Systematic Mapping Studies And Systematic Literature Reviews

EMSE-UVic Fall 2020

Margaret-Anne Storey

Week 5, Oct 9/2020

"Indeed, one of my major complaints about the computer field is that whereas Newton could say, "If I have seen a little farther than others, it is because I have stood on the shoulders of giants,"

I am forced to say, "Today we stand on each other's feet." Perhaps the central problem we face in all of computer science is how we are to get to the situation where we build on top of the work of others rather than redoing so much of it in a trivially different way. Science is supposed to be cumulative, not almost endless duplication of the same kind of things".

Richard Hamming 1968 Turning Award Lecture

History of SLRs in software engineering

Rather new, only since the 90’s

Inspired by evidence based medicine

‘the conscientious, explicit, judicious use of current best evidence in making decisions about the care of individual patients.’ (Sackett et al. 1996)

Kassa *BMC Infectious Diseases* (2018) 18:216
https://doi.org/10.1186/s12879-018-3126-5

BMC Infectious Diseases

RESEARCH ARTICLE Open Access

Mother-to-child transmission of HIV infection and its associated factors in Ethiopia: a systematic review and meta-analysis

Getachew Mullu Kassa

Abstract

Background: Mother-to-child transmission (MTCT) is the main mode of HIV transmission in children under 15 years old. This problem is significant in the Sub-Saharan African countries, where more than 80% of children living with HIV are found. Previous studies in Ethiopia present inconsistent and inconclusive findings on the prevalence and associated factors of MTCT of HIV. Therefore, this study was conducted to determine the pooled prevalence of MTCT of HIV and its associated factors in Ethiopia.

Methods: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline was followed. All published studies were retrieved using relevant search terms in MEDLINE, PUBMED, Cochrane Library, EMBASE, Google Scholar, CINAHL, and African Journals Online databases. Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) was used to critically appraise articles. STATA version 14 software was used to perform the Meta-analysis. The I^2 statistics was used to test heterogeneity and publication bias was assessed using Begg's and Egger's tests. Odds ratio (OR) with 95% confidence interval (CI) was presented using forest plots.

Results: A total of nine studies, 3688 mother-baby pairs, were included in this meta-analysis. The pooled prevalence of MTCT of HIV in Ethiopia was 9.93% (95% CI: 7.29, 12.56). The subgroup analysis showed a higher prevalence of MTCT of HIV in Dire Dawa City Administration (15.7%) and lowest in Southern Nations, Nationality and Peoples Region (SNNPR) (4.16%). Associated factors with MTCT of HIV include: mixed feeding, OR = 7.46 (95%CI: 4.71, 11.81), absence of infant ARV prophylaxis, OR = 7.89 (95%CI: 4.32, 14.42), home delivery, OR = 5.08 (95%CI: 2.32, 11.15), and absence of maternal PMTCT intervention, OR = 7.13 (95% CI: 3.31, 15.35).

Conclusions: Almost one in ten HIV exposed infants become HIV positive in Ethiopia. Factors like: mixed feeding, the absence of infant ARV prophylaxis, home delivery and absence of mother's PMTCT intervention were significantly associated with MTCT of HIV. Therefore, the governmental and non-governmental organizations need to focus on the identified factors and work towards improving the prevention of mother to child transmission of HIV (PMTCT) program.

Keywords: HIV, PMTCT, MTCT, Prevalence of MTCT of HIV, Vertical HIV transmission, HIV-exposed infant, Systematic review, Meta-analysis, Ethiopia

Correspondence: gechm2005@gmail.com
College of Health Sciences, Debre Markos University, Debre Markos, Ethiopia

Evidently Cochrane

Sharing health evidence you can trust

Chapman S. "Convalescent plasma to treat people with COVID-19: the evidence so far". Evidently Cochrane blog, 15 May 2020, last updated 10 July 2020. https://www.evidentlycochrane.net/convalescent-plasma

"Convalescent plasma to treat people with COVID-19: the evidence so far"

Take-home points

- A Cochrane rapid review with 20 studies, including one small randomized controlled trial, shows that the effectiveness and safety of convalescent plasma for people with COVID-19 are uncertain.
- The review authors identified 98 ongoing studies, including 50 randomized trials.
- This review is being regularly updated as a 'living systematic review', based on monthly searches for new evidence, and the results are likely to change.

