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Systematic Mapping Study in Information Systems Research

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Abstract

A systematic mapping study is a type of secondary study with the goal of providing an overview of a subject as it is reported in primary studies. A systematic map often describes research trends over time, uncovers possible research gaps and focus points, and provides a synthesis of the chosen subject. We believe that while a systematic mapping study should not be the sole research method for a researcher, it is a noteworthy candidate for one of the first research methods in a researcher's career. In this study, we argue for and against utilizing a systematic mapping study as one of the first research methods in information systems research and provide accessible guidelines for conducting a systematic mapping study. Although these instructions are for educators, we have strived to communicate these guidelines for an undergraduate or graduate thesis writer by providing examples of other mapping studies, giving our opinions on the numbers of primary studies regarding each step of the mapping process to manage a feasible workload, and presenting hints and tips on applicable tools.

Keywords: systematic mapping study, information systems research, research method

DOI: 10.17705/3jmwa.000079

1. Introduction

As the number of scientific studies on a particular field or subfield grows, it is arguably and understandably more and more difficult to understand current research trends, subject areas, and research gaps. In such cases, it is intuitive to map the studies in the field to achieve a high-level understanding. This process is called a systematic mapping, and the result of the process is a systematic map (Petersen et al., 2008). The word systematic typically implies that the steps a researcher or researchers have taken follow a process that is reported in explicit detail so that the process can be replicated by other scholars. In contrast, many scientific studies include a background section that discusses prior studies which are selected and described in a non-systematic way.

The method behind a systematic mapping study is closely related to systematic literature review. The difference between a systematic literature review and a systematic mapping study can be summarized in the depth and breadth of the methods. That is, a systematic literature review often strives for an in-depth understanding of a particular topic through previously published studies, while a systematic mapping study is often interested in a higher-level understanding of, e.g., topics, approaches, and bibliographic summarization of previously published studies. As summarized by Petersen et al. (2008), a systematic mapping study is often concerned with a broader range of primary studies, but the analysis is not as deep as in a systematic literature review because of different goals. Furthermore, the authors commend a systematic mapping study's accessibility through visualizations and broad focus that makes a systematic mapping study potentially a more accessible introduction to a topic than an in-depth systematic literature review. However, some systematic mapping studies also describe phenomena on a detailed level, making the definition and separation between the two methods often blurry (e.g., López et al., 2021; Novais et al., 2013).

While there are several guidelines for performing systematic mapping studies in the field of software engineering (Petersen et al., 2008; Kitchenham & Charters, 2007), to our understanding, there are no guidelines targeted specifically for information systems, and above all, for novices. In this study, we present arguments for and against using the systematic mapping process as a way to teach novices the basics of the scientific method and provide accessible guidelines for conducting a systematic mapping study. These guidelines were initially formed by applying and particularizing previously established guidelines (Petersen et al., 2008) in information systems research. The guidelines were subsequently refactored for novices through novice feedback and expert opinions, and by observing and supervising novices applying the guidelines. This was not done in a systematic fashion, and therefore, this study presents an iterated expert opinion and examples from prior studies, rather than a systematic mapping on how to conduct a systematic mapping study.

The rest of the study is structured as follows. In the next section, we provide a high-level overview of systematic mapping study steps. These steps are detailed in the following sections. Section 3 describes the initial steps such as defining the scope, research questions, and exclusion criteria, Section 4 details the database searches, Section 5 the study selection process and snowballing, and Section 6 guides in reporting the results and limitations of a systematic mapping study. In Section 7, we discuss the incentives and limitations of using a systematic mapping study in general. Section 8 concludes the study.

2. Overview

This section provides an overview of the steps involved in conducting a systematic mapping study. The steps are described in more detail in the subsequent sections, named identically to the leftmost column in Table 1. Other examples of the systematic mapping process are presented in Figure 1. The process illustrated on the left side of Figure 1 is a common approach starting from database searches and ending with the final study selection. *E*s in the figure refer to exclusion criteria. The process on the right side of Figure 1 presents a different approach starting from a previous systematic mapping study and continuing with several rounds of snowballing, i.e., using citations or references in finding more relevant primary studies. Notice how the snowballing ends when new papers are no longer found. Snowballing is discussed in more detail in Section 5.5.

What to do (Section number)	Document for reporting in the Subsequent Manuscript	The number of potential primary studies after the step	Section
Refine study scope			3.1
Phrase the research questions	Your research questions.		3.2
Judge and justify whether a mapping study is needed	Motivation for your systematic mapping, other similar or tangential systematic maps and literature reviews.		3.3
Draft inclusion and exclusion criteria	Your criteria as a numbered list.		3.4
Select relevant databases	Your selected databases.		4.1
Define the search terms	Your search terms for each of your selected databases.		4.2
Extract metadata and the articles	How many articles were returned by your searches from each of your selected databases? All available article metadata, at the very least the title, authors, publication year, publication forum, and the source database.	Hundreds, but more than 2,000 may make the selection process overly arduous for a single researcher.	4.3
Selection based on title	Which articles were removed and why? Refer to a specific exclusion criterion.	Dozens or hundreds.	5.1
Selection based on abstract	Which articles were removed and why? Refer to a specific exclusion criterion.	Dozens or hundreds.	5.2
Selection based on full text	Which articles were removed and why? Refer to a specific exclusion criterion.	Dozens.	5.3
Refine criteria	Your refined criteria as a numbered list.	Dozens.	5.4
Snowballing (*snowballing* refers to finding relevant works by using references or citations)	How many rounds of snowballing was conducted? How many articles for each round of snowballing were added? Report the type of snowballing, i.e., backward, forward or both.	Dozens.	5.5

