Instituto Superior de Engenharia do Porto

Mestrado em Engenharia Informática

Preparação para a Dissertação
Revisão da Literatura

T: ACS

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Introduction

Engineering:

- Importance of concepts

- Fact oriented

- Scientific basis

- Critical thinking (rationalism)
  - Rational critic to any claim – in this context, claims must be analyzed, informed by facts. So, claims should be subjected to tests

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Facts/Evidence

- Decisions concerning the choice of engineering (SE) techniques and tools should rest on **facts** and not just on opinions [Fenton...,2014]

- **Facts** - are evidence usually resulting from accomplished empirical research

- This leads to an evidence-based informatics engineering, an important step toward an engineering discipline with scientific bases

"Informatics" Engineering is the application of an empirical, scientific approach to finding efficient, economic solutions to practical problems in software. [adapted from Farley, 2022]

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Some General Characteristics of Quality Research

General characteristics:

- Understanding of the problem and provides clearly defined research question(s)
  - What do we want?

- Well defined research process (protocol)
  - Research is not simple, think in advance

- Can be easily repeated (replicated)
  - Need to be confirmed

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Motivation
Overview of the Research Process

1. Start by defining the problem

2. Provide a strong literature review of the area

3. Choose and apply the research strategy and method(s) to be used according a research design

4. Disseminate study results

Evidence-based SW Engineering

- Evidence-based (software or other) engineering (EBSE)

Goal:
to provide the means by which current best evidence from research can be integrated with practical experience in the decision-making process regarding the development and maintenance of software. Adapted from [Kitchenham et al, 2004]

How: by reviewing the evidence

Evidence based Engineering

What EB (informatics in a broad sense) engineer can provide:

- Better assurance that research is directed to the requirements of industry and other stakeholders
- A means by which industry practitioners can make rational decisions about technology adoption
- A means to improve the dependability on software intensive systems, as a result of better choice of development technologies
- A means to increase the acceptability of software intensive systems by society

[Adapted from Kitchenham et al, 2004]

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Experts and Reviews

- Some History
  - Medical studies from the late 80s and early 90s showed that [Kitchenham et al, 2004]:
    - failure to organize medical research in systematic review could cost lives
    - clinical judgement of experts compared unfavorably with the results of systematic reviews

- **Need of a systematic review method**

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Literature Reviews and the Engineer

- An engineer does not have to be an expert about all subjects

"I know nothing about the subject, but I'm happy to give you my expert opinion."

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Literature Reviews
Who cares

- Professionals need to evaluate proposals of innovations
- Students and researchers need to develop state of the art reports
- Professionals need to choose among several (innovative) tools, techniques or methods, or develop new ones

  Should start by finding what is already known about the subject

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Literature Review

Definition

- **Literature review** is a research activity intended to organize and summarize the research work already done in the area of interest [Sampaio,2015]

- Literature reviews are secondary studies – because they review original studies

Literature Reviews

Goals of a Literature Review

1. Provide a solid theoretical foundation for the proposed study in the dissertation course (related to "what is already known?")
2. To help the student understand the existing body of knowledge including where excess research exists (i.e. what is already know?) and where new research is needed (i.e. what is needed to be known?)
3. Substantiate the presence of the research problem (related to "what is needed to be known?")
4. Frame the valid research methodologies, approach, goals, and research questions for the proposed study (dissertation)
5. In certain cases, justify the proposed study as one that contributes something new to the body of knowledge

Adapted from
[Levy&Ellis, 2006]

Literature Reviews
Methods

Main Methods for Literature Review:
- Narrative literature review (not systematic)
  - Possibly with no clear scientific value
- Systematic Methods:
  - Systematic literature Reviews
    - In depth, requiring significant time and statistical analysis
  - Systematic mapping (scoping) reviews
    - A simplified version of the previous
    - Adequate for our purpose
- All easier today with digital libraries

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Literature Reviews
Methods - Narrative literature review

- It is the traditional method
- Has no clear scientific value

Procedure
1. Start a search from an initial reference, or a limited set or references
2. Try to find other interesting papers
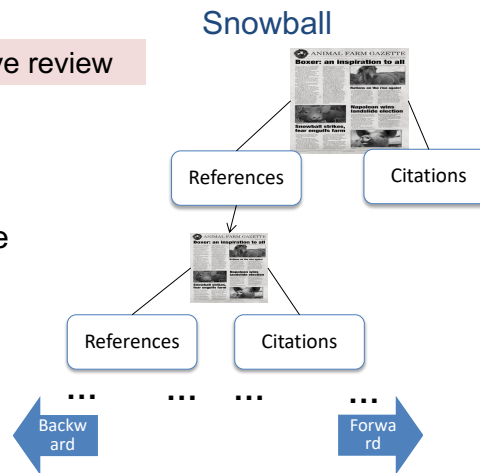3. Finish when satisfied

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Literature Reviews
Narrative literature review

Snowball

Using snowball improves narrative review

If with snowball, proceed through the references until the research is satisfied or no new references found (and/or through citations)

References

Citations

References

Citations

... ...

Backward

Forward

Literature Reviews
Syatematic Reviews

- Traditional review is very dependent on the researcher' "mood" and initial choices!!

