[Sistematic] Mapping Study
(also known as Scoping Review)

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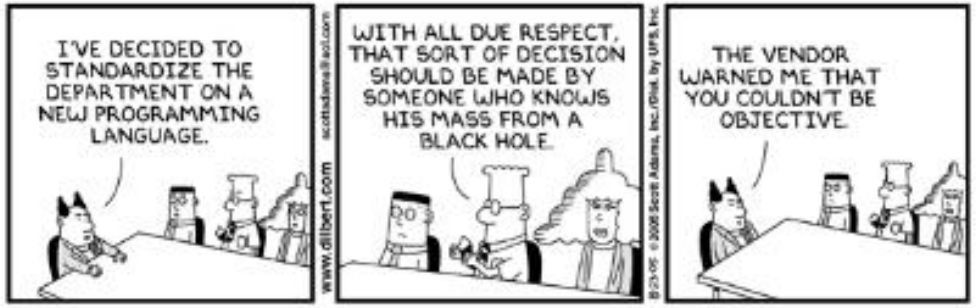
EBSE



Evidence-Based Software Engineering: A Paradigm for the Future?

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JavaZone, Oslo, 15 September 2005

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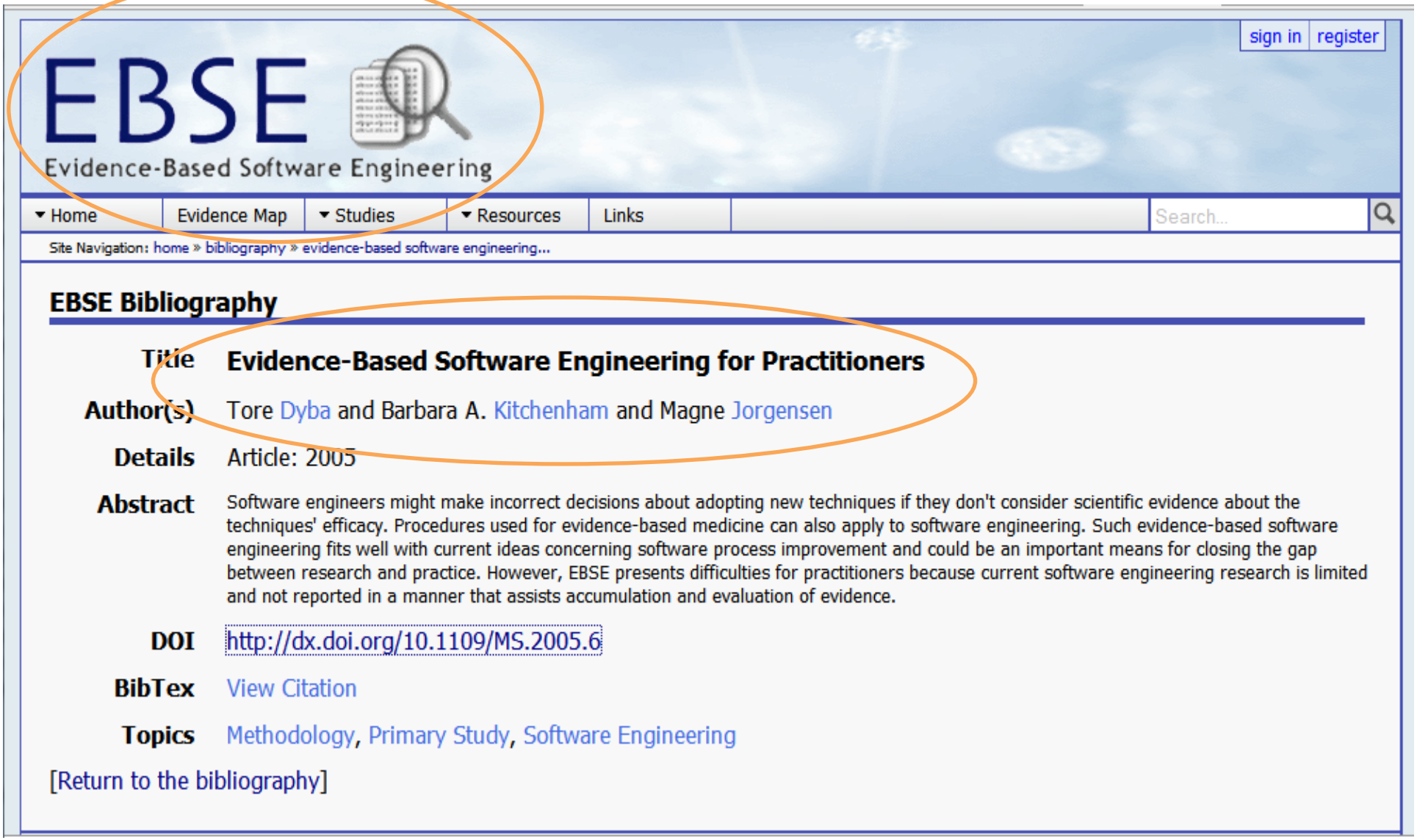


