1 Systematic Review and Mapping

Kitchenham [Kitchenham, 04] emphasized that an evidence-based approach to software engineering is an important research issue. Evidence-based software engineering (EBSE) highlights the need to find and aggregate evidence on a specific topic using secondary studies such as systematic literature reviews and mapping studies as the methodological framework for identifying and aggregating evidence.

In this context, the main purpose of a systematic review is to identity, evaluate and interpret the available studies in literature considering the research questions. Through a systematic review, it is possible to gather evidence in order to identify gaps and research opportunities in the targeted area. Systematic mapping is a form of systematic literature review that aims to provide an overview by identifying and categorizing the available research on a broad topic based on the guidelines proposed by Kitchenham [Kitchenham, 07].

This review was organized based on the main activities proposed by Kitchenham [Kitchenham, 07]: planning, conducting and reporting the study.

1.1 Review and Mapping Planning

The planning activity identifies the objectives and defines a protocol. The protocol specifies the method to be used in the systematic review and mapping in order to reduce researcher bias [Steinmacher et al., 13]. Moreover, the systematic review and mapping must be reproducible and the protocol has an important role to fulfill in this requirement. This section summarizes the protocol.

Research Questions. The systematic mapping aims to answer the questions below:

MQ1: How many studies were published over the years?
MQ2: Who are the most active authors in the area?
MQ3: Which publication vehicles are the main targets for research production in the area?
MQ4: In which domains has pragmatic interoperability been applied? (e.g. Bioinformatics, Telemedicine, Business)
MQ5: Which type of computational support has pragmatic interoperability techniques provided (e.g. framework, software architecture, etc.)?
MQ6: Which definitions of pragmatic interoperability have been used?
MQ7: Which methods were used to validate the proposed pragmatic interoperability solutions?

The systematic review aims to answer the questions below:

RQ1: Which solutions have been used to enhance pragmatic interoperability?
RQ2: How did the proposed solutions address pragmatic interoperability?

Based on the research questions, we take into account the PICOC method proposed by Petticrew and Roberts [Petticrew and Roberts, 08] to define our scope:


To select the papers to be analyzed in order to answer the research questions some criteria were defined.

Inclusion and Exclusion Criteria. The process used to include and exclude a paper was organized in four inclusion criteria (IC) and four exclusion criteria (EC), presented below:

IC1: The papers reports the pragmatic interoperability solution (method, technique, model, tool, framework) AND
IC2: The proposed solution are applied on software OR system OR application OR service OR infrastructure AND
IC3: The papers are described in English language AND
IC4: The papers are reported in peer reviewed Workshop or Conference or Journal or Technical Reports.

The following exclusion criteria were established:
EC1: The papers do not propose a pragmatic interoperability solution OR
EC2: The proposed solution are not applied on software OR system OR application OR service OR infrastructure OR
EC3: The papers are not described in English OR
EC4: The papers are not published in a peer reviewed conference or journal

After the definition of the research questions and the paper inclusion and exclusion criteria, the following steps were (i) to define the sources of the papers and (ii) the search string that was performed in
these sources. The databases were chosen according to the following requirements, based on [Costa and Murta, 13]:

- They are capable of using logical expressions or a similar mechanism.
- They allow full-length searches or searches only in specific fields of the works.
- They are available in the researcher’s institution.
- They cover the research area of interest in this mapping: computer science.

**Sources.** The search was done in six electronic databases namely:

- Scopus (www.scopus.com).
- IEEExplore (ieeexplore.ieee.org).
- ScienceDirect (www.sciencedirect.com).
- Compendex (www.engineeringvillage.com).
- Web of Science (apps.webofknowledge.com).

**Query String.** Initially, to create the search string, the major terms from the defined research questions and PICOC and their alternate spelling and synonyms were identified.

Based on the above terms, an initial string was formed using Boolean OR/AND operators. Synonyms and alternate spellings were concatenated using Boolean OR and then these terms were concatenated using Boolean AND to form one string. A set of potential primary studies were also defined, as suggested in [Zhang and Muhammad, 10], to validate the search string accuracy in the selected databases and if the search retrieved relevant studies. The keywords from the potential interest studies and from newly fetched ones were analyzed in order to find new relevant terms to be included as part of the search string.

The final search string was described as follows:

(pragmatic OR pragmatics OR pragmatism) AND (interoperability OR interoperate OR interoperable OR interoperation OR similarity OR integrate OR integration) AND (solution OR method OR technique OR model OR tool OR framework OR architecture OR infrastructure OR approach) AND (computational OR system OR application OR software)

[Tolk et al., 06] and [Kutvonen, 08] were known potential interest studies that were used to control if the search string was finding relevant studies.

The review and mapping were carried out and the details for this step are presented in the following subsection.

**Review and Mapping Conduction**

The first step in this phase was to execute the search string, considering the selected sources. Afterwards, the study selection process was performed. The process comprised the following steps: (1) The results from all databases were merged in JabRef and duplicates were removed. (2) The papers were analyzed based on their titles and abstracts, considering the inclusion/exclusion criteria. Those papers considered clearly irrelevant were excluded. The introduction, background and conclusion sections of the papers considered doubtful were read. Finally, papers considered included were analyzed in the next step. (3) The papers were fully read and analyzed considering the research questions. The selected papers were submitted to a quality assessment checklist and information was extracted and put on a form. A snowballing process was also performed in the set of papers, which was approved in the quality assessment, by reviewing their references in order to find other potential primary studies. The papers not obtained initially were requested to the authors by e-mail.

**References**


1 http://jabref.sourceforge.net/