Table 1. An overview of steps involved in conducting a systematic mapping study

3. Initial Steps

3.1 Refine Study Scope

As with many other research approaches, designing a systematic mapping study starts with refining the scope of the study. In contrast to empirical studies, the scope of a systematic mapping study or a systematic literature review is typically limited to three distinct approaches. First, *a precision mapping* of a single theme, as Pahl and Jamshidi (2016) did in their mapping study on microservices. Second, the mapping by Rios and Paredes-Velasco (2021) in their article on augmented reality in education is a fitting example of systematic mapping in the *intersection of two themes*. Finally, a *theme can be reflected from the viewpoint of a theory*, as Murillo et al. (2021) did in their mapping regarding Moodle and the Technology Acceptance Model.

3.2 Phrase the Research Questions

Systematic mapping studies often have two types of research questions. First, there are research questions typical for systematic mapping studies. These questions map the selected primary studies in terms of publication years, publication fora, research approach, and theme. A little less common is the mapping of the geographical distribution of the primary study author countries and evaluating the primary studies in terms of validity and reliability. Publication trends in gamification: A systematic mapping study by Kasurinen and Knutas (2018) is an example of a systematic mapping study focused on research questions such as these. Second, systematic mapping studies may also include other, more domain-specific research questions. For example, Paternoster et al. (2014) aimed to answer the question "What are the reported work practices in association with software engineering in startups?", and Taipalus and Seppänen (2020) attempted to answer "Which practices have been proposed for teaching SQL?" in addition to answering research questions typical for a systematic mapping study.

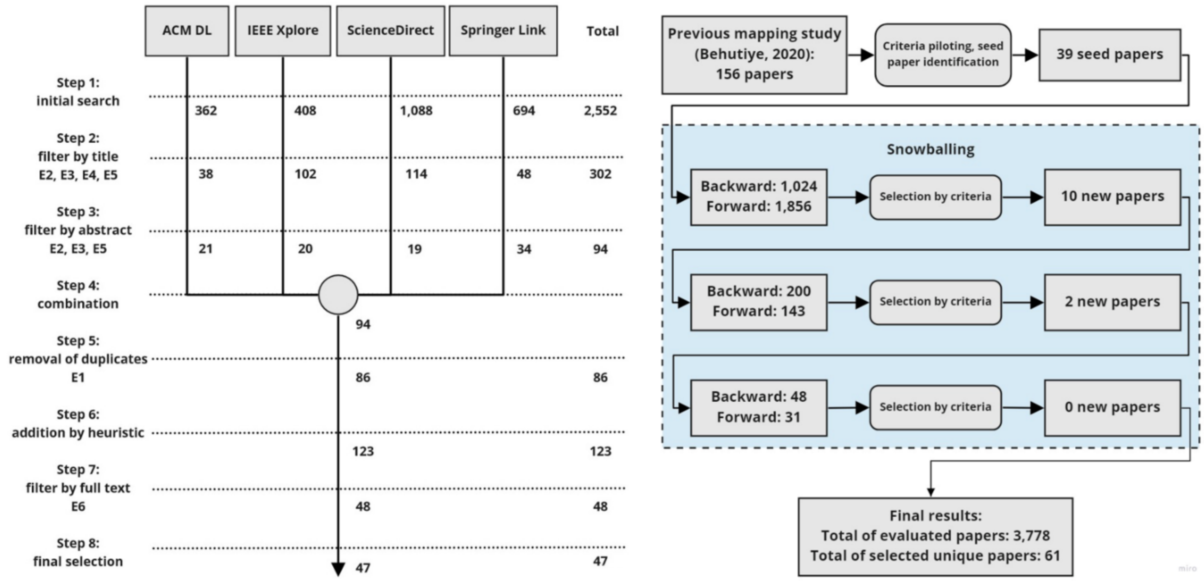


Figure 1. Two examples of reporting the process of selecting primary studies (left side adapted from Bischoff et al., 2019, right side adapted from López et al., 2021)

Research questions	Source
"*What is the annual trend of publications?*"	Akoka et al. (2017)
"*What research methods have been used?*"	Bischoff et al. (2019)
"Which topics for testing product lines have been investigated and to what extent?"	Engström & Runeson (2011)
"What analysis tasks does the SEV [software evolution visualization] *claim to support?"*	Novais et al. (2013)
"What tools are used to manage and visualize these QMIs [quality management indicator]*?"*	López et al. (2021)
"Which practices have been proposed for teaching SQL?"	Taipalus & Seppänen (2020)
"Which factors influence successful adoption of dataspaces?"	Hutterer & Krumay (2022)
"How are developed maturity models validated?"	Wendler (2012)

Table 2. Examples of research questions (RQ) in systematic mapping studies – the three first rows show RQs typical for mapping studies, and the five last rows subject specific RQs

Another diligently followed example concerning the outcomes of a systematic mapping study is the categorization of primary studies according to both the primary study theme and research approach. As perhaps the most suitable example, Petersen et al. (2008) categorize their selected primary study themes into metric, tool, model, method, and process. This categorization by study theme is typically context-dependent. Further, the authors categorize their selected primary study research approaches into evaluation research, validation research, solution proposal, philosophical paper, experience report, and opinion paper. Categorizations such as these are an accessible way of identifying research gaps as well as focus points. Both categories and themes should be explicitly defined. The research approaches utilized by Petersen et al. (2008) are summarized from the work of Wieringa et al. (2006) and are relatively common. Sometimes, however, these categories of research approach may be unsuited for a particular subject. For example, Taipalus and Seppänen (2020) redefined these categories for their mapping study to more adequately fit educational research. Some examples of research questions in systematic mapping studies are presented in Table 2.