EBSE

EBSE relies on ***empirical software engineering*** research but emphasizes the need to ***find and aggregate best available evidence*** on a specific topic and ***uses secondary studies such as systematic literature reviews*** *and* ***mapping studies*** as the methodological framework ***for finding and aggregating evidence.***

(Kitchenham and Charters, 2007)

Mapping Study: Concept

- *Mapping study is an evidence-based approach, applied in order to* ***provide an overview of a research area, and identify the quantity and type of research and results available within it*** *(Silveira Neto et al., 2011).*
- ***Before we can undertake SLRs, we need to have a better understanding of what evidence is available within a domain - and mapping studies are particularly useful for this purpose*** *(Budgen, 2008).*
- ***A more open form of SLR, intended to map out the research that has been undertaken rather than to answer a detailed research question.***
  - ***Intended to identify gaps in the set of primary studies, where new or better primary studies are required,***
  - ***as well as clusters where there may be scope for more complete SLRs to be undertaken.***

Systematic Review

VS.

Mapping Study

Systematic Review vs. *Mapping Study*

- One difference is the type of question they answer.
  - while mapping studies ask more general questions such as *"What do we know about OO related metrics?"*
  - A systematic literature review asks a fairly specific question such as *"Which of the Chidamber and Kemerer OO metrics are good predictors of fault-proneness?"*,

(Kitchenham, 2010)

Systematic Review vs. *Mapping Study*

- Systematic reviews are particularly concerned in answering very narrow questions
- Mapping study is an alternative to systematic reviews and could be used if the amount of empirical evidence is too little, or if the topic is too broad, for a systematic review to be feasible
- A mapping study is performed at a higher granularity level with the aim to identify research gaps and clusters of evidence in order to direct future research

(Engström and Runeson, 2011); (Barreiros, 2011)

The systematic mapping process

The systematic mapping process

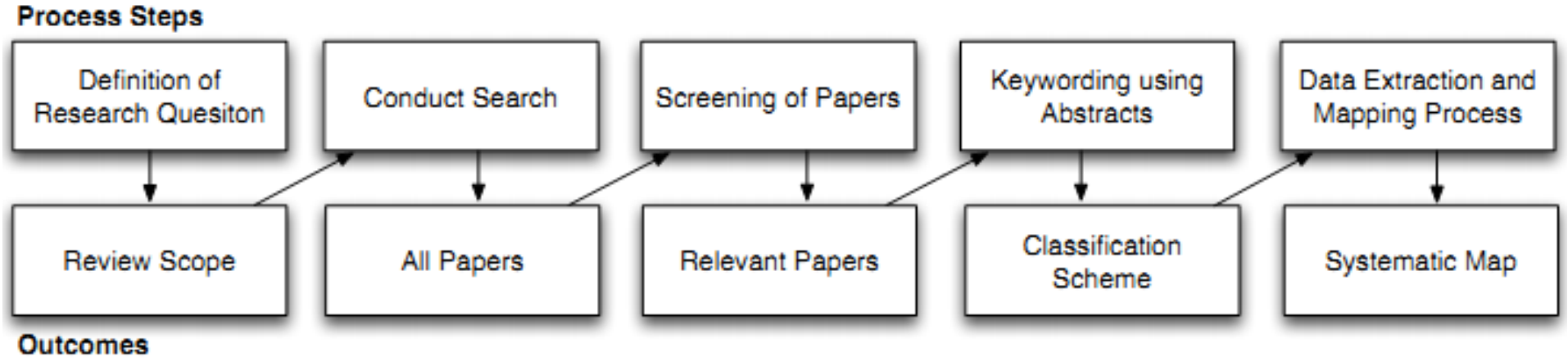
Three stages by Budgen et al. (2008):

