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A systematic literature review of stakeholder identification methods in requirements elicitation

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ABSTRACT

This paper presents a systematic review of relevant published studies related to topics in Requirements Engineering, specifically, concerning stakeholder identification methods in requirements elicitation, dated from 1984 to 2011. Addressing four specific research questions, this systematic literature review shows the following evidence gathered from these studies: current status of stakeholder identification in software requirement elicitation, the best practices recommended for its performance, consequences of incorrect identification in requirements quality, and, aspects which need to be improved. Our findings suggest that the analyzed approaches still have serious limitations in terms of covering all aspects of stakeholder identification as an important part of requirements elicitation. However, through correctly identifying and understanding the stakeholders, it is possible to develop high quality software.

1. Introduction

The Requirements Engineering (RE) area is an essential part of any software development project that specifies, analyzes, and defines the product goal, functionality, and limitations of the final product (IEEE, 1998; Wiegers, 2003; Hofmann and Lehner, 2001). The fact that software requirements have a significant impact on final software product quality implies that it is reasonably well documented (Liscomb, 2003; Standish 2009; IEEE, 2004; SEI, 2006).

Usually RE can be described as a common series of stages including elicitation, analysis, specification, validation, and management (Pressman, 2005; Sommerville and Sawyer, 1997). In addition, three of the most important categories of problems affecting the correctness of software requirements are defined in the literature: gaining, comprehension and volatility (Loucopulos and Karakostas, 1995; Sommerville and Sawyer, 1997; Kotonya and Sommerville, 2000).

Our research is focused on the first of these stages, namely: requirements elicitation. Requirements elicitation is recognized as one of the most critical activities of software development (Davis et al., 2006); poor execution of elicitation will almost certainly guarantee that the final project is a complete failure. Since project failures are so uncontrolled (Standish, 2009), it is quite likely that improving how the industry performs elicitation would have a dramatic effect on the success record of the industry (Hofmann and Lehner, 2001). Improving requirements elicitation requires us to first understand the stakeholder identification phase (Nuseibeh and Easterbrook, 2000). In the case of requirements elicitation activities – in which the problem to be solved is identified – the most important thing is that the stakeholders be correctly identified (SEI, 1992). Relationships and ways of communicating between the development team and the customer are established at this time (ISO, 2004; Sommerville, 2002). Despite its importance, the identification of stakeholders, including the identification of their needs and expectations, is poorly achieved in software projects (Sommerville, 2002; Pressman, 2005). One probable cause is that this process is mistakenly viewed as a self-evident task in which direct users, clients and the development team are the only stakeholders. It could also be due to the fact that the identification area can be eliminated or substituted by opinions or knowledge obtained from other more accessible sources of information. In the short term, this would create less conflicts of interest resulting from different points of view (Smith, 2000).

Theoretical and empirical approaches are now being undertaken more often to investigate a widening range of phenomena in Software Engineering (SE) specifically in requirements elicitation as part of RE. As each approach is certainly limited in scope, researchers need to be able to rigorously and systematically locate, assess and aggregate outcomes from all significant empirical and theoretical studies related to a particular topic of interest, in order to provide an objective summary of the relevant evidence. This need has been addressed through the application process of a Systematic Literature Review (SLR).

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In previous work, we performed an empirical study to identify how the stakeholder identification process can affect requirements quality and, as a consequence, the developed software quality. This study, presented in Pacheco and Tovar, proposed a categorization of stakeholder identification methods in requirements elicitation. Our work in this paper focused on three issues that had not been examined in earlier work. First, although stakeholder identification methods were identified we needed to determine and provide evidence about effective practices recommended to use them. Secondly, once those effective practices were exposed we needed to determine the consequences of incorrectly performing the stakeholder identification methods; and thirdly, with the collected data of previous issues, we summarized what aspects of stakeholder identification needed to be improved.

Consequently, in this paper, we present and discuss our experiences of applying the systematic literature review in order to gather and evaluate available evidence pertaining to Stakeholder Identification (SI) in requirements elicitation.

This paper is organized as follows: Section 2 presents other approaches related to SLR in requirements elicitation; Section 3 describes the method used for our SLR, reporting on the quality of the papers included in this section; Section 4 reports on the results of our synthesis of identified topics based on our four research questions; Section 5 presents some of the limitations of this study; in Section 6, we give suggestions for further research; and finally in Section 7, we present our conclusions.

2. Related work

There is still no substantial research related to SLR in requirements specification and elicitation techniques, and above all, in stakeholder identification, as seen below.

In 2006, Davis et al. (2006) reported a systematic review of empirical studies concerning the effectiveness of elicitation techniques, and the subsequent aggregation of empirical evidence gathered from those studies. These are the most significant results that were obtained: (1) interviews, preferentially structured, appear to be one of the most effective elicitation techniques; (2) many techniques often cited in the literature, like card sorting, ranking or thinking aloud, tend to be less effective than interviews; (3) analyst experience does not appear to be a relevant factor; and (4) the studies conducted have not found significant positive effects for the use of intermediate representations during elicitation.

Cheng and Atlee reviewed RE research and identified "future" research directions suggested by emerging software needs. This research examined technologies developed to address specific requirements tasks, such as elicitation, modeling, and analysis. Such a review enabled authors to identify mature areas of research, as well as areas that warrant further investigation. Next, they reviewed several strategies for performing and extending RE research results, to help delineate the scope of future research directions (Cheng and Atlee, 2007).

Davis et al. (2006) proposed recommendations based on the previous systematic review, which was updated and expanded with 13 new empirical studies and more than 60 new empirical results, to present some recommendations about the situations in which elicitation techniques are useful (Dieste et al., 2008).