3.3 Judge and Justify Whether a Mapping Study is Needed

Once you have defined your research questions, one thing to evaluate is whether a systematic mapping study is needed. Evidence to the contrary might simply be that there are not enough primary studies that would form a feasible map. After all, the goal of a mapping study is to provide an overview of a subject, but if the number of primary studies is counted in single digits, an overview might be better formed by simply reading these primary studies rather than conducting a systematic mapping study.

On the other hand, there might be several mapping studies on the same topic with similar research questions already published, which raises the question of whether yet another mapping study would contribute to the increased understanding of the topic. As an example, from another field of science, healthcare data analytics has received several dozen systematic mapping studies or systematic literature reviews over the past twenty years. It follows that novel secondary studies on healthcare data analytics are arguably expected fresh perspectives, rather than stating similar findings as previous studies. This perspective can be derived from the combination of new themes, new data analytics methods or healthcare subfields, or simply time, as a mapping study written in 2010 can only look at primary studies published in 2010 or before. If there are mapping studies published on the same or even a tangential topic, be sure to discuss them in your research, position your mapping study accordingly, and justify the need for your mapping study.

3.4 Draft Inclusion and Exclusion Criteria

Inclusion and exclusion criteria define which primary studies you include in your systematic mapping. These criteria are reported as explicitly as feasibly possible. Some researchers define both inclusion and exclusion criteria, but as effectively every inclusion criterion can be swapped as an exclusion criterion by negation (and vice versa), other researchers simply define only inclusion or only exclusion criteria.

The criteria can be diverse. Typically, researchers exclude studies that are not written in a particular language or languages. Other common criteria concern the availability of full texts, a range of accepted publication years, and limiting the primary studies to those published in scientific peer-reviewed fora, which typically leaves out whitepapers, blog and forum posts, etc. All in all, the criteria can be whatever serves the process of answering the research questions, e.g., Švábenský et al. (2020) did in their mapping study on cyber security education, limited solely to articles published in ACM's SIGCSE and ITiCSE conferences, and Da Silva et al. (2014) limited their primary studies solely on replication studies. It is worth noting that the criteria utilized by Švábenský et al. typically require solid arguments on why other similar fora were not considered in the mapping process.

In addition to the aforementioned criteria concerning article *metadata*, systematic mapping studies usually also define criteria concerning article *content*. These criteria can be related to how concepts are defined, which definitions are acceptable, whether an article focuses on the topic or merely mentions it, or whether the articles present empirical findings. For example, Oliveira et al. (2019) defined one of their exclusions criterium as "*the study does not present any type of findings or discussion about Data Ecosystems*."

Whatever you choose as your criteria, unless you are an expert on previously conducted research on the topic, prepare to iterate your criteria as your research progresses. That is, define your criteria as accurately as possible, but as you familiarize yourself more with the topic by reading potential primary studies, you are likely to learn more about the topic. This process may reveal that your initial criteria were ill-defined, inaccurate, unfeasible for a systematic mapping study, or simply based on incorrect assumptions.