1. identification of primary studies that may contain relevant research results (searching);

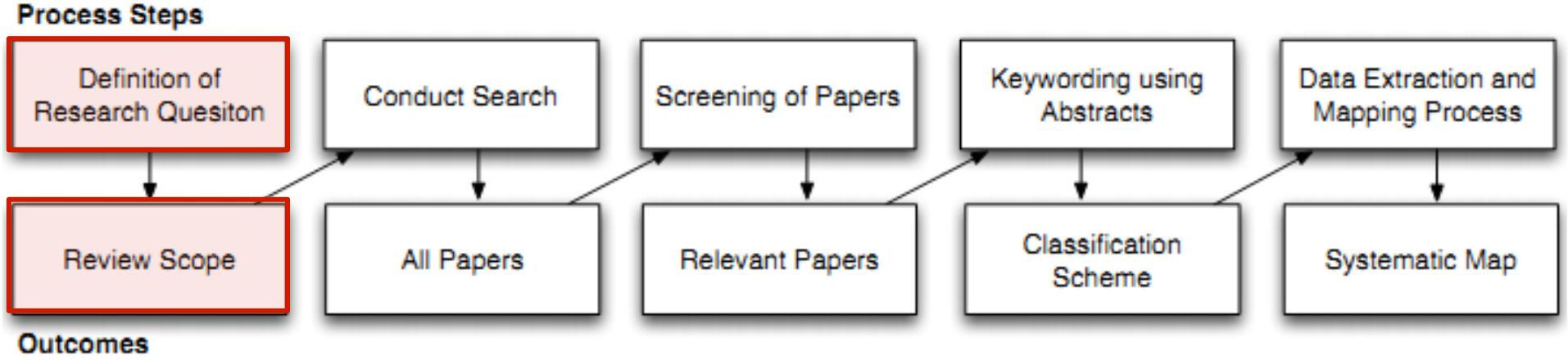
2. selecting the appropriate primary studies from these after further examination (inclusion/exclusion);

3. where appropriate, performing a quality assessment of the selected studies (bias/validity)

Mapping process by Petersen et al. (2008):



The systematic mapping process

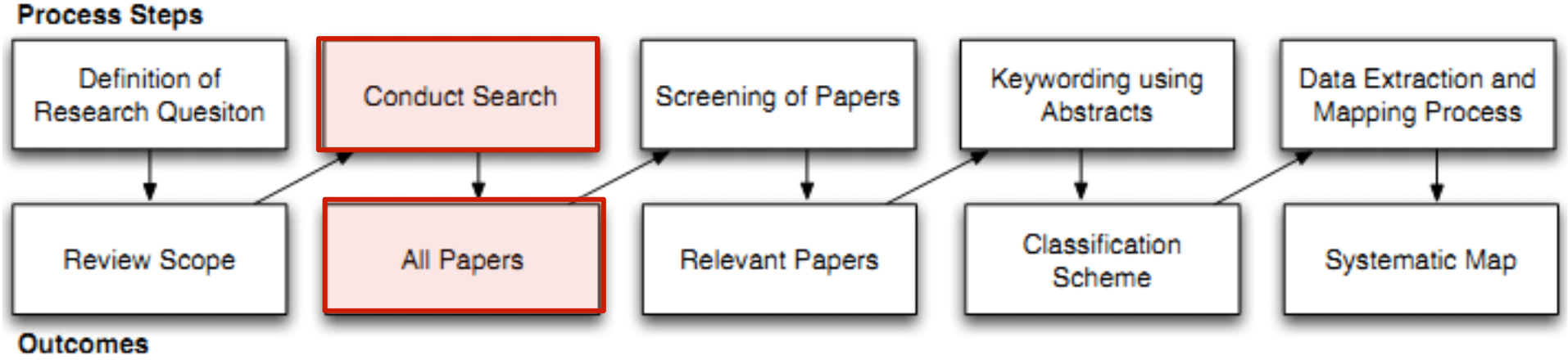


Examples:

Object Oriented Design Map (Bailey et al. 2007)
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?

Software Product Line Variability Map (Mujtaba et al. 2008)
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?