Nicolás and Toval presented a systematic review of the literature related to the generation of textual requirements specifications from software engineering models. According to the results obtained, the benefits of both lists of textual requirements (usually written in natural language) and software engineering models (usually specified in graphical form) – can be brought together by combining the two approaches in the specification of system and software requirements documents (Nicolás and Toval, 2009).

Condori-Fernandez et al. described an empirical mapping study, which was designed to identify what aspects of software requirement specifications were empirically evaluated, in which context, and by which research method. On the basis of 46 identified and categorized primary studies, authors found that understandability was the most commonly evaluated aspect of SRS; experiments were the most commonly used research method, and that the academic environment was where most empirical evaluation takes place (Condori-Fernandez et al., 2009).

Dieste and Juristo presented the results of a systematic review of 564 empirical studies on elicitation techniques and aggregated these results to gather empirically grounded evidence. They selected and extracted data from 26 of those publications (containing 30 empirical studies) to provide a set of elicitation applicability guidelines based on the gathered pieces of knowledge. Their general finding is that interviews are the most effective of all of the tested elicitation techniques (although they are possibly less efficient in some domains than other techniques, like laddering or sorting techniques). Likewise, the authors do not recommend the use of introspective techniques (i.e., protocol analysis) because they fared worse than all of the other techniques in all of the tested dimensions (effectiveness, efficiency, and completeness) (Dieste and Juristo, 2011).

In summary, these studies only cover some aspects of requirements elicitation; however none of them analyze stakeholder identification evidence, despite this being a crucial part within requirements elicitation.

3. Research method

A SLR is "a means of evaluating and interpreting all available research relevant to a particular research question or topic area or phenomenon of interest" (Kitchenham, 2004). The research papers summarized in the review are referred to as primary studies, while the review itself is a secondary study. The accumulation of evidence through secondary studies can be very valuable in offering new insights or in identifying where an issue might be clarified by additional primary studies.

A SLR examines and interprets all available research relevant to a particular question or topic area. It aims to present an evaluation of the literature relative to researching a topic by using a rigorous and auditable methodology summary (Beecham et al., 2007).

So, due to the impact of SE and RE on software quality, as mentioned briefly in Section 1, we conducted a systematic review to see how SI is performed and how it can be improved.

We followed guidelines derived from those used by medical research, adapted and applied by Kitchenham (2004) and Kitchenham et al. (2004) to reflect the specific problems of SE and RE research (i.e. Beecham et al., 2007; Brereton et al., 2007).

In accordance to Kitchenham (2004) and Kitchenham et al. (2004), we took the following steps.

3.1. Identify the need for a systematic literature review

RE is a discipline that arose when it became evident that the quality of requirements specification was the key factor in preventing, with the least possible cost, many of the causes leading to software failure (Raghu, 1995). Thus, efforts in this direction employed at an early stage of a project have great repercussions, and are also more profitable than other efforts carried out afterwards. The problem of the "software crisis" has, therefore, to a great degree shifted to requirements. But, is there some aspect within the requirements area that deserves to be given particular treatment? Based on our previous line of thinking, this aspect should be connected to one of the initial activities of RE; that is,

the case of requirements elicitation, an activity where the problem to be solved is discovered, and more importantly, the stakeholders are identified, thereby establishing the relationships and the ways of communication between the development team and the client (IEEE, 2004).

Software engineers need to identify, characterize, and handle all the viewpoints of the different types of stakeholders (Kotonya and Sommerville, 2000). The stakeholders may vary from one project to another. It is, therefore, always necessary to carry out an adaptation assessment of stakeholders' contributions and their vested interests in a project (Raghavan et al., 1994). However, SI, as well as identification of their needs and expectations, is poorly conducted in software projects (SEI, 2006), probably because this process is mistakenly seen as a self-evident task where direct users, clients, and the development team are the sole stakeholders. It could also be due to the fact that the identification area can be eliminated or substituted by opinions or knowledge of other more accessible sources of information that, in the short term, produce less conflict of interest, as different visions exist and may cause disagreement. The SI impact on the quality of software requirements is reflected in the success achieved in the project as well as, in the current practices used to carry out this task.

As a consequence to the growing number of studies in empirical and theoretical research in RE it is pertinent to apply a systematic approach to assessing and aggregating research outcomes in order to provide a balanced and objective summary of research evidence.

Therefore we need to apply the SLR specifically in requirements elicitation, to obtain research evidence for SI methods or techniques. Also, we would show what aspects software engineers need to improve in requirements elicitation (Mitchell et al., 1997) in order to produce high quality software.

3.2. Formulate review research questions

Our systematic approach to analyzing published studies enables us to identify reliably where the literature presents the different practices developed to carry out this task.

We summarized this evidence in order to know what aspects need to be adapted to improve the SI and what process is necessary to carry out an adaptation of stakeholders' assessment, their contributions and vested interests in a project. We looked at the literature to answer these research questions:

Question 1: *What methods or techniques are currently used to carry out SI in Requirements Elicitation?*
Question 2: *What are the effective practices*[1] *recommended for performing SI?*
Question 3: *What are the consequences of incorrect SI on the quality of Software Requirements?*
Question 4: *What aspects of SI are necessary to use as advisable practices?*

Fig. 1 gives an overview of how our four research questions work together to give a comprehensive view of our topic.