Glossary (1 of 2)

Primary study. (In the context of evidence) An empirical study investigating a specific research question.

Secondary study. A study that reviews all the primary studies relating to a specific research question with the aim of integrating/synthesising evidence related to a specific research question.

Tertiary study (also called a tertiary review) is a review of secondary studies related to the same research question.

Glossary (2 of 2)

"***Systematic mapping study*** (also referred to as a scoping study): A broad review of primary studies in a specific topic area that aims to identify what evidence is available on the topic." (Kitchenham and Charters, 2007)

"***Systematic literature* review:** (also referred to as a systematic review). A form of secondary study that uses a well-defined methodology to identify, analyse and interpret all available evidence related to a specific research question in a way that is unbiased and (to a degree) repeatable." (Kitchenham and Charters, 2007)

"***Reliability*:** Demonstrating that the operations of a study – such as the data collection procedures – can be repeated, with the same results." (Yin, 2009)

Typology of literature reviews

Narrative literature review

Situates a study within the relevant literature, non-systematic

Systematic literature review

Provides a comprehensive summary of literature

Systematic **mapping** review

Characterizes quantity and themes of research in an area

Systematic **scoping** review

Similar to mapping, but considered preliminary

For even more types: http://bit.ly/2h2IVqE

https://research-seminar.github.io/slides/EiriniKalliamvakou_SystematicLiteratureReviews.pdf

A common point of confusion!

Systematic literature mapping studies → structure a research area

Systematic literature reviews gather and synthesize evidence

General advice...

Do a mapping study before a systematic literature review…

Systematic Mapping Studies

Research goals for a mapping study may be:

- To examine the extent, **range** and **nature** of research activity (service)
- To determine the **value** of undertaking a full systematic review
- To summarize and **disseminate** research findings (comprehensive overview, inventory of studies)
- To identify **gaps** in the literature (well cited)