The systematic mapping process

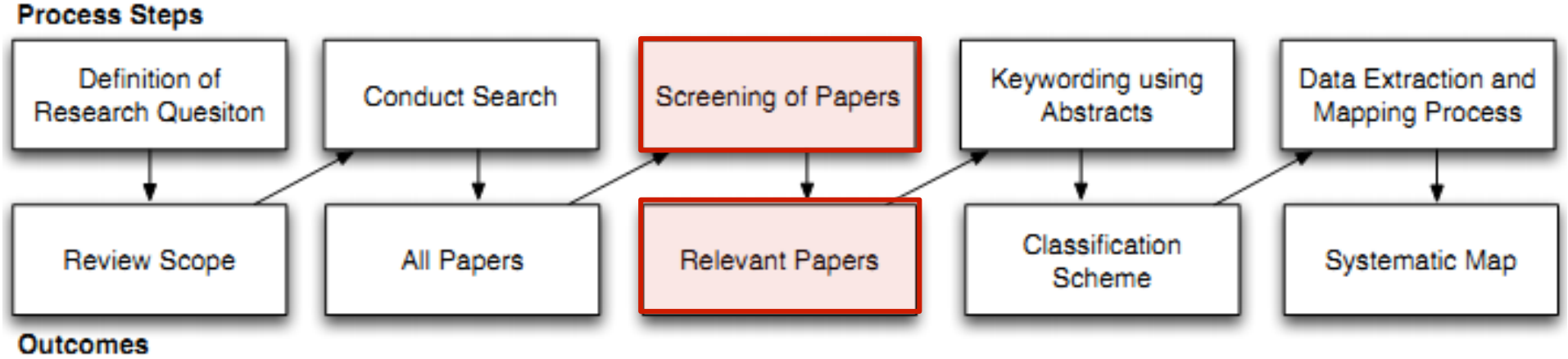


- The primary studies are identified by using search strings on scientific databases or browsing manually through relevant conference proceedings or journal publications.
- The choice of databases may be different among mapping studies

Examples of search querires:

- *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")

The systematic mapping process

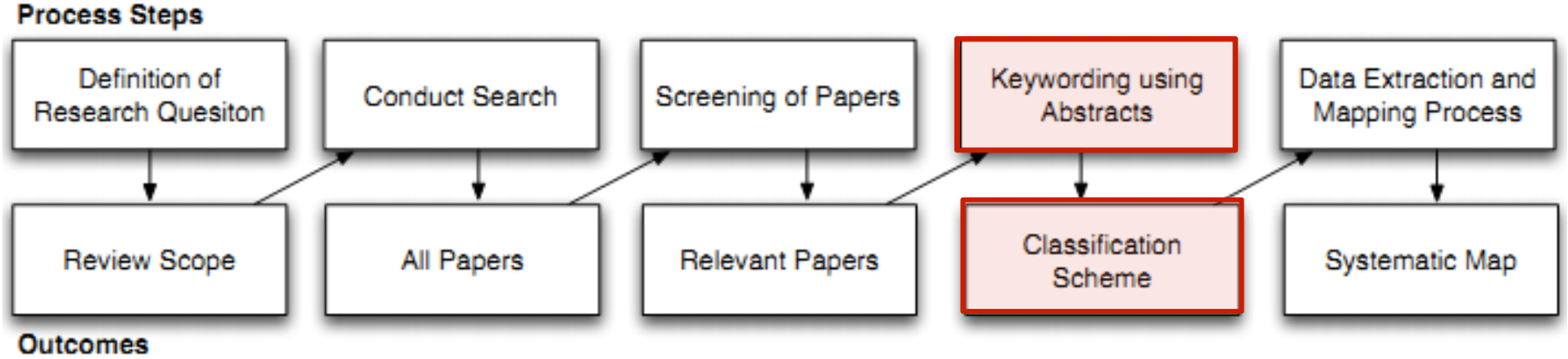


Apply inclusion and exclusion criteria to filter out studies that are not relevant to answer the research questions.

Examples of inclusion/exclusion criteria:

Object Oriented Design Map (Bailey et al. 2007)	Software Product Line Variability Map (Mujtaba et al. 2008)
Inclusion: books, papers, technical reports and grey literature describing empirical studies regarding object oriented software design. Where several papers reported the same study, only the most recent was included. Where several studies were reported in the same paper, each relevant study was treated separately. **Exclusion:** Studies that did not report empirical findings or literature that was only available in the form of abstracts or Powerpoint presentations.	**Inclusion:** The abstract explicitly mentions variability or variation in the context of software product line engineering. From the abstract, the researcher is able to deduce that the focus of the paper contributes to product line variability research. **Exclusion:** The paper lies outside the software engineering domain. Variability and variation are not part of the contributions of the paper, the terms are only mentioned in the general introductory sentences of the abstract.