- Works that summarizes research (primary studies) should not engage in glossing over applicable studies
  - **Glossing over** here means omit, downplay, or avoid certain studies intentionally or unintentionally

- If studies' contributions are ignored, they do not inform and impact practice, and evidence-based informatics engineering has gaps

- The actual context of evidence-based Informatics Engineering, requires a systematic approach

Literature Reviews
Systematic Literature Review (SLR)

SLR

*Definition: A systematic literature review is a <u>formalized</u> method to address a **specific question** by analyzing the breadth of published literature while <u>minimizing</u> bias*
(adapted from [Smith et al., 2022])

- "address a specific question" is a concrete test

  Example: does drug A cures disease X

- However, this is not always needed
- MEI/PREPD is such a case, where the goal of the review is not to answer a specific question

Literature Reviews
Mapping study (MS)

The method we are going to use

Mapping Study (MS)
Definition: A method to provide a wide overview of a research area, to establish if exists research evidence on a topic and provide an indication of the quantity of the evidence

- Also know as systematic mapping study, systematic scoping review, or simply a mapping study (MS)

- Can be more or less "rapid" depending on the constraints of time and resources. More rapid when the area, or the situation, changes fast.

Literature Reviews
Mapping- Goal

Main goals of mapping studies:

- To provide an overview of a research area, to evaluate the quantity and type of research and results available in the area and,

- to determine the publications where research is published

- to identify gaps in the research

Literature Reviews
Mapping- A Method

Stages:
1. Protocol and definition of research questions
2. Conducting the search for primary studies
3. Screening
4. Classification system
5. Coding: data extraction and aggregation
6. Analysis and report
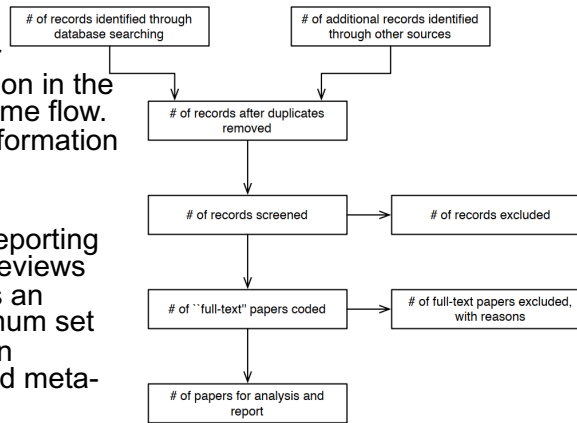
- The method complements each step with:
  - Purpose
  - Outcomes
  - QA activities

Not applicable parts in GREY

Literature Reviews
Mapping- The Method

- The method allows for obtaining the information in the figure, and with the same flow. This is the PRISMA information flow

- PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) is an evidence-based minimum set of items for reporting in systematic reviews and meta-analyses

```
# of records identified through        # of additional records identified
database searching                     through other sources

              # of records after duplicates
                      removed

# of records screened    →    # of records excluded

# of ``full-text'' papers coded  →  # of full-text papers excluded,
                                          with reasons

# of papers for analysis and
            report
```

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Literature Reviews
Literature Review – Conclusion

- Final Notes:
  - An analysis step is fundamental
  - Include limitations
  - Draw conclusions relevant to the state of the art, ie, relevant to your work

- Review in the Dissertation
  - A section in the "State of the Art" chapter

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Literature Reviews
Literature Review – Conclusion

- Review in the Dissertation

Dissertation	Estado da Arte
Introduction • Goal(s)/Research question(s) • …	**Introduction/Protocol** • Goal(s)/Research Question(s) for the Review • …
State of the Art • … • Literature Review • …	**Method Application**
…	…
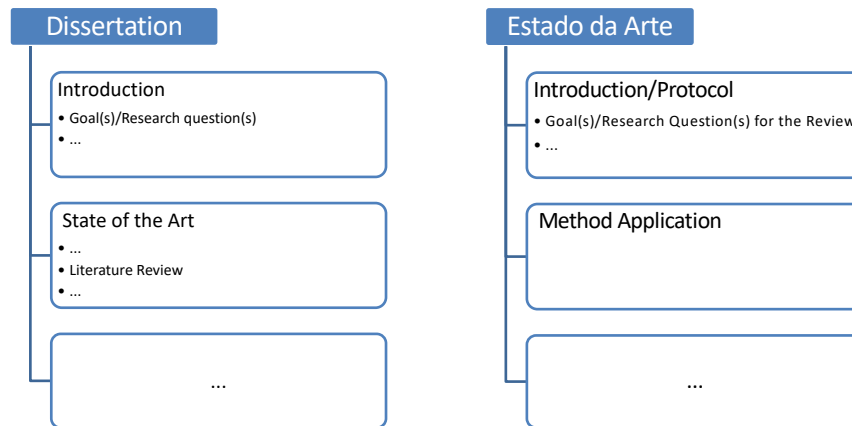
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Literature Reviews
Systematic vs Narrative

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	Narrative	Systematic
Question for research	Not existent or broad in scope	Yes
Sources of research	Not specific, biased	Previously specified and wide-ranging, with an explicit search strategy
Selection of studies	Not specific, biased	Criterion based selection, systematically applied
Appraisal	Variable	Rigorous and complete
Synthesis	Qualitative summary	Quantitative or semi quantitative (at least graphical and/or tabular) summary
Inferences	Uncommon, but sometimes evidence-based	Always evidence-based
Protocol	Brief method description	Yes

[Adapted from Varandas, Carneiro,2006]

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Literature Reviews
Mapping vs SLR

Item	SLR	Mapping
Goal Type	Very specific	Broader
Protocol	Yes (include statistical methods)	Yes
Search strategy	Defined and Systematic	Defined and Systematic
Inclusion/exclusion criteria	Defined a priori	Defined a priori, but flexible
Appraisal of studies	Always	Not usual (but possible)
Synthseis	Quantitative	Usually qualitative, or semi quantitative, but graphical or tabular
Goal	Comparison of alternatives	Overview of studies

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Literature Reviews
AULA TP

- Para a próxima aula TP o aluno deverá:
- Escolher um tópico para revisão da literatura
- Preferencialmente, mas não obrigatoria/e sobre o tema escolhido pelo aluno para a disciplina de Dissertação

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FIM

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