3.2.1. Search terms

From our four research questions we derived the keywords: "*Requirements elicitation*, *Stakeholder identification*, *Method*, *Technique*, *Effective practices*". A search string was constructed using relevant terms based on research questions. Also we made a list of synonyms of each of these keywords, as in the example for RQ1, which contains keywords "stakeholder identification" and "requirements elicitation":

Keywords ((elicitation* OR obtaining* OR gaining* OR extracting* OR acquisition* OR discovery* OR capture*) AND (stakeholder* OR interested party* OR person involved*) AND (identification * OR classification* OR categorization* OR recognition* OR naming* OR detection*)).

We expanded the terms using Word Net Version 3.0 (Princeton, 2010), and Soule's dictionary of English synonyms. The list of search terms was adapted to match each of our four research questions.

3.3. Searching strategy

The SLR process recommends searching several electronic sources (Kitchenham, 2004; Kitchenham and Charters, 2007), so we used the following seven electronic databases:

- ACM Digital Library
- IEEE Xplore
- Springer Verlag
- Google Scholar
- ScienceDirect
- Metapress
- Wiley InterScience

In order to determine if similar work had already been performed and locate potentially relevant studies, the search strategy for the review was primarily directed toward findings in published papers (journals, conference proceedings, technical reports, or books) from the content of the 7 electronic databases mentioned above, although each identified primary source was checked for other relevant references. We conducted trial searches using a number of search strings constructed using a combination of keywords and synonyms mentioned in Section 3.2.1.

3.4. Studies selection

The selection of material for our SLR was based on the following criteria and procedure.

3.4.1. Studies selection criteria

The main criterion for inclusion as a primary study was the presentation of empirical or practical data showing how the SI is carried out. All the material used in our SLR was selected based on the following inclusion criteria:

- Directly answer any one or more of our research questions or synonyms (see Section 3.2.1).
- Was published in years: 1993[2]–2011.
- Relates to any practitioner directly producing software.

Since the focus of this review is the SI in Requirements Elicitation, we excluded texts:

- In the form of slide presentations.
- Workshops.
- Opinions, viewpoints or anecdotes.
- Tools without empirical evaluation of their application.

[1] Effective practices are activities that people with recognized expertise in a particular area have identified from experience as making significant contributions to project success (Tchidi and Zhen, 2010).

[2] The year 1993 was chosen as the baseline because the first RE symposium was in 1993.

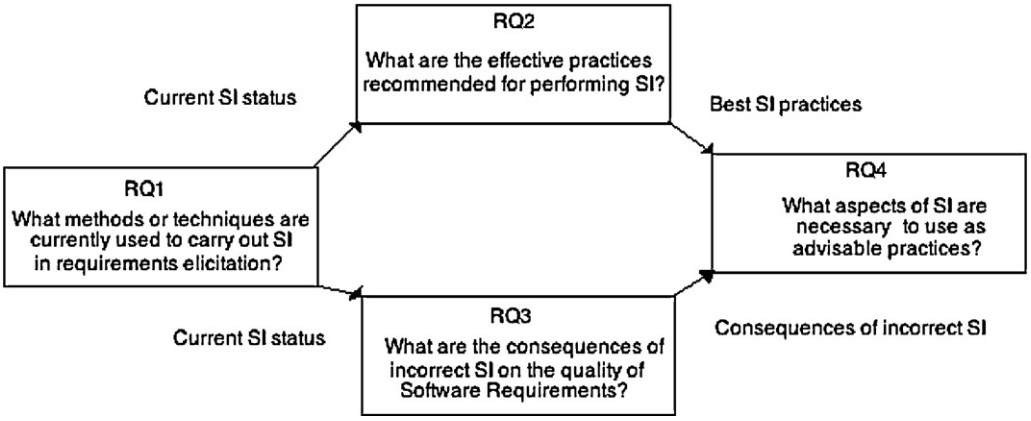

Fig. 1. The relationship between our four research questions.

Table 1
Quality assessment.

Assessment criteria	Score	Response options for score (field in Endnote)
Is the aim of the research sufficiently explained?		Yes = 1/moderately = 0.5/no = 0
Is the presented approach clearly explained?		Yes = 1/moderately = 0.5/no = 0
For a paper, what is the acceptance quality rate based on the findings?		No findings = 0 Over 80% = 1/under 20% = 0/between = .5
%		Enter % in quality assessment field in Endnote

These criteria were applied to studies in industrial and academic environments.[3]

3.4.2. Studies selection procedure

The preliminary selection of probable primary studies was initially based on review of title, abstract, and keywords, although this search was extended to include a conclusions section in the cases where title, keywords and abstract did not provide sufficient information. After this, all selected sources were reviewed against a detailed set of our inclusion criteria applied over all publications to obtain the primary studies. Furthermore, we conducted secondary searches based on references found in our primary studies. All researchers were prompted to record additional references for follow-up work on the primary studies 'results' form.

In order to avoid any study duplication; we examined all the studies to find repeated publications, i.e. if a similar study were published in different publications, even with different first authors, only the most recent or broadest study was included in the review (if two studies were found to be equally dated and broad, one study was included).

3.5. Study quality assessment

The study quality assessment can be used to guide the interpretation of the synthesis findings and to determine the strength of the elaborated inferences (Kitchenham and Charters, 2007). The quality of each accepted study was evaluated according to the criteria shown in Table 1.

With the first criterion we assessed if the authors of the study clearly state the aims and objectives of the conducted research. This question could be answered positively for all the reviewed publications. With the second criterion we asked if the study provides enough information (either directly or by referencing to the relevant literature) to give the present research the appropriate context and background. For almost all publications (87.5%) this was answered positively. The last question allows us to assess if the outcome of the research was sufficient for our research purpose. This question could be answered positively in almost all publications (83.3%). The appraisal measures were established by a group of three experienced software engineering researchers from the Technological University of the Mixtec Region and validated by our independent reviewer. However, the scoring is a heuristic only to be used as a guide and no study was rejected on the basis of its quality score. We normalized the data from the 47 papers, combining the percentage obtained in the quality criterion (see Table 2).