The systematic mapping process

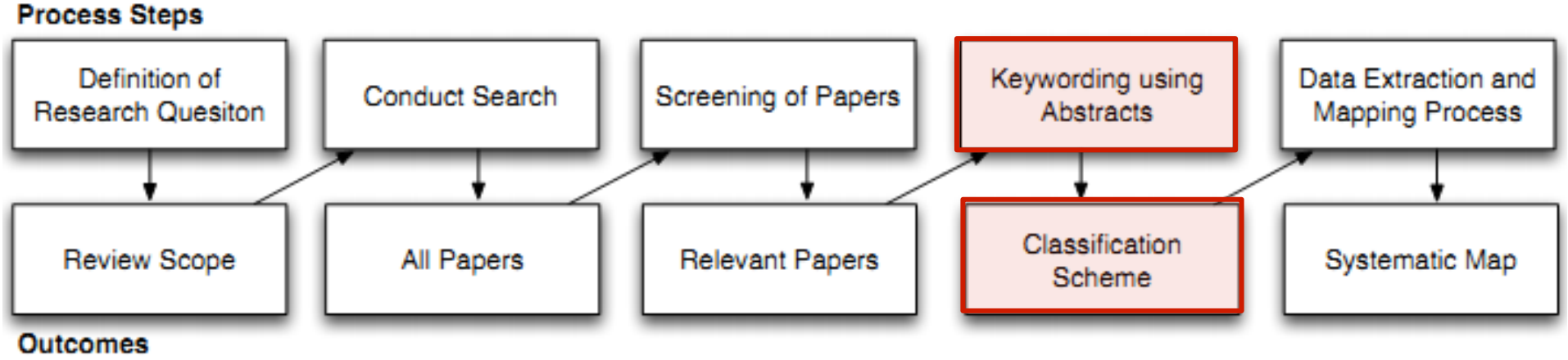


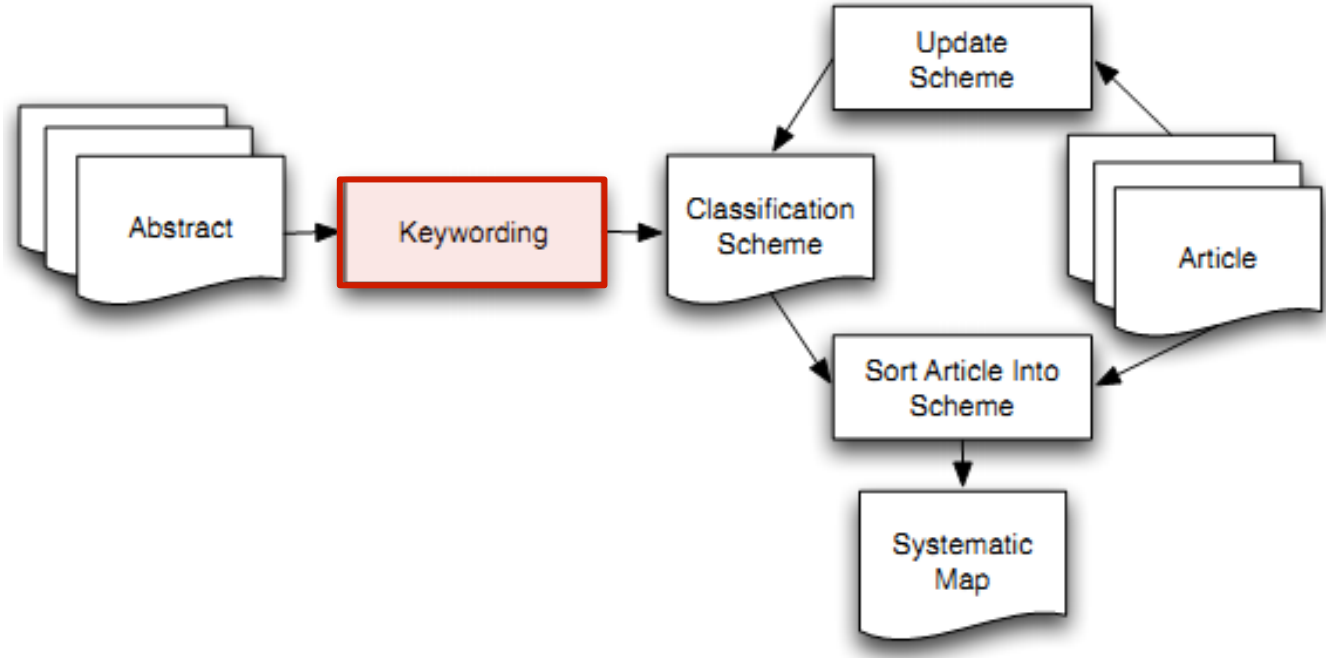
Keywording is a way to reduce the time needed in developing the classification scheme and ensuring that the scheme takes the existing studies into account.

