schemes*. A *ranking scheme* allows assigning a number to a publication, which could

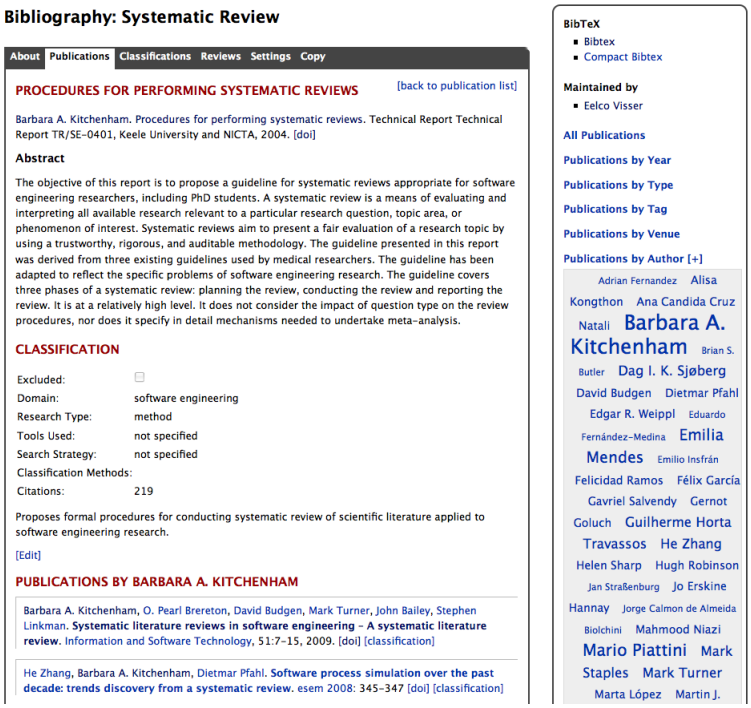

Fig. 3. Classification of publication for systematic review in bibliographyxs.

express a quality score, relevance ranking, or citation count. A *labeling scheme* allows the definition of a number of symbolic labels (tags) to be assigned to publications (Figure 2). A labeling scheme can be mutually exclusive in order to divide publications into categories, or not, to enumerate 'features' of a publication.

2.4 Reviewing

Given the raw publication selection and a set of classification schemes, reviewing can start. First, based on title and abstract, publications that are not relevant for the purpose of the review can be excluded, recording the reason in the comments. Next, after reading of the full text of the publication, it can be scored according to the classification schemes.

2.5 Summary

The bibliography interface provides faceted browsing of publications using word clouds for the standard and custom classification schemes. Other reporting mechanisms are under development.

3 Discussion

Contrary to the idealized sketch of research procedures in the introduction, the systematic reviewing workflow for researchr was not designed after a systematic review of systematic reviewing practices. Rather, a cursory investigation of Kitchenham-style reviewing, suggested that the missing ingredients in researchr, were (1) copying publication sources, such as searches, to a bibliography, (2) recording these sources for reproducibility, (3) defining custom classification schemes for a bibliography, and (4) classification of individual publications. The workflow that is described above supports these ingredients and is available to registered users of the site. However, further application to systematic reviewing will undoubtely suggest refinements and extensions. A systematic review of tool use in existing systematic review projects will be beneficial in speeding up this process. However, from a first scan of the literature it seems that tool use is not part of standard reports on systematic reviews.

The researchr database contains more than a million publication records mainly from computer science, providing a good basis for conducting systematic reviews in this field. However, the data set has its limitations. Most records are imported from DBLP and provide good quality bibliographic data, but lack abstract and references. However, a link to the DOI and Google scholar make finding the complete records a matter of following one or two links. Researchr is designed for contributions that correct, complete, and complement the existing publication records, which allows it to grow to a rich resource for conducting systematic reviews. Feedback on the systematic reviewing workflow from the community is very welcome.

References

1. Muhammad Ali Babar and He Zhang. Systematic literature reviews in software engineering: Preliminary results from interviews with researchers. In *ESEM '09: Proceedings of the 2009 3rd International Symposium on Empirical Software Engineering and Measurement*, pages 346–355, 2009.
2. Maria Teresa Baldassarre, Nicola Boffoli, Danilo Caivano, and Giuseppe Visaggio. A hands-on approach for teaching systematic review. In *profes*, pages 415–426, 2008.
3. Bas Cornelissen, Andy Zaidman, Arie van Deursen, Leon Moonen, and Rainer Koschke. A systematic survey of program comprehension through dynamic analysis. *TSE*, 99(2):684–702, 2009.
4. Jorge Calmon de Almeida Biolchini, Paula Gomes Mian, Ana Candida Cruz Natali, Tayana Ucha Conte, and Guilherme Horta Travassos. Scientific research ontology to support systematic review in software engineering. *aei*, 21(2):133–151, 2007.
5. Barbara Kitchenham. Procedures for performing systematic reviews. Technical Report Technical Report TR/SE-0401, Keele University and NICTA, 2004.
6. Barbara Kitchenham. Evidence-based software engineering and systematic literature reviews. In *profes*, page 3, 2006.
7. Barbara Kitchenham, O. Pearl Brereton, David Budgen, Mark Turner, John Bailey, and Stephen Linkman. Systematic literature reviews in software engineering a systematic literature review. *Information and Software Technology*, 51:7–15, 2009.
8. Emilia Mendes. A systematic review of web engineering research. In *isese*, pages 498–507, 2005.

TUD-SERG-2010-010
ISSN 1872-5392