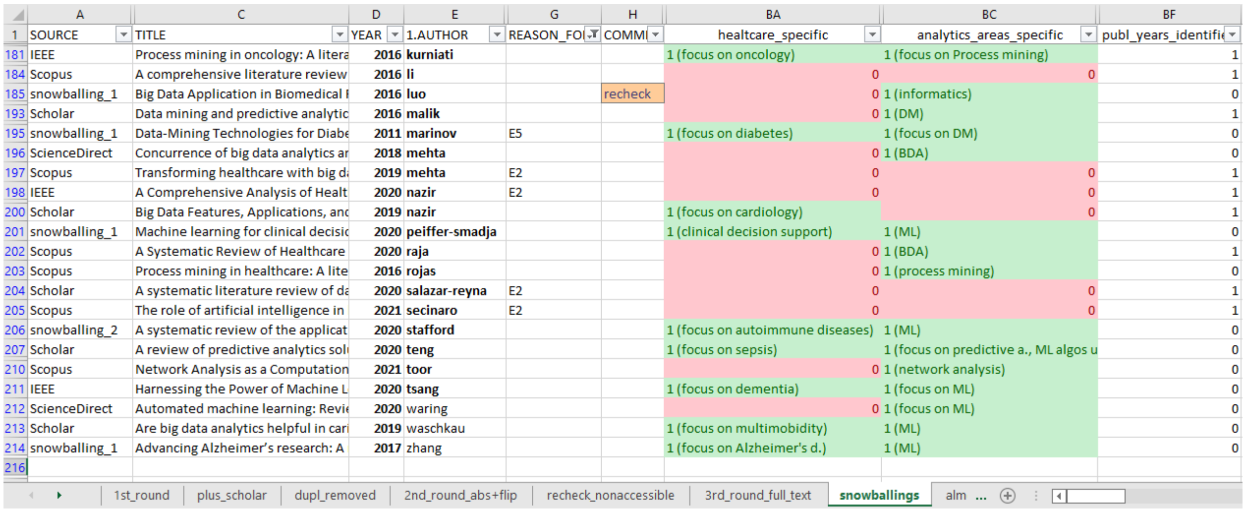
4. Database Searches

4.1 Select Relevant Databases

Selecting relevant databases to search for primary studies is a crucial step in finding and arguing for finding relevant prior works. In the field of information systems which lies in the intersection of information technology and several other disciplines such as business and economics, psychology, and management, it is arguably required to apply a wide selection of databases. Perhaps the most prominent database focused on information systems science fora is the Association for Information Systems (AIS) eLibrary. Other common and related databases are Association for Computing Machinery's (ACM) Digital Library, and the Institute of Electrical and Electronics Engineers' (IEEE) Xplore. ScienceDirect indexes journal articles and book chapters published by Elsevier, and Scopus indexes these and additional sources from scientific fora counted in tens of thousands. The databases listed here are also suitable for systematic mappings in fields such as software engineering, computer science, or information technology in general. Another approach is to utilize databases of selected journals if these are available. While Google Scholar indexes effectively all research, we have found it unsuitable for systematic mappings or systematic reviews because searches return stochastic results which number typically in tens or hundreds of thousands, making the selection process unnecessarily arduous and the search non-replicable by other researchers. If your criteria do not apply to publication fora, it is common to select two to five databases for the search.

Search term	Source
(("software develop* OR "system* develop*" OR "software engineer*") AND (competence*))	Assyne et al. (2021)
TITLE-ABS-KEY ((“IoT” OR “Internet of Things”) AND (medic* OR health* OR hospitals OR clinic* OR diseases))	Sadoughi et al. (2020)
((uml OR unified modeling language OR unified modelling language) AND (consistency OR inconsistency))	Torre et al. (2014)

Table 3. Examples of search terms and their reporting in selected systematic mapping studies



	A	C	D	E	G	H	BA	BC	BF
1	SOURCE	TITLE	YEAR	1.AUTHOR	REASON_FO	COMMI	healtcare_specific	analytics_areas_specific	publ_years_identifi
181	IEEE	Process mining in oncology: A litera	2016	kurniati			1 (focus on oncology)	1 (focus on Process mining)	1
184	Scopus	A comprehensive literature review	2016	li			0	0	1
185	snowballing_1	Big Data Application in Biomedical I	2016	luo		recheck	0	1 (informatics)	0
193	Scholar	Data mining and predictive analytic	2016	malik			0	1 (DM)	1
195	snowballing_1	Data-Mining Technologies for Diabe	2011	marinov	E5		1 (focus on diabetes)	1 (focus on DM)	0
196	ScienceDirect	Concurrence of big data analytics ar	2018	mehta			0	1 (BDA)	0
197	Scopus	Transforming healthcare with big da	2019	mehta	E2		0	0	1
198	IEEE	A Comprehensive Analysis of Healt	2020	nazir	E2		0	0	1
200	Scholar	Big Data Features, Applications, and	2019	nazir			1 (focus on cardiology)	0	1
201	snowballing_1	Machine learning for clinical decisio	2020	peiffer-smadja			1 (clinical decision support)	1 (ML)	0
202	Scopus	A Systematic Review of Healthcare	2020	raja			0	1 (BDA)	1
203	Scopus	Process mining in healthcare: A lite	2016	rojas			0	1 (process mining)	0
204	Scholar	A systematic literature review of da	2020	salazar-reyna	E2		0	0	1
205	Scopus	The role of artificial intelligence in	2021	secinaro	E2		0	0	1
206	snowballing_2	A systematic review of the applicat	2020	stafford			1 (focus on autoimmune diseases)	1 (ML)	0
207	Scholar	A review of predictive analytics solu	2020	teng			1 (focus on sepsis)	1 (focus on predictive a., ML algos u	0
210	Scopus	Network Analysis as a Computation	2021	toor			0	1 (network analysis)	0
211	IEEE	Harnessing the Power of Machine L	2020	tsang			1 (focus on dementia)	1 (focus on ML)	0
212	ScienceDirect	Automated machine learning: Revie	2020	waring			0	1 (focus on ML)	0
213	Scholar	Are big data analytics helpful in cari	2019	waschkau			1 (focus on multimobidity)	1 (ML)	0
214	snowballing_1	Advancing Alzheimer's research: A	2017	zhang			1 (focus on Alzheimer's d.)	1 (ML)	0
216									

Figure 2. Master file in Microsoft Excel; *E*s in column *G* refer to exclusion criteria

4.2 Define the Search Terms

After selecting the databases, you need to define your search terms. Based on the initial screening of articles, you should have at least a preliminary understanding of key terms, their synonyms, and the context they appear in. Most databases allow the use of logical operators, parentheses, and wildcards, but the syntax usually differs from database to database. It is worth noting, just in case, that e.g., the search string *"information AND systems OR education"* is not equivalent to *"(information AND systems) OR education"*, the latter being more restricting (cf. Table 3 for more examples).