3.6. Data extraction strategy

The data extraction process was conducted using the Endnote version 9, to document references for each study. According to Beecham et al. (2007), each study used to answer the research question(s) was recorded on a separate results form, with the aim of identifying the topics emanating from the findings reported in each accepted paper. In our case, these identified topics gave us the categories reported in our findings and results section. We also discovered after data extraction that we did not have a significant number of publications that provide steps or guidelines to carry out the stakeholder identification (see Section 4).

3.7. Synthesis of the extracted data

Kitchenham's guidelines are not entirely clear about the nature of the data extraction process – how much categorization is done during data extraction, and how much is done in the data synthesis step. We opted for trivial data extraction resulting in a list of quotes that were only minimally paraphrased. We categorized these in the early parts of the synthesis stage.

In Section 4 we present frequencies of the number of times each theme is identified in different sources. We give each occurrence the same weight. The frequencies merely reflect how many times a given issue is identified in different papers, not how important it may be.

3.7.1. Document retrieval

Our searches allowed us to obtain more than 980 references. Analyzing the title and abstract, we could reject approximately

[3] Specifically, empirical studies based on direct evidence or experiments in industrial contexts, and theoretical or conceptual studies based on an understanding of the field from experience and reference to other related work (i.e. academics findings) were analyzed according to our selection criteria to determine study inclusion or exclusion.

Table 2
Quality scores of accepted papers.

	Quality (scores)					Total
	Poor (<26%)	Fair (26–45%)	Good (46–65%)	Very good (66–85%)	Excellent (>86%)	
Number of studies	4	6	19	11	7	47
Percentage of papers	~8.5%	~12.7	~40.4%	~23.4%	14.9%	100%

Over 78% of papers included in our literature review have quality scores that are good to excellent.

735 of these (see Section 3.4.2). The number of false positives in the initial set (papers that may have been relevant but on detailed investigation turned out not to be so) was disappointingly high. We then looked at 245 papers in full to establish a final list of 47 papers. All the steps involved in the selection process are shown in Table 3.

Our validation exercises included:

(1) *Inter-rater agreement*: According to Fleiss' Kappa (Fleiss, 1971) the inter-agreement denotes thereby the data extraction consistency between the research studies when two or more researchers assess each paper. So, we ran inter-rater agreement tests on the 245 paper references we found in our preliminary search. The primary researcher group, conformed by experts from the Technological University of the Mixtec Region analyzed meticulously each one of these papers (9 papers appeared as unobtainable). The primary researchers accepted 50 papers. Our independent researcher analyzed randomly 28 papers chosen among rejected and accepted papers (approximately each 8th study from an alphabetical list of 245). A 99.4% conformity was recorded with the original assessments. This percentage of agreement allows us to have certainty in our acceptance and rejection decisions.
(2) *Independent appraisal*: We conducted this validation exercise on the 51 accepted studies. In this exercise we had a high percentage of agreement between the primary researchers and the independent expert (99.8%), and any disagreement was discussed. There was disagreement on four of the accepted papers, so we requested the opinion of a second independent researcher, who agreed to reject these four papers after having taken into account how each study answered our research questions. As a result of this exercise, 47 papers were left for inclusion.

Table 3
Papers reviewed and validated.

Selection process	# Papers	Papers used in validation
Papers extracted from electronic databases	<980	n/a
Sift based on title and abstract	245	n/a
Papers – full versions available [245–9]	236	[28 papers randomly selected from this set for validation 1]
Papers accepted (by primary researchers)	50	–
Papers rejected by independent researcher (validation 1)	49	[1 paper rejected from the 28 paper sample that formed part of the 50 accepted papers]
Papers added by independent researcher (validation 1)	51	[2 papers accepted out of the 28 randomly selected papers that were previously rejected by primary researchers]
Papers rejected in validation 2 (47 papers remain in our review)	47	All 51 papers assessed and qualitative forms completed by an independent researcher – 4 rejected

4. Results

A total of 47 studies discuss the SI methods in RE. Citations for 47 papers included in this section are given in numerical form with a bibliography for further reading. It is very important to mention that, due to the unstructured sources and high level of heterogeneity of the analyzed studies, meta-analysis techniques such as aggregated data or could not be applied (we cannot combine them) (Kitchenham, 2004; Kitchenham and Charters, 2007).

Also, it is very important to say that as the majority of the studies analyzed are not validated, we were unable to analyze their impact in requirements elicitation. Prior to presenting results and analysis for each research question we will give a short overview of the general characteristics of the studies.

4.1. Overview of the studies

4.1.1. Research method

The inspected publications were classified according to the applied research method. Our initial strategy of categorization was simple and straightforward: extract the mentioned research method without interpreting the content study. Therefore, we defined the following categories to classify the studies:

- Empirical, i.e. findings are based on direct evidence or experiment.
- Theoretical or conceptual studies based on an understanding of the field from experience and reference to other related work.
- Others.