Mapping study steps

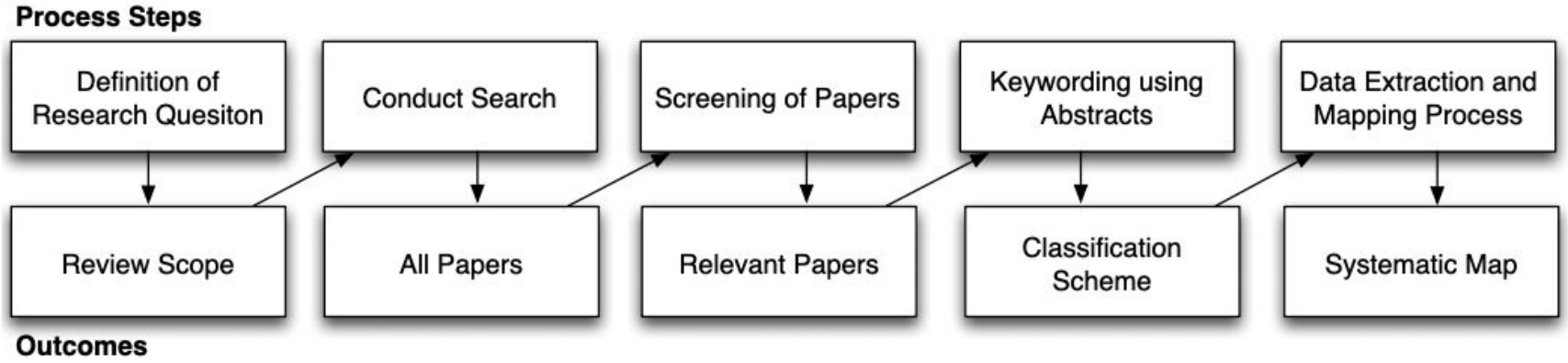
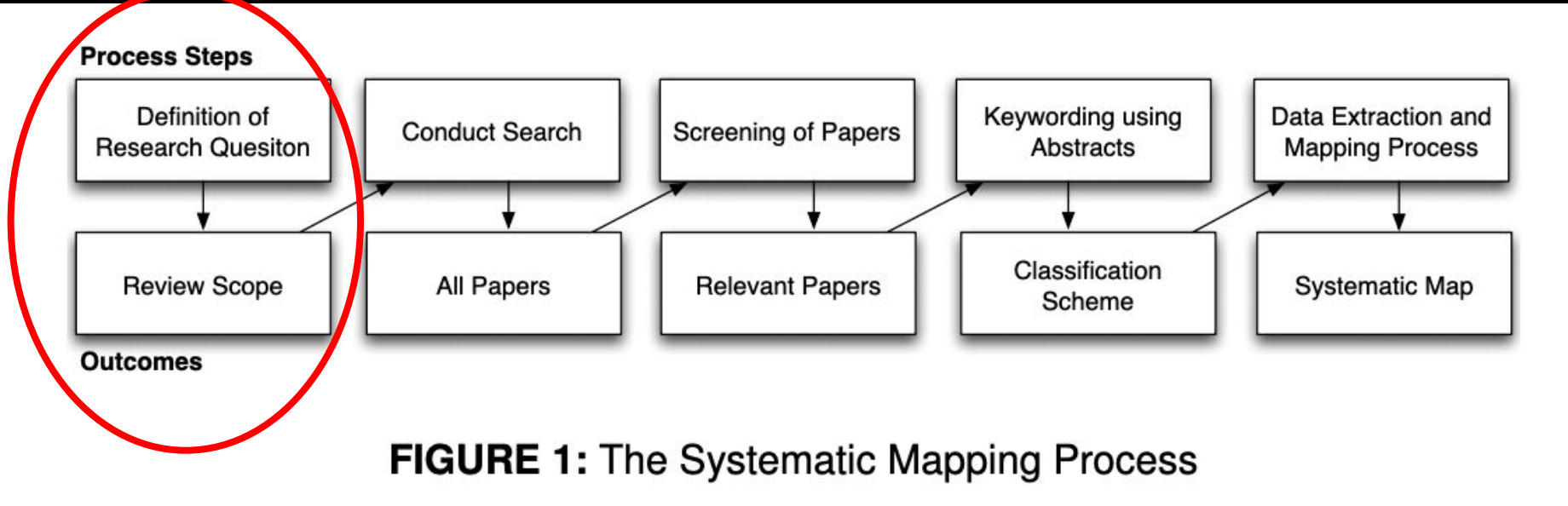


FIGURE 1: The Systematic Mapping Process

http://robertfeldt.net/publications/petersen_ease08_sysmap_studies_in_se.pdf

Mapping study steps



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Research scope (Mapping studies…)