Defining the search terms and iterating them is a crucial step toward selecting a feasible number of primary studies for inspection. While there is no commonly agreed number of search results to aim for, we have come to experience that the total number of search results from all your selected databases should not be more than 2,000 articles if you are conducting the systematic mapping on your own. If you have co-authors who can share the workload, more articles may be selected.

4.3 Extract Metadata and the Articles

After a search has been executed, many databases allow the extraction of the search results, i.e., article metadata such as title, author names, and publication forum as Microsoft Excel files (.xlsx) or as comma-separated values (.csv), and while each database offers this feature a little differently, the feature is usually there. If it is not, the process of extracting results manually is an arduous task, but usually worth the initial time. Having article metadata in a single file makes keeping track of the total of articles easier and helps with the final reporting. We call this record the *master file* (Figure 2). Gathering all the database searches in a single Excel spreadsheet (or similar) makes it easy to remove duplicates (simply sort by the column containing the article title), see publication years (sort by publication year), and keep track of which articles are still part of the systematic map, and which are not and why. We like to color the cells that fail some criterion and use an additional column in which we type which criterion was not met.

5. Study Screening

5.1 Selection Based on Title

We like to select the articles based on three rounds of reading, i.e., selection based on title, selection based on abstract and keywords, and finally selection based on full text reading. Selection based on title is typically easiest done using a spreadsheet (or wherever you have compiled your search results). Before starting to read the titles, however, be sure to apply exclusion criteria concerning the publication years and fora, if any, to avoid unnecessary work. When you start reading the titles, most of them typically reveal that the article does not fit the scope of your mapping. This is because many databases return results in abundance, and the connection between an article and your search terms may not always be clear. Sometimes, though, a title clearly implies that the article is relevant, or that further inspection is warranted. It is not uncommon that even up to 90 percent of the articles returned by the database searches are excluded based on the reading of the title alone.

5.2 Selection Based on Abstract

Second, you start familiarizing yourself with the primary studies by reading the abstracts of articles that were either clearly or borderline relevant. At this stage, articles that were deemed clearly relevant based on the title may turn out to be outside the scope of the systematic mapping, and borderline articles may reveal themselves as relevant or irrelevant. Again, you should note which of the articles were excluded at this stage and why by explicitly referring to your criteria. A yardstick for work required at this stage can be roughly measured by considering that a typical abstract is approximately 200 words in length and reading 30 abstracts amounts to reading one full-length article of 6,000 words.

5.3 Selection Based on Full Text

Third, and depending on your criteria, this step may involve quick skimming or thorough reading of the full articles. For example, if you have defined your criteria in a way that you only include studies with empirical results, reading the methodology and results sections of the articles may be enough. In contrast, if your criteria involve strict adherence to a definition of a concept, for example, you may need to read the full texts thoroughly. Nevertheless, the number of articles at this stage is typically measured in dozens, not hundreds.

Once you are quite sure that an article fits your criteria, you may want to download or otherwise save it for easier access in the future (if you have not done so already). However, sometimes full text articles may be difficult to find or access. While many academic institutions provide access to various databases with full text articles, it is useful to know that while this way is often the easiest, in case it is not available, there are other ways. Often, a Google Scholar search reveals other sources than that of the publishers, e.g., the article can be stored as a final draft (that is, a version that was accepted for publication, but not necessarily typeset or formatted as the final publication) in the author's organization's repository. A search on arXiv can also reveal a final draft that is available without a subscription. Finally, if all else fails, authors are often more than happy to send a copy of their article against a request via ResearchGate or email. The easiest place to search for the author's email is typically on the first page of an article.

5.4 Refine Criteria

No matter how pedantic you were in defining your inclusion and exclusion criteria earlier, it is rather typical that after reading the full articles, you may need to iterate your criteria. For example, you may have narrowed your systematic mapping to cognitive load theory in educational contexts. However, after you read the articles, you begin to understand that there are many interpretations of cognitive load theory, some of which fit your initial definition and some of which do not. For the repeatability of your systematic mapping, you may need to revise your criteria and re-apply them to all the articles to see whether they still qualify for your systematic mapping. After this stage, it is typical that no articles are excluded anymore.

5.5 Snowballing

Effectively all database searches are subject to omitting key works – or alternatively, returning too many articles for a feasible title-based reading. This challenge can be mitigated by a process called *snowballing*, i.e., following either references or citations to capture relevant works more inclusively (Wohlin et al., 2022). Effectively, you read the lists of references of your selected primary studies (this is called *backward snowballing*) and include relevant works. Alternatively, or additionally, you may check which newer studies cite your selected primary studies (this is called *forward snowballing*). Among others, Google Scholar (Figure 3, right side top), Wiley Online Library (Figure 3, right side bottom), and Web of Science provide a list of works that cite a particular study. Snowballing can be done several times to better ensure that all relevant works are included in the systematic mapping, as on the right side in Figure 1.