Keywording is done in two steps:

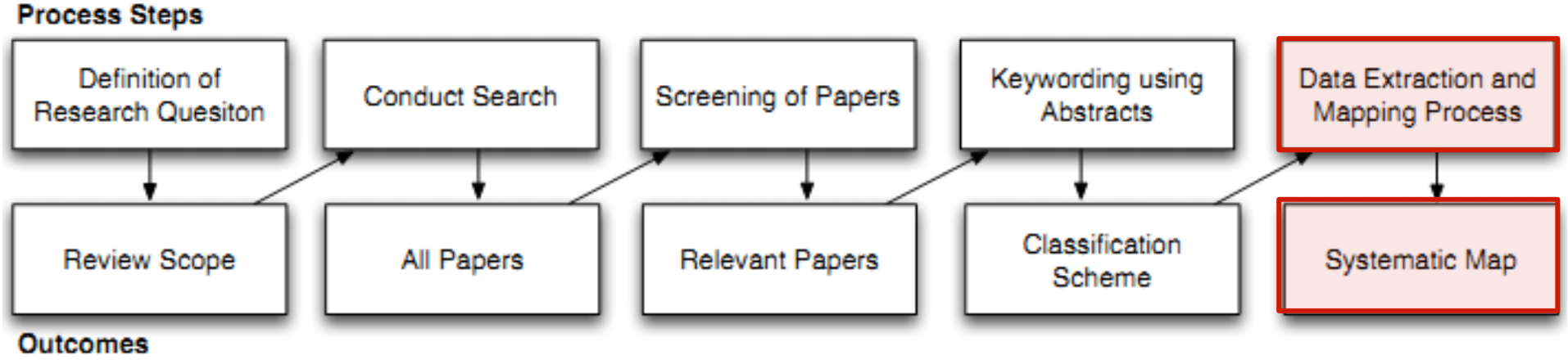
- First, the reviewers read abstracts and look for keywords and concepts that reflect the contribution of the paper. While doing so the reviewer also identifies the context of the research.
- When this is done, the set of keywords from different papers are combined together to develop a high level understanding about the nature and contribution of the research.
- This helps the reviewers defining a set of categories which is representative of the underlying population.
- When abstracts are of too poor quality, reviewers can choose to study also the introduction or conclusion sections.
- When a final set of keywords has been chosen, they can be clustered and used to form the categories for the map.