You want to provide an overview of a research area

Identify quantity/type of research, available results

Frequency of publications over time

Identify which forums publish research in an area

http://robertfeldt.net/publications/petersen_ease08_sysmap_studies_in_se.pdf

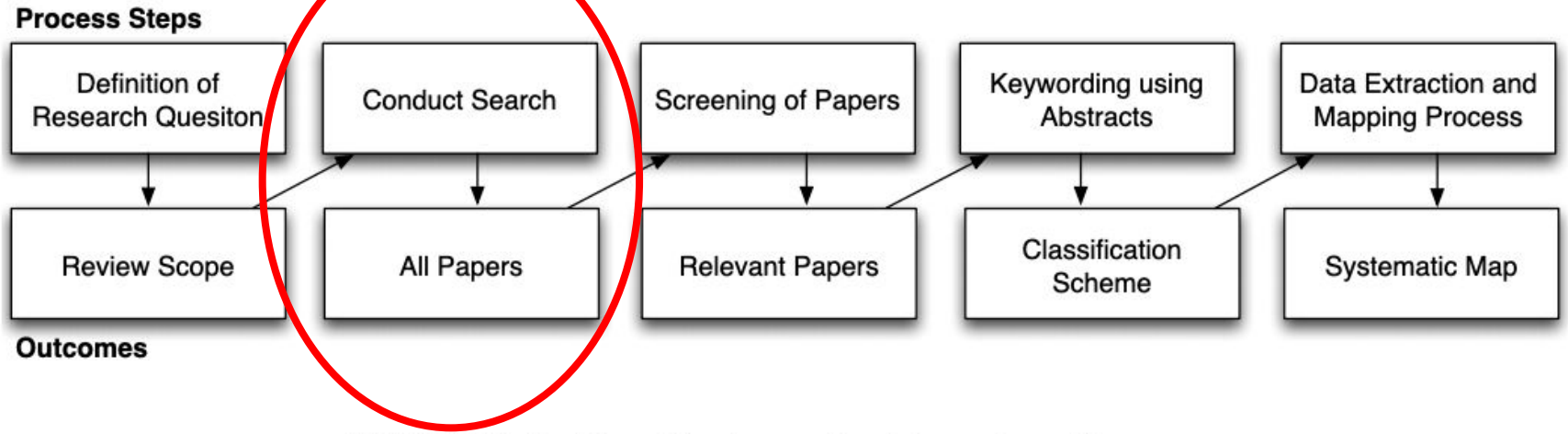
Research questions

TABLE 1: Research Questions for Systematic Maps

Object Oriented Design Map (Bailey et al. 2007)	Software Product Line Variability Map (Mujtaba et al. 2008)
RQ1: Which journals include papers on software design? **RQ2:** What are the most investigated object oriented design topics and how have these changed over time? **RQ3:** What are the most frequently applied research methods, and in what study context?	**RQ1:** What areas in software product line variability are addressed and how many articles cover the different areas? **RQ2:** What types of papers are published in the area and in particular what type of evaluation and novelty do they constitute?

http://robertfeldt.net/publications/petersen_ease08_sysmap_studies_in_se.pdf

Mapping study steps



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Search for primary studies

Scientific databases, or manually through conference proceedings or journals

Object Oriented Design Map: (”object oriented” AND ”design” AND ”empirical evidence”) OR (”OO” AND ”empirical” AND ”design”) OR (”software design” AND ”OO” AND ”experimental”)

Software Product Line Variability Map: ”software” AND (”product line” OR ”product family” OR ”system family”) AND (”variability” OR ”variation”)

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Use PICO(C) when formulating the search string (if relevant!)

Population: role, category of software engineer, an application area, industry group… (i.e., who will be affected by an intervention…)

Intervention: a methodology, tool, technology, or procedure that is studied

Comparison: what is being compared (e.g., conventional versus new)

Outcomes: of the studied interventions (factors studied, e.g., cost, quality)

Context: Where the comparison takes place (e.g., open source, academia, industry)

https://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf
http://robertfeldt.net/publications/petersen_ease08_sysmap_studies_in_se.pdf

Example (from an SLR…)

Population: software or Web project.

Intervention: cross-company project effort estimation model.

Comparison: single-company project effort estimation model.

Outcomes: prediction or estimate accuracy.

https://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf

Study identification considerations

Are there already well known sub-areas of the field covered in other mapping studies?

Are the main publication forums specific to this area or to more general topics

Are there explanations for major changes in the number of studies published per year (e.g., bots versus chatbots)