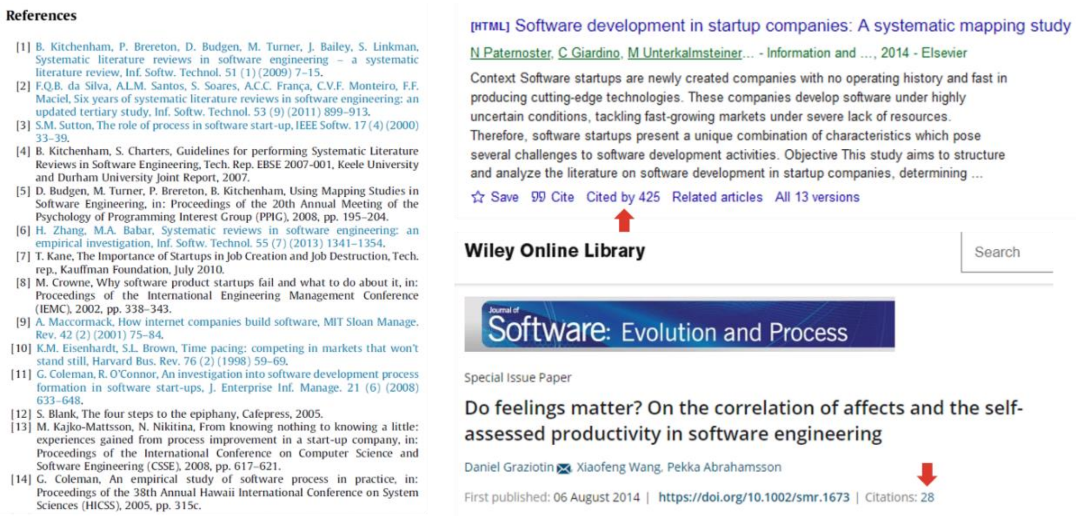


Figure 3. Backward snowballing is conducted by following the lists of references (left side from Paternoster et al., 2014), and forward snowballing by exploring studies that cite the selected primary study (see red arrows in both right-side figures)

Now that you have selected your primary studies, it is time to read them thoroughly, especially with your research questions in mind. If you chose to categorize your primary studies by, e.g., research approach and topic as discussed in Section 3.2, you should also write them down in your master file.

6. Reporting

6.1 Reporting the Systematic Map

Once you have completed your systematic mapping, it is time to compile the process and the systematic map as a research article. This is typically done in two parts. First, as the process is *systematic*, it is crucial that it is reported as explicitly as feasibly possible for repeatability. Crucial parts to report from the systematic process are the inclusion and exclusion criteria, databases selected, search terms, the number of results from each database, and the number of articles selected for inclusion in each step of the process. Refer to the examples in the previous sections for reporting each of these parts.

Second, you need to report the systematic map, i.e., the results of your systematic mapping process. What you report in your systematic map depends on your research questions, many of which are likely to be typical for a mapping study (cf. Section 3.2). Two common findings to report are publication years (cf. Figure 4) and publication fora. On the left side of Figure 4, notice how each selected primary study (identifiers inside the circles) is positioned according to the publication year. Additionally, the chart shows the publication forum for each primary study presented by the acronyms. On the right side of Figure 4, in addition to reporting the number of primary studies published each year, the stacked bar chart shows the research approaches of the primary study each year, and it is relatively easy to see from the chart that, e.g., empirical research on the subject is on a steady rise.

If you chose to map research approaches and themes, these are commonly reported in a form of a bubble chart (cf. Figure 5). A bubble chart gives a quick overview of which themes research has focused on (and perhaps neglected) and how these themes have been studied. Notice in Figure 5 that research foci and gaps are relatively easy to spot, e.g., validation research on requirements engineering studies seems to be scarce. You may also want to consider using other types of presentations or visualizations of information that may help you to explain your findings. For example, Taipalus and Seppänen (2020) found that based on their selected primary studies, the field of SQL education seems segregated into research silos, and studies in some silos seldom cite studies in other silos. To more effectively explain this, the authors constructed a citation graph (Figure 6). Finally, you may want to consider whether to include the list of your selected primary studies in your list of references, or as a separate list or appendix. This approach clearly separates the studies selected for your systematic map from the studies you have utilized in your introduction and background sections.

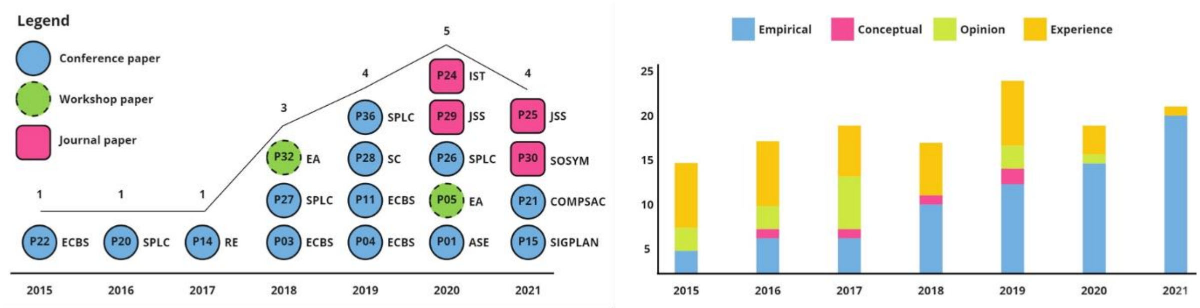


Figure 4. Examples of visualizations of publication trends by year (left side adapted from Bischoff et al., 2019, right side adapted from Isomöttönen et al., 2018)