Fig. 2 shows that out of the 47 studies, 90% are empirical, 8% theoretical and, a small number of studies (2%) are either reviews

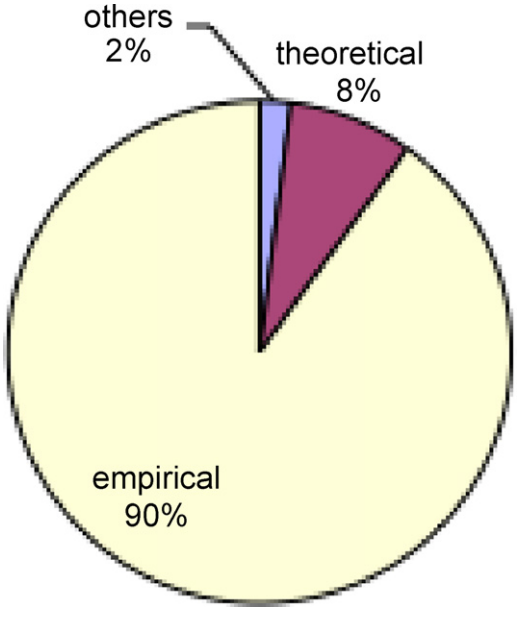

Fig. 2. Research method in our accepted papers.

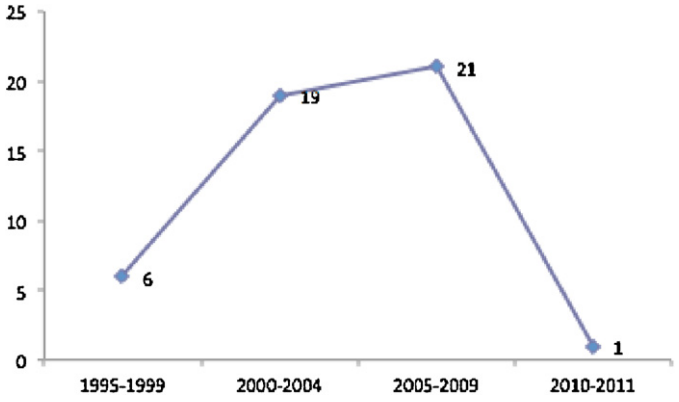

Fig. 3. Number of papers included in the review by 5-year intervals.

of the literature or secondary studies, where empirical work is re-examined.

4.1.2. Publication year

The reviewed papers were published between 1993 and 2011. Fig. 3 shows that over 14 years (1993–2007) there is a recent increase in published papers covering SI, specifically from 2000 to 2007. The increase may be a reflection of a growing awareness of the importance of motivation in RE or may just match a general rise in published papers in SI in RE. Nevertheless, since 2008 the number of SI studies has decreased possibly due to the fact that research on stakeholders identification changed its focus to other areas such as characterization of stakeholders in other media like social networks as we can see in Lim and Bentley (2011), Costa and Cunha (2010), Lim et al. (2010a,b, 2011), Lim and Finkelstein (2011), Tsung-Ting et al. (2010), and Woolridge and Bailey (2011).

4.2. Stakeholder identification in requirements elicitation

By investigating the four research questions, we aim to gain a broad picture of what the literature is reporting on SI in requirements elicitation. We collected information about what methods or techniques are currently used to carry out the SI in Requirements Elicitation (RQ1); what are the effective practices in SI (RQ2); what are the consequences of incorrect SI on the quality of Software Requirements (RQ3), and, what aspects of SI are necessary to use as advisable practices (RQ4). The following sections look at each of our four-research questions in more detail.

4.2.1. RQ1 – methods and techniques to carry out the stakeholder identification in Requirements Elicitation

Forty papers were identified in answering *Research Question 1 (RQ1): What methods or techniques are currently used to carry out the SI in Requirements Elicitation?*

All the studies analyzed gave us the impression that many attempts have been made to define and give detailed explanations of how the SI is done. This, however, is not the case. Currently, stakeholder identification methods are few and they are not structured as each author describes the process from their viewpoint, lacking a common framework of study and a uniform description. The high level of heterogeneity of the studies analyzed does not allow us to present a quantitative data analysis.

The current status of SI referred to in the present paper shows different interpretations of the scope of this process. All of the software initiatives referred to contribute to the improvement of the software process, by implementing a set of good industry practices for RE that have been identified, acknowledged, and disseminated. However, they have not explained how to carry out the SI.

Table 4
SI studies categories.

Categories	Paper references	Frequency (# of studies)
Studies that exclusively describe stakeholders.	Ban Al-Ani and Edwards (2004), Barber and Jernigan (2000), Fuentes-Fernández et al. (2009), Kasirun and Salim (2008), Lauesen (2002), and Robertson and Robertson (1999).	6
Studies focusing on the interaction between stakeholders.	Alexander and Robertson (2004), Arguello and Callan (2007), Coakes and Elliman (1999), Coughlan and Macredie (2002), Coughlan et al. (2003), Damian (2007), Fassin (2009), Glinz and Wieringa (2007), Halling et al. (2003), In and Roy (2001), Kaiya et al. (2005), Laporti et al. (2009), Niu and Easterbrook (2008), Oshiro et al. (2003), Pahl (2004), Sharp et al. (1999), Smith (2000), Stallinger and Grünbacher (2001), Söderholm et al. (2007), Stone and Sawyer (2006), Preiss and Wegmann (2001), Wong (2005), and Woolridge et al. (2007).	23
Studies that include an assessment of stakeholders.	Ballejos and Montagna (2006, 2008a), Davison et al. (2006), Greer and Ruhe (2004), Kulkarni (2008), McManus (2004), Mitchell et al. (1997), Parent and Deephouse (2007), Pouloudi (1997), Pouloudi et al. (2004), and Young et al. (2001).	11

Some initiatives provide numerous examples of who can be stakeholders by establishing generic categories into which they may be grouped (see Section 4.2.1.1). Other studies analyzed are more ambitious. However, the studies mentioned in this paper are not standardized and consequently the SI is not standardized either. Also, not all of them cover the same aspects and thus are not applicable to the same situations. This makes it difficult to select a correct stakeholder identification method because some methods only characterize the stakeholders, without assigning a stakeholder's role in a specific project, nor analyzing the stakeholder interaction, nor covering the human aspects of stakeholder identification (see Section 4.2.1.2). Only a few methods include stakeholder assessment (see Section 4.2.1.3). Furthermore, not all the studies analyzed take into account important aspects (Lewis, 1991; Lloyd et al., 2002) such as when and how we know that the stakeholders identified are sufficient for the project, and how all the information collected will be documented.