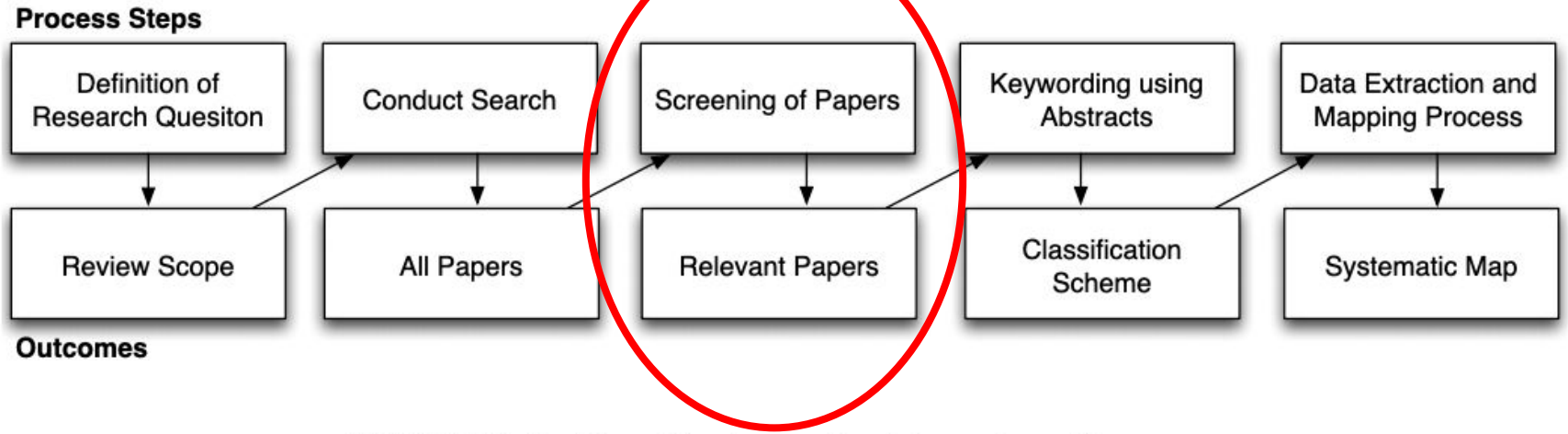
Choose articles from distinct communities (that don't cite each other)

Use snowballing

Use PICO to develop the search term (not all may apply)

Define a stopping criteria (e.g., search terms and manual search reveal no new papers)

Mapping study steps



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Inclusion/exclusion criteria

Inclusion criteria may include venues, time period, quality criteria, language, topic

Exclusion criteria may refer to lower quality venues, articles non peer reviewed, domain, shallow treatment of topic…

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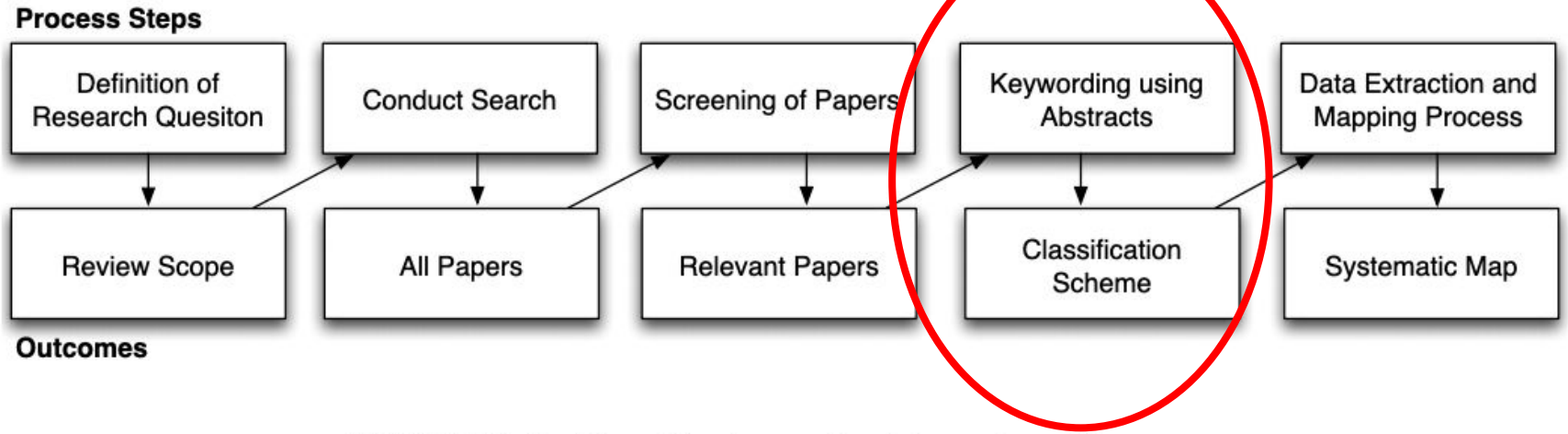
Mapping study steps



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Data extraction and classification

Normally consider the title, abstract in the earlier phases...