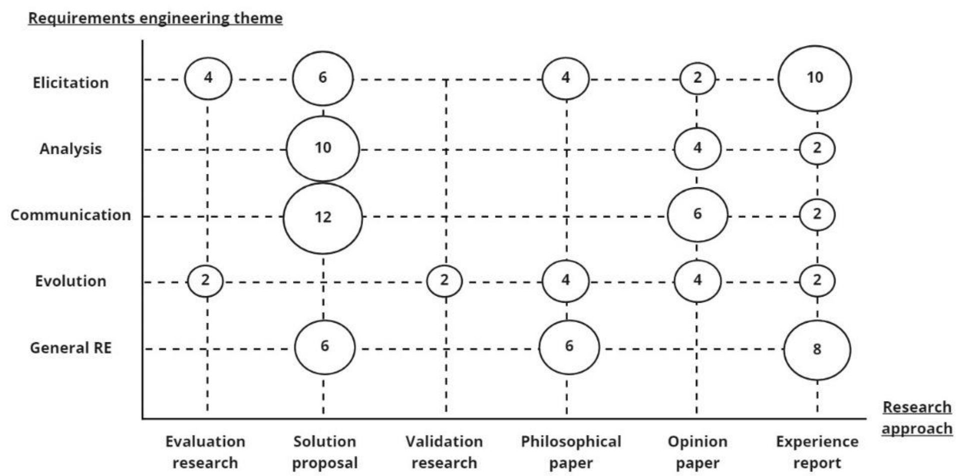


Figure 5. A typical bubble chart where the bubble size in the intersection of themes and research approaches represents the number of primary studies (adapted from Lemos et al., 2012)

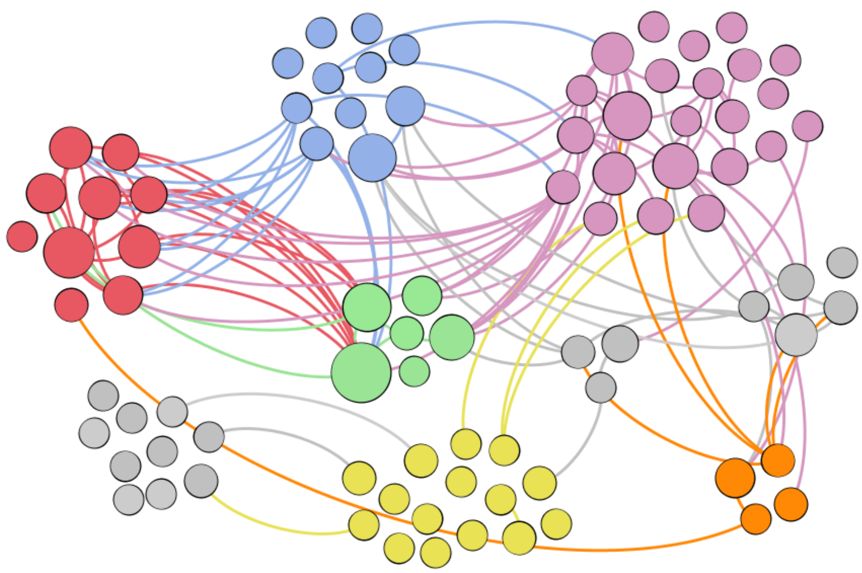


Figure 6. A citation graph showing citations among primary studies to highlight the segmentation of the research field (adapted from Taipalus & Seppänen, 2020)

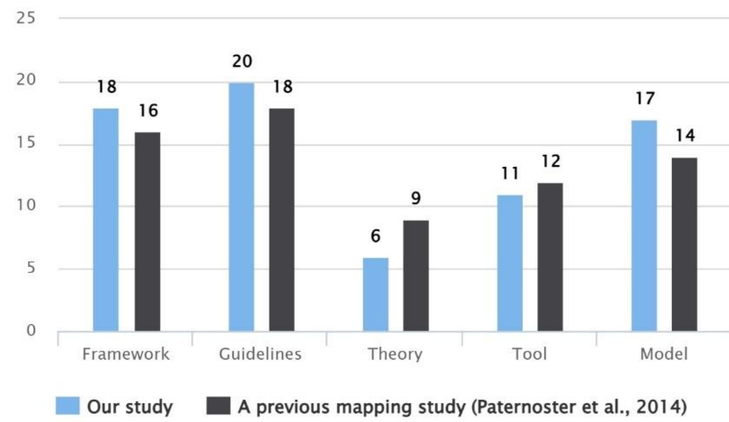


Figure 7. A bar chart comparing the number of primary studies in each theme to the results of another systematic mapping study (adapted from Berg et al., 2018)

6.2 Formulating a Synthesis and Discussing the Implications

After conducting the systematic mapping study, you are likely one of the few researchers who know your exact topic to this degree. Along with your relatively objective systematic map, your more subjective input on the state of research, industry, and education concerning the topic is the most interesting part of your research. Do not leave the discussion on the practical implications of your systematic map to the level of "*the systematic map provides an increased level of understanding concerning the topic"*. Rather, compile and interpret your findings, and provide concrete suggestions on to how these insights can be utilized by other researchers, industry, and educators. Is research concerning the topic increasing or declining over the years? Why? What does this trend imply and how should we react? Did you notice research gaps or focus points? Where? Are these insights important and for whom? Compare your results to other similar or tangential systematic maps and literature reviews, if applicable. What can you infer from such comparisons? This is the part of your research where you can show your expertise (or lack thereof) accumulated during the mapping process.