In 2007, Pacheco and Tovar (2007) identified three attributes related to the 'issues' of SI that can be structured into three categories: studies that exclusively describe stakeholders, studies focusing on the interaction between stakeholders, and studies that include an assessment of stakeholders. So we have grouped the 40 papers into these three categories. Section 4.2.1.1 gives the first category of studies that limit themselves to only proposing a list of possible stakeholders. Section 4.2.1.2 presents the second category of studies that not only indicate who the stakeholders can be, but also study their interactions. The third category, in Section 4.2.1.3, deals with studies that include an assessment of stakeholders (see Table 4). As we can see, within the RE area, there are no guidelines or proper standards to help and guide software engineers in stakeholder identification.

Table 5
List of potential stakeholders.

Types of stakeholders	Paper references	Frequency (# of studies)
Development team, clients/sponsors, and negotiators.	Ban Al-Ani and Edwards (2004) and Kasirun and Salim (2008).	2
Customers, final users, developers, producers, test staff, suppliers, marketing staff, and maintenance staff.	Fuentes-Fernández et al. (2009), Barber and Jernigan (2000), Lauesen (2002), and Robertson and Robertson (1999).	4

4.2.1.1. Studies that exclusively describe stakeholders. According to Pacheco and Tovar (2007), these papers provide a list of potential stakeholders from which it is possible to determine which ones are really relevant and how each one may be contacted. Nevertheless they only provide a helpful guide to establish a final list of stakeholders (see Table 5).

What must not be overlooked is that stakeholders will normally have to contribute their effort, time and/or money, and they must therefore know what benefits can be gained in return. Potential stakeholders must therefore be characterized by gathering relevant information about them. This information may also be useful for evaluating a set of identified stakeholders, and for obtaining new and more appropriate configurations (Pacheco and Tovar, 2007).

In general, these studies cannot be properly regarded as an identification of stakeholders because they only provide information that facilitates their identification. They do not ensure that all the necessary stakeholders are detected.

4.2.1.2. Studies focusing on the interaction between stakeholders. Pacheco and Tovar proposed that once we have an idea of who the main stakeholders are, the basic interactions between these actors should be identified. This enables stakeholders to clarify which part of the problem falls within each one's scope. "Interaction" involves communicating, reading a set of rules or guidelines, searching for information, etc. (Pacheco and Tovar, 2007).

The range of studies shown in Table 6 assigns stakeholder roles on the basis of an analysis of the interactions between different stakeholders and between the stakeholder and the system.

4.2.1.3. Studies that include assessment of stakeholders. In this category the methods shown suggest that the identification of people related to the project will be based on their relevance to the project (priority interests), their knowledge and skills, and having a suitable attitude toward the process. See Table 7.

Table 6
Way in which the interaction between stakeholders and relationships is established.

Manner	Paper references	Frequency (# of studies)
Using a context diagram to enable stakeholders to see what is happening in the system.	Coakes and Elliman (1999), Damian (2007), Fassin (2009), Halling et al. (2003), In and Roy (2001), Laporti et al. (2009), Niu and Easterbrook (2008), Preiss and Wegmann (2001), Smith (2000), Stallinger and Grünbacher (2001), Söderholm et al. (2007), Stone and Sawyer (2006), Wong (2005), and Woolridge et al. (2007).	15
Establishing the interaction, selecting a principal stakeholder and analyzing all stakeholders around him (providers, etc.).	Arguello and Callan (2007), Couhglan and Macredie (2002), Coughlan et al. (2003), Glinz and Wieringa (2007), Kaiya et al. (2005), Oshiro et al. (2003), Pahl (2004), and Sharp et al. (1999).	8

Table 7
Studies that include assessment of stakeholders.

Categories	Paper references	Frequency (# of studies)
Priority interests in the project.	Ballejos and Montagna (2006, 2008a), Davison et al. (2006), Greer and Ruhe (2004), Kulkarni (2008), Mitchell et al. (1997), Parent and Deephouse (2007), Pouloudi (1997), Pouloudi et al. (2004).	9
Skills and other suitable attitudes.	McManus (2004), Young et al. (2001).	2

So far, we have explained how each software project may have different types of stakeholders, and how selecting them appropriately has a strong impact on software requirements quality, and consequently, on the success of the software project itself.

4.2.2. RQ2 – effective practices recommended for performing SI

Sixteen papers answered *Research Question 2 (RQ2): What are the effective practices recommended for performing SI*?

There is general agreement about the need to find effective practices relating to SI in industry. We identified the three best SI practices in the papers analyzed (see Table 8):

a. *Identify and consult all likely sources of requirements*: This practice is based on the knowledge that stakeholders should meet the demands in terms of experience and expertise for effective teamwork. So, it requires (a) carefully selecting team members who are skilled in the application domain and RE processes, (b) assigning experienced, capable project managers to RE, and (c) consulting domain experts and stakeholders at an early stage of the process to increase and validate the team's knowledge.
b. *Identify user classes and their characteristics*: This practice emphasizes the need for stakeholder identification. There may, in fact, be many groups of customers who use the product, and these can be classified in terms of frequency of use of the product, user characteristics, levels of privileges, or levels of skills. Since each type of project (for example, commercial applications, integrated systems, web developments, etc.) requires different experts, proper selection of stakeholders is recommended. This selection involves a previous assessment of stakeholders in terms of risk and cost, and also taking into account standard types of communication between users and developers. For example, communication in which developers can talk directly to

Table 8
Best SI practices.