- Topic (e.g., using Swebok, keywords…)
- Research type (see next slide)
- Research method (e.g., case study, experiment…)

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TABLE 3: Research Type Facet

Category	Description
Validation Research	Techniques investigated are novel and have not yet been implemented in practice. Techniques used are for example experiments, i.e., work done in the lab.
Evaluation Research	Techniques are implemented in practice and an evaluation of the technique is conducted. That means, it is shown how the technique is implemented in practice (solution implementation) and what are the consequences of the implementation in terms of benefits and drawbacks (implementation evaluation). This also includes to identify problems in industry.
Solution Proposal	A solution for a problem is proposed, the solution can be either novel or a significant extension of an existing technique. The potential benefits and the applicability of the solution is shown by a small example or a good line of argumentation.
Philosophical Papers	These papers sketch a new way of looking at existing things by structuring the field in form of a taxonomy or conceptual framework.
Opinion Papers	These papers express the personal opinion of somebody whether a certain technique is good or bad, or how things should been done. They do not rely on related work and research methodologies.
Experience Papers	Experience papers explain on what and how something has been done in practice. It has to be the personal experience of the author.

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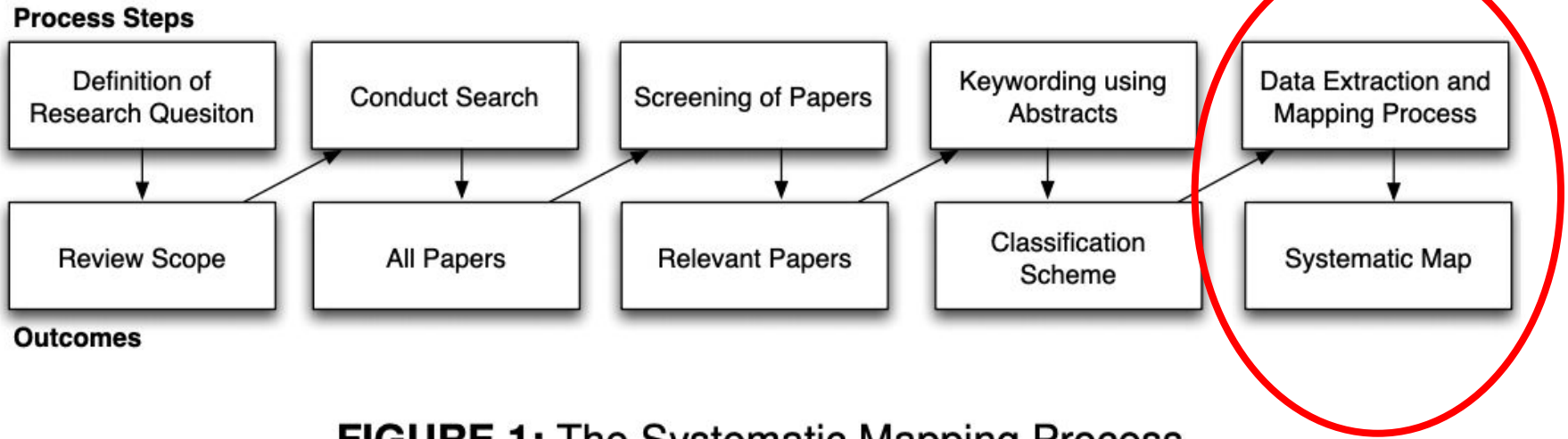
Mapping study steps



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Developing a Systematic Map

Sort the articles using the scheme you chose

Visualize the results

You may include frequency information or other categories (be creative!)