The systematic mapping process



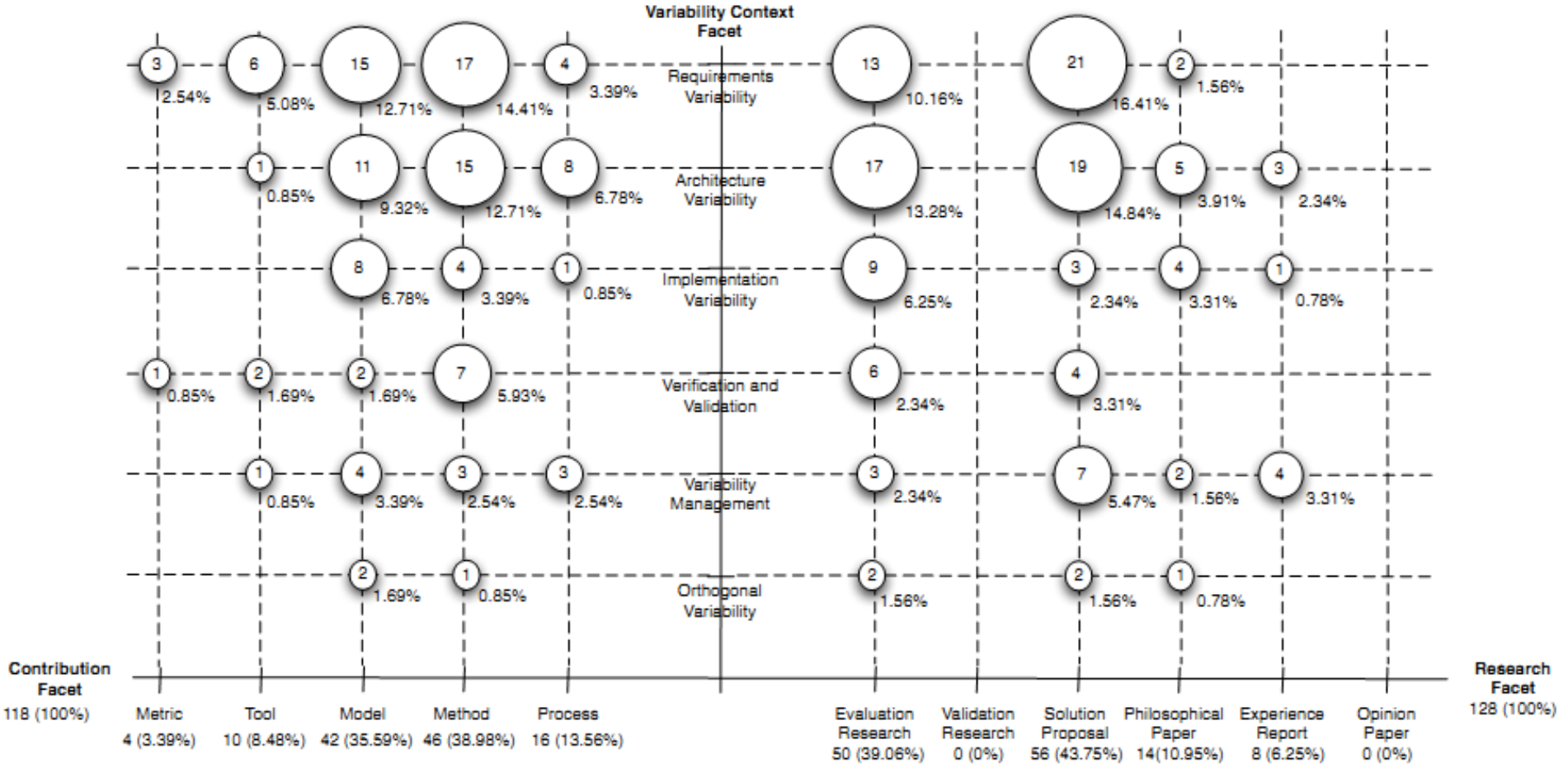


The systematic mapping process



- In this step, use a spreadsheet to document the data extraction process. The table may contain each category of the classification scheme.
- **Every time reviewers enter the data of a paper into the scheme, they must provide a short rationale why the paper should be in a certain category**
- From the final table, the frequencies of publications in each category can be calculated.
- The analysis of the results focuses on presenting the frequencies of publications for each category. This makes it possible to see which categories have been emphasized in past research and thus to identify gaps and possibilities for future research.

Visualization of a systematic map in the form of a bubble plot





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(BACKUP SLIDE)

Systematic Review vs. ***Mapping Study***

The main differences between SLRs and SMSs are (Barreiros, 2011):

- Mapping studies generally have broader research questions driving them and often ask multiple research questions;
- The search terms for mapping studies will be less highly focused than for systematic reviews and are likely to return a very large number of studies, for a mapping study however this is less of a problem than with large numbers of results during the search phase of the systematic review as the aim here is for broad coverage rather than narrow focus;
- The data extraction process for mapping studies is also much broader than the data extraction process for systematic reviews and can more accurately be termed a classification or categorization stage. The purpose of this stage is to classify papers with sufficient detail to answer the broad research questions and identify papers for later reviews without being a time consuming task;
- The analysis stage of a mapping study is about summarising the data to answer the research questions posed. It is unlikely to include in depth analysis techniques such as meta-analysis and narrative synthesis, but totals and summaries. Graphical representations of study distributions by classification type may be an effective reporting mechanism;
- Dissemination of the results of a mapping study may be more limited than for a systematic review; limited to commissioning bodies and academic publications, with the aim of influencing the future direction of primary research.