6.3 Reporting Threats to Validity

Kitchenham et al. (2010) emphasize rigor in conducting the systematic mapping study for the results to be a valid baseline for other researchers. Effectively all research is subject to several threats to validity, i.e., factors that can have unexpected and unwarranted effects on the results. By following systematic mapping guidelines and reporting all steps explicitly and transparently, you can mitigate many of the acknowledged threats to validity concerning systematic mapping studies. For example, snowballing is conducted to further ensure that you have not missed relevant primary studies due to ill-phrased search terms or database selections.

If you conducted the mapping study as the sole author, your main threat to validity is probably the fact that the primary study selection and categorization (by research approach, theme, etc.) is based solely on your subjective interpretation. If you conducted the mapping study as a bachelor's or a master's thesis, which is typically a single-author work, there is usually not much you can do to mitigate this threat. Based on conventions in your institution, you may ask if you can use the help of another student or your thesis supervisor to validate a part of your work. Commonly used metrics for measuring agreement between researchers selecting and classifying primary studies are Fleiss' (1981) or Cohen's (1960) Kappa. If there are other systematic mapping studies with similar subject areas and research questions, consider comparing their results with yours, as presented in Figure 7. Nevertheless, reporting any threat to validity, even in the case you did not or could not mitigate it, shows that you understand the potential pitfalls in the research method, and in your application of it.

6.4 Further Reporting for Transparency

Instead of simply reporting the numbers of primary studies by research approach, you might be asked to explicitly show which particular primary studies you have categorized to which research approach. You might be required to report which potential primary studies you excluded and why. A reviewer or a supervisor may request that you list all the research articles returned by your database searches, not only the number of results from each database. With these considerations in mind, keeping your systematic mapping process explicitly reported throughout all the steps in the process will help you if more transparent reporting is required. Even if it is not, you can include your master file in your research as a supplementary appendix from the very beginning.

7. Discussion

7.1 Incentives for Using a Systematic Mapping Study

Compared to other research methods, a systematic mapping study is a relatively accessible and agile way of experiencing the underlying mechanisms of the scientific method. Starting with data collection, a systematic mapping study is as effortless as other secondary research methods such as systematic literature reviews. The method is also applicable to various fields of science such as education, medicine, art, and business (Vanhala et al., 2022). If the researcher has access to relevant scientific databases, the data collection process can begin relatively effortlessly. Furthermore, a systematic mapping study is not subject to data collection problems arising from the uncertainty of finding study participants, sometimes long waiting times of acquiring enough data, or the risk of selecting a participant sample that does not represent the population. While such considerations are relatively common in scientific research, they arguably take from the process of learning the application of a scientific method or halt the process completely. Furthermore, the primary study selection process may be iterated with relative ease, and without committing to a decision in the early phases of the research.

In the analysis phase, a systematic mapping study does not necessarily require methodological expertise besides applying the systematic mapping process. Should the researcher choose so, however, both qualitative and quantitative methods may be applied to the selected primary studies. Generally, however, the process of applying the systematic mapping process is more about understanding the subject matter, rather than applying a method. Guidelines for reporting a systematic mapping study such as those of Petersen et al. (2008, 2015) and Kitchenham (2004) also discuss and recommend that the researchers consider and report different threats to validity. These considerations are suitable for the teaching of the scientific method through a systematic mapping study, as the effects of mitigating threats to validity are rapidly reflected upon the selection or categorization of the primary studies.

7.2 Limitations of a Systematic Mapping Study

While a systematic mapping study can be suitable for applying the scientific method in practice, the method emphasizes the accumulation of knowledge on the subject matter over developing skills important for a researcher in general. As the data collection process is merely concerned with primary studies and not participant-generated data, applying the method does not yield the researcher the experience of working with anomalous or missing data, or with unexpected values therein. Furthermore, as the systematic mapping process does not require the researcher to commit to an approach early on, this agile approach may not teach the importance of planning the research as deeply as a failed experiment with weeks or months of planning.

In the analysis phase, the researcher may not be subjected to research methods other than the systematic mapping process. While this is true with other research methods as well (i.e., a study with a regression analysis only applies regression analysis), it might be seen as a weakness because new knowledge yielded by a systematic mapping study is largely limited to what can be synthesized, abstracted, or inferred from the primary studies. In this regard, the research avenues are limited to those of prior studies. All in all, the systematic mapping study is a fast and relatively risk-free approach to learning many of the principles of the scientific method. While a systematic mapping study is unlikely to be hindered by data collecting or analysis-related issues, from a pedagogical point of view, it is important to understand the limitations as well.

8. Conclusion

Systematic mapping studies are often warranted in order to form and report a high-level overview of research directions, gaps, and trends regarding a particular scientific topic. In this study, we presented accessible systematic mapping study guidelines and examples targeted specifically for novices and information systems research. Additionally, we presented arguments for utilizing systematic mapping studies in teaching the principles behind the scientific method and discussed the limitations of using a systematic mapping study. These guidelines may be utilized by both educators teaching the process of systematic mapping study in information systems research, as well as by learners in applying the method in practice.

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