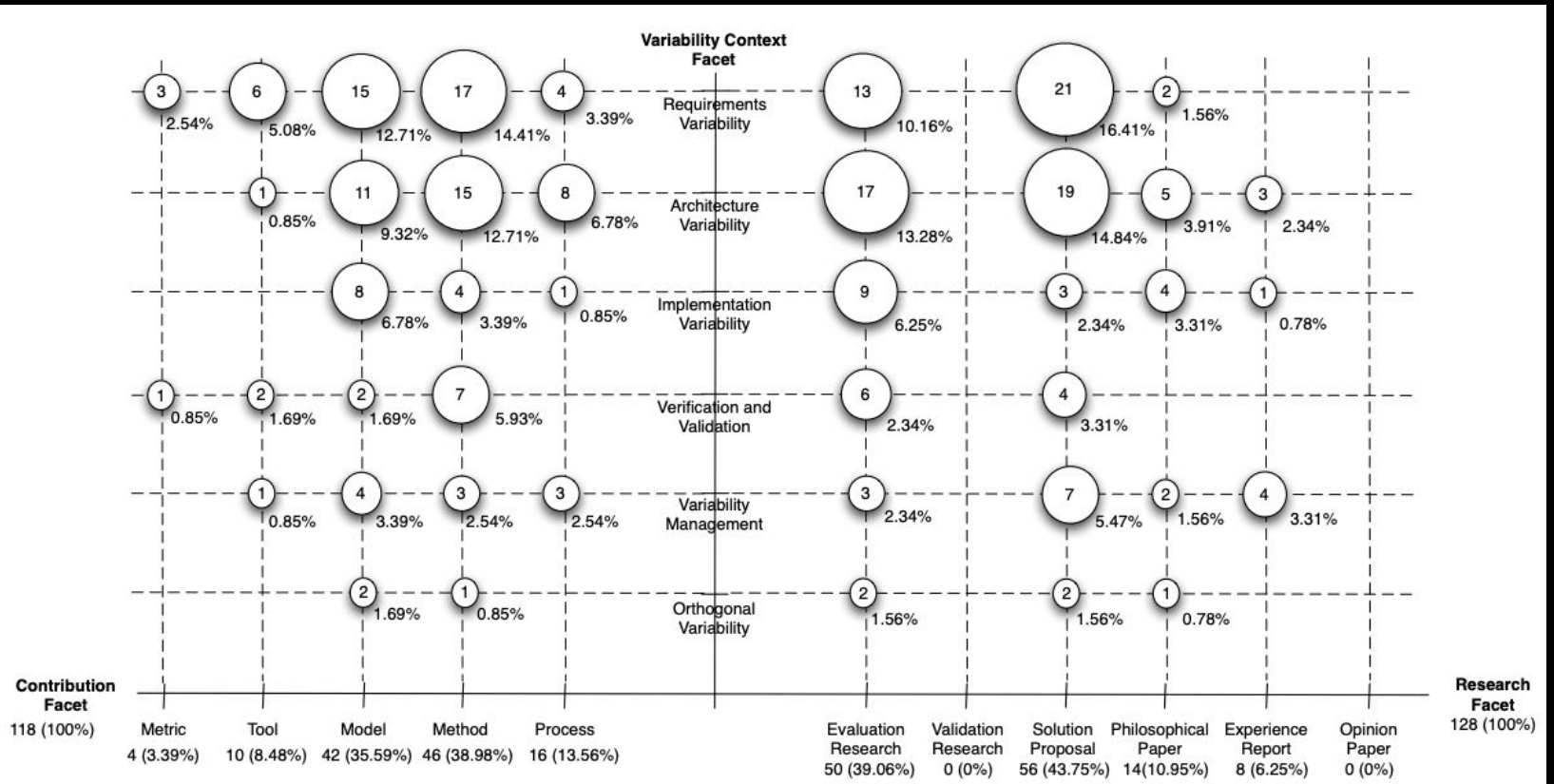

FIGURE 3: Visualization of a Systematic Map in the Form of a Bubble Plot

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Validity Evaluation of Mapping Studies

Descriptive validity: are the observations described accurately and objectively? (keep quotes…)

Theoretical validity: do you capture what you intend to capture? (are there biases in the selection process? Articles missed? Did someone else review the map?)

Repeatability: is the process reported in detail? Are existing guidelines used?

Systematic Literature Reviews

https://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf

Systematic Literature Review

"…a means of evaluating and interpreting all available research relevant to a particular research question, topic area, or phenomenon of interest. Systematic reviews aim to present a fair evaluation of a research topic by using a trustworthy, rigorous, and auditable methodology." (Keele Staff, 2007)

https://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf

Features of systematic literature reviews

A clearly defined review protocol that specifies the research question and methods to conduct the review

Defined and documented search strategy that will capture as much of the relevant research as possible

Explicit inclusion, exclusion and quality criteria to assess each potential primary study

(a prerequisite for any quantitative meta-analysis)

https://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf

Research question examples for SLRs

Assessing the effect of a software engineering technology

Assessing the frequency or rate of a project development factor such as the adoption of a technology, or the frequency or rate of project success or failure

Identifying cost and risk factors associated with a technology

Identifying the impact of technologies on reliability, performance and cost models

Cost benefit analysis of employing specific software development technologies or software applications

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Critiquing your questions!