Best SI practices	Paper references	Frequency (# of studies)
a. Identify and consult all likely sources of requirements.	Ballejos and Montagna (2008b), Coakes and Elliman (1999), Hofmann and Lehner (2001), Parent and Deephouse (2007), and Robertson and Robertson (1999).	5
b. Identify user classes and their characteristics.	Glinz and Wieringa (2007), Ko et al. (2007), Sharp et al. (1999), McManus (2004), Young et al. (2001) and Wiegers (2003).	6
c. Identify and consult with the stakeholders of the system.	Coughlan and Macredie (2002), Fuentes-Fernández et al. (2009), Kaiya et al. (2005), Pouloudi et al. (2004), and Wong (2005).	5

potential users is more effective because it avoids loss of information due to the use of intermediaries.

c. *Identify and consult with the stakeholders of the system*: This practice recommends making a very specific list of stakeholders at an early stage of the RE process. It proposes a method of following guidelines that ensure only appropriate stakeholders are identified within each category of the proposed stakeholder classifications. It further suggests that an explicit list of stakeholders be drawn up and reasons given why the requirements will probably be important.

However, effective practices, or standards such as CMMi, SWEBOK, BABOK, and ISO/IEC 12207 (SEI, 2006; IEEE, 2004; IIBA, 2009; ISO/IEC 12207, 2004) have the following limitation: they do not explain how to define the entire set of stakeholders. Furthermore, this process is not always self evident, and so organization must be analyzed in order to identify all possible stakeholders. Hence, the application of a SI method sometimes becomes indispensable.

4.2.3. RQ3 – What are the consequences of incorrect SI on the quality of Software Requirements?

Only two papers were identified as answering *Research Question 3 (RQ3): What are the consequences of incorrect SI on the quality of Software Requirements?*

To answer this question, in the first place, it is necessary to consider what Software Requirement Specification Quality (SRSQ) involves. The IEEE Standard 830 (IEEE1998) gives a summary of the properties that should ideally be part of software requirement specification: *Correctness*, *Completeness*, and *Consistency*. The SI impact on the quality of software requirements is reflected in the success achieved in a project, as well as, from the current practice used to carry out this task (Pacheco and Tovar, 2007).

Any identification process that mistakenly recognizes someone as a stakeholder will probably include requirements, which do not correspond to any real need (a feature of correctness of the standard). Also, when the identification task fails to detect participants who are needed for the software project, requirement specifications are no longer complete due to the omission of relevant requirements for project success, and this could give rise to inconsistent specifications. Failing to obtain these properties can create risks that could affect the project.

Completeness, *Correctness* and *Consistency* in the SRSQ can be ensured by applying proper SI and elicitation techniques such as: scenarios, case studies, etc. These three aspects are essential to obtain high quality requirements. The implications of SI on the quality of requirements are significant. For example, the ISO/IEC 25000: 2503n Software Quality Requirements and Evaluation (ISO25010, 2011), and ISO/IEC 9126: Software Quality Characteristics and Metrics (ISO9126, 2001) all mention that the principle characteristic of software quality related to requirements is functionality: the essential purpose of any product or service (completeness, correctness, and suitability), and the quality of the software used is satisfaction: the capability of the software product to satisfy users in a specified context of use.

On the other hand, a good SI can provide many benefits. A proper selection of stakeholders improves the coverage of requirements, avoids an overlapping of requirements in the user community, and allows for a more rational organization of requirements. In this way, people get involved more easily, and are less reluctant to implement the system and give information relating to requirements.

4.2.4. RQ4 – SI advisable practices

After reading and analyze 19 papers, we can answer *Research Question 4 (RQ4): What aspects of stakeholder identification are necessary to use as advisable practices?*

Table 9
SI issues that must be improved.

Issues	Paper references	Frequency (# of studies)
a.	Ballejos and Montagna (2008b), Mitchell et al. (1997), Young et al. (2001), McManus (2004), and Viller et al. (1999).	5
b.	Al-Salem and Samaha (2007), Ballejos and Montagna (2006), Coughlan and Macredie (2002), Fassin (2009), In and Roy (2001), Ko et al. (2007), Sharp et al. (1999), Young et al. (2001), Kaiya et al. (2004), and Wong (2005).	10
c.	Kulkarni (2008), Parent and Deephouse (2007), Pouloudi et al. (2004), and Stone and Sawyer (2006).	4

In requirements elicitation, the appropriate identification of stakeholders is vitally important as a means of understanding the environment in which the software project will be developed and operated, and also to identify which stakeholders will participate in the project. This is a key aspect in the process of obtaining the expected quality requirements specification, in the sense that they must be appropriate, complete, and free of contradictions.

A proper selection of stakeholders in order to improve the coverage of requirements, avoids an overlapping of requirements in the user community, and allows for a more rational organization of requirements. This means that all stakeholders need to have an appropriate knowledge and no stakeholder can be omitted.

In view of the aforementioned explanation, the benefits of an adequate SI are evident. So, we can define the SI process as: "*A process that contributes to the identification of relevant stakeholders in RE*" (Conger, 1994; Finkelstein, 2000; Macaulay, 1996; Zowghi and Paryani, 2003), and it must contain the following advisable practices:

a. Assign appropriate roles to stakeholders through an analysis of skills, behavior in group dynamics and personality tests; aspects that would render the SI repeatable and verifiable. However, it depends on the stakeholders' availability.
b. The establishment of constructive interaction between all stakeholders during the requirements gathering process, and also between all stakeholders and the system to avoid conflicts and problems of communication arising from different points of view.
c. Classify requirements elicited from the stakeholders according to an evaluation of their priorities in relation to the project goal, in order to define the interactions between the stakeholders themselves, and between the stakeholders and the project. This enables us to verify whether the initial project goal has been satisfied.