Is the question meaningful and relevant to practitioners and/or researchers?

Will the review lead to any changes in practice or in how or which research is conducted?

Will the review confirm existing or lead to new knowledge?

Will the question dispute or help reveal discrepancies between commonly held beliefs and reality?

Data extraction instruments

You may want to develop a form to capture the data you extract from the papers (especially for quantitative data)

Having a second “extractor” independently code the paper helps address errors and biases

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Table 7 Data Collection form completed for Maxwell et al., 1998

Data item	Value	Additional notes
Data Extractor		
Data Checker		
Study Identifier	S1	
Application domain	Space, military and industrial	
Name of database	European Space Agency (ESA)	
Number of projects in database (including within-company projects)	108	
Number of cross-company projects	60	
Number of projects in within-company data set	29	
Size metric(s): FP (Yes/No) Version used: LOC (Yes/No) Version used: Others (Yes/No) Number:	FP: No LOC: Yes (KLOC) Others: No	
Number of companies	37	
Number of countries represented	8	European only
Were quality controls applied to data collection?	No	
If quality control, please describe		
How was accuracy measured?	Measures: R^2 (for model construction only) MMRE Pred(25) r (Correlation between estimate and actual)	

https://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf

Quality assessment

Focusing on quality of included (primary) papers is more relevant for systematic reviews than mapping studies

Quality differences may provide explanations for differences in study results

Will help you “weigh” the evidence from individual studies during synthesis, guiding recommendations, future research

Assessing quality is not straightforward (and is controversial)!

Reliability of inclusion decisions

When two or more researchers assess each paper, agreement between researchers can be measured using the Cohen Kappa statistic

https://idostatistics.com/cohen-kappa-free-calculator/#calculator

Validity threats (similar to mapping studies)

Publication bias (theoretical validity)

Poorly design data extraction forms and and recording of data (descriptive validity)

Quality of the sample of studies with respect to the population (theoretical validity)

Generalizability of the results

*Reliability of conclusions drawn (more specific to reviews)

	Mapping studies:	**Systematic literature reviews:**
Research questions	General questions about the topic, what has been done	More specific, aim to aggregate evidence
Search process	Considers the landscape of research/topics/area	Driven by a research question
Quality assessment	Less important to do (but may be discussed)	Rigor and relevance of primary studies is very important
Results	Descriptive	Theoretical insights, framework, synthesizes evidence, may lead to new hypotheses

Replication challenges

These studies often lead to different papers and findings (note: searches of digital libraries are almost impossible to replicate!)

Poor phrasing of questions

More may not be better

Articles may be missed (search process, inclusion criteria)

Value to future research, education, practice is questionable

But often beneficial for students

unibz

SOFTWARE
AND SYSTEMS
ENGINEERING
research group

Case Survey Studies in Software Engineering Research

Jorge Melegati and Xiaofeng Wang
Free University of Bozen-Bolzano, Italy
October 2020

Activity on literature reviews

Using the definitions we heard today, how would you classify the following literature reviews?

A systematic review on regression test selection techniques, https://portal.research.lu.se/portal/files/4288476/3738217.pdf by Engstrom et al., IST 2010.

Motivation in Software Engineering: A systematic literature review, https://www.researchgate.net/publication/260734375_Motivation_in_software_engineering_A_systematic_review_update/link/02e7e53c143b195ba1000000/download, by Beecham et al., IST 2008.

Behavioral software engineering: A definition and systematic literature review, https://www.sciencedirect.com/science/article/abs/pii/S0164121215000989 by Per Lenberg et al., JSS 2015.

Defining and Classifying Software Bots: A Faceted Taxonomy, https://alexeyza.com/pdf/botse2019invited.pdf by Lebeuf et al., ICSE/BotSE 2019.