Table 9 shows the most important cited SI aspects that must be improved according to the literature: assigning of appropriate roles, establishment of constructive interaction, and classification of requirements according to an evaluation of their priorities in the project.

5. Limitations

5.1. Completeness

We have conducted a very thorough review of the literature eliciting work from 38 different authors including some secondary studies (where we used the reference in the primary study to lead to another study). We found that 47 out of 280 studies partially describe stakeholder identification (see Section 4). We note that with the increasing amount of work in this area during 1993–2007,

we cannot guarantee to have captured all the available material in this area.

Another area of concern is that we did not consider studies published in a non-English language, this is not a limitation of our approach, but a reflection of the limitations imposed on us by the available research in this area.

5.2. Publication bias

Publication bias refers to the general problem that positive research outcomes are more likely to be published than negatives ones (Kitchenham and Charters, 2007). We regard this threat as moderate, since the research questions in this review are not geared toward the performance of a specific stakeholder identification method or technique for the purpose of a comparison.

The studies included in this review underwent a thorough selection process that involved several researchers cross-checking the completeness of searches and validating the suitability of each study for inclusion. Therefore we decided not to include gray literature (technical reports, work in progress, unpublished or non-peer reviewed publications).

However, as there is a systematic bias in the way the research is conducted in many of the included studies (often based on convenience samples) we note that our results may not be representative of all SI methods; for example we did not take into account non-English language studies. So, we cannot generalize from our results.

5.3. Data synthesis

Different areas in Software Engineering, Software Requirements and Stakeholder Identification studies, were grouped in order to identify topics that answer our research questions. However, we may have lost some of the details in changes over time by grouping all the papers together by theme because they have a high level of heterogeneity. Also, we lack dates of publication in the period of 1984–2011. When we aggregated our topics the reported frequencies were treated with maximum caution.

6. Further research

This review has raised many issues that would benefit from further research. For example, in stakeholder identification we need the following:

a. To take into account the impact of personality types and the roles they may play, because this aspect could be a repeatable character of SI.
b. To take into account the project type to be developed because not all projects need the same stakeholders to obtain the project requirements.
c. To assess stakeholders in terms of their characteristics, the knowledge needed, and their influence on a project to determine the priority of their requirements.
d. To use schemes to characterize and evaluate appropriate relationships between all stakeholders. For example, we could use this research question: Does the method analyzed contain labels such as, “one person is in charge of”, “this person is an assistant to”, “he/she is crucial for”, “he/she provides the information for”?

All these issues can be useful in order to improve stakeholder identification, and consequently requirements elicitation, which would in turn improve software quality.

In addition, further work is needed to develop a method or model to carry out SI in the RE area.

7. Conclusions

This paper presents a systematic literature review that investigates how stakeholder identification in requirements elicitation is carried out. The aim is to identify and characterize different approaches to provide a comprehensive outline and discussion of methods, standards, and techniques used in Requirements Engineering, specifically in requirements elicitation.

In the area of requirements elicitation it is critical to describe the stakeholder identification process in order to provide correct, consistent, and complete requirements specification. However, one of our findings suggests that during 2000–2007, an increased interest for developing methods in SI existed, as compared to previous and posterior years. For example, we have found that from 2008 until now, stakeholder identification changed focus to other areas such as characterization of stakeholders in other media like social networks as we can see in Lim and Bentley (2011), Costa and Cunha (2010), Lim et al. (2010a,b, 2011), Lim and Finkelstein (2011), Tsung-Ting et al. (2010), and Woolridge and Bailey (2011).

Also, we can see that stakeholder identification in the requirements elicitation phase has received very little attention from the different existing initiatives in software development, for example in CMMi, SWEBOK, BABOK, and ISO/IEC 12207. All these initiatives recognize the existence of different types of stakeholders in the RE area. However, they only suggest examples and categories of stakeholders, and do not provide practices or guidelines to help and guide software engineers to identify stakeholders (who need to be identified in each project as an indispensable part of requirements elicitation).

Despite the fact that success and quality in software products depends to a great extent on requirements specification quality, only two papers take standards into account (ISO9126, 2001; ISO25010, 2011).

All the analyzed papers confirm the variety of existing stakeholders involved in software development, each having different priorities and interests. However, in requirements elicitation, all of these studies take SI for granted and do not go beyond indicating “who” the stakeholders may be. Software engineers need to identify, characterize, and handle all the viewpoints of the different types of stakeholders specifically in the requirements elicitation phase.

The SLR cites three advisable practices for improvement of the stakeholder identification process: “For the stakeholder role assignation they must be subjected to personality tests” (this depending on the free time of each busy stakeholder), “the establishment of constructive interaction between all stakeholders during requirements elicitation” (to avoid conflicts and problems of communication), and “classification of requirements elicited according to an evaluation of their priorities in relation to the project goal” (to verify whether the initial project goal has been satisfied). However, only 19 papers mention some aspects of these issues.

As a final conclusion, the obtained findings, including an examination of the shortcomings found in this systematic literature review, provide strong evidence to encourage further research in the development of a new methodology to adequately perform SI. In addition, we propose the development of a guide that recommends the use of a specific method for stakeholder identification based on the particular characteristics of the project to be developed.

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