Using rapid reviews to support software engineering practice: a systematic review and a replication study

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Using Rapid Reviews to Support Software Engineering Practice: A Systematic Review and a Replication Study

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Abstract Context: A few years ago, rapid reviews (RR) were introduced in software engineering (SE) to address the problem that standard systematic reviews take too long and too much effort to be of value to practitioners. Prior to our study, few practice-driven RRs had been reported, and none involved collaboration with practitioners lacking SE research experience.

Objective: To investigate practitioners' perspectives on the use of RRs in supporting SE practices, we aimed to validate and build upon the findings of the seminal RR in SE study, specifically considering practitioners without explicit SE research experience.

Method: First, we studied previously conducted RRs in SE through a systematic review. Second, we carried out an external replication of the first study that proposed the use of RRs in SE. Specifically, we conducted an RR for an agile software development team looking to improve its knowledge management practices.

Results: Most of the software development team's perceptions about RR results were positive and strongly consistent with previous research. In particular, RR results were considered more reliable than other sources of information and adequate to address the problems detected. Some months later they confirmed using some of the recommendations.

Conclusions: The results show that practitioners without explicit SE research experience appreciate the value of evidence and can make use of the results of RRs. However, SE research may need to be translated from broad recommendations to specific process change options. Our research also reveals that SE RRs reporting needs to be substantially improved.

Keywords rapid review · action research · replication study · industry–academia collaboration · systematic literature review

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1 Introduction

Cartaxo et al. (2018) introduced the concept of rapid reviews (RRs) to software engineering (SE) researchers to address concerns that standard systematic reviews (SRs) take too long and require too much effort to be of significant value to the software industry. They explained that, *"RRs are lightweight secondary studies focused on delivering evidence to practitioners in a timely manner"*. To achieve this, reviewers simplify or skip steps from full SRs. For example, RR process options include only having one reviewer, omitting quality assessment of the studies, or limiting the literature search.

RRs were first used in health care, and have proved to be extremely useful, especially in emergency situations. For example, during the COVID-19 pandemic more than 3000 RRs were conducted (Tricco et al., 2022). They are also recognized as a good option for low-resource settings, in which there is no capacity to produce a full SR. Given this recent explosion of RRs in medicine, they have been studied in greater depth to reach agreement on their characteristics and methods (see, for example, Tricco et al. (2022); Mijumbi-Deve et al. (2022); Kelly et al. (2022); Wilson et al. (2021); King et al. (2022)).

RRs could become a valuable resource in SE for several reasons. In a similar way to what happened in the health field, they would make it possible to obtain recommendations to address problems or improve practice based on offering evidence in short time scales or for low-resource settings. Moreover, because they are designed to tackle issues collaboratively with practitioners, RRs could establish a connection between EBSE and professional practice in a manner that SRs have not yet accomplished (Rico et al., 2024). For example, Hassler et al. (2014) identified a significant barrier to SRs in the lack of industry connection, and Cartaxo et al. (2016)'s survey of Stack Exchanges users revealed that SRs often fail to address practitioners' specific questions. A tertiary study examining 120 SRs by Da Silva et al. (2011) found that only 32 providing recommendations for users, highlighting a gap in their practical applicability. Furthermore, Kitchenham et al. (2015) discussed only a single paper reporting a direct EBSE application in industry up to 2015 (Kasoju et al., 2013).

In their original paper, Cartaxo et al. (2018) evaluated the perceptions of some practitioners on the use of an RR to support decision-making in an industrial setting. The results were promising. Practitioners perceived that RRs offer reliable results and reduced decision-making time, and help better understood the problem and potential solutions. Two months later, the practitioners reported that they had adopted some of the evidence provided. In subsequent publications, Cartaxo et al. (2019, 2020) encouraged RR producers to publish their experiences and the feedback received from companies or practitioners to better inform SE researchers of the benefits and limitations of RRs.

We agree with Cartaxo and his colleagues, that SE researchers and practitioners would benefit from having more knowledge about the practical use of RRs, and this is the rationale for this replication study. In particular, our main focus is on determining whether RRs can assist practitioners in utilizing the findings of SE research, even in the absence of prior experience in SE research.

To fulfill this objective, we (1) conducted a systematic review on SE RR to explore the characteristics of RR adoption in our field, and (2) carried out a replication of the original study by Cartaxo et al. (2018).

Our replication involved assessing the use of RR in SE, with a particular emphasis on their potential to assist practitioners without experience in SE research. Specifically, it implied conducting an RR designed to assist a software company in addressing a real-world problem and evaluating practitioners' perceptions of the RR results. The systematic review, although smaller in scope, allows both positioning our replication and its results with respect to previous SE RR research and an overview of how RR studies are used in SE research.

The rest of this paper is structured as follows.

- In Section 2 we briefly outline the main characteristics of RRs both in the health field and in SE.
- In Section 3, we report a systematic review of the RRs published in SE.
- In Sections 4 to 7, we used Carver (2010)'s guidelines for reporting experimental replications and the principles and criteria for Action Research (the research method used both in the original study and in our replication) proposed by Davison et al. (2004). Specifically:
  - Section 4 presents the main characteristics of the original study by Cartaxo et al. (2018)
  - Section 5 presents the main aspects of our replication, this includes our research purpose (5.2), the research context (5.3), ethical issues (5.4), research steps (5.5), variations from the original study (5.6), and data collection and analysis procedures (5.7).
  - Section 6 presents details of the RR protocol and conduct.
  - Section 7 presents the results of our replication.
- Section 8 presents a discussion of the results of our systematic review and our replication.
- We present our concluding remarks in Section 9.
- Finally, Appendices I and II include additional information on the conducted RR and the data analysis of our replication study, respectively.

It is essential to point out that the replication was conducted before the systematic review. However, the systematic review is presented first in the paper to provide readers with more detailed information about RRs in SE and healthcare, enabling them to better evaluate the methodology and significance of our replication. The systematic review did not influence the conduct of the replication but provides additional information to assess the benefits and risks of RRs in SE.

2 Rapid Reviews

This section introduces RRs and their application in SE. First, we summarize the types of literature, and subsequently provide a brief overview of the definition and characteristics of RRs, as they are commonly used in the healthcare field. Second, we summarize the main characteristics of RR in SE, as proposed by Cartaxo et al. (2018). Finally, we outline the main differences between RRs and other types of literature reviews.

2.1 Types of Literature Reviews

Ralph and Baltes (2022) classified literature reviews in the following types.

Ad Hoc Reviews: These involve discussions of specific literature, e.g., commonly found in the related work section of most research papers. Researchers use purposive sampling, i.e., selectively choosing papers or studies that are useful, relevant, or supportive of their arguments. This unsystematic approach introduces sampling bias and challenges replication.

Systematic Reviews: These literature reviews follow a systematic, replicable process for selecting primary studies. The management and analysis of these primary studies define the type of systematic review. Apart from rapid reviews, which will be discussed in the next subsection, the types of SRs include:

- **Meta-analysis:** An archetypal SR that examines a set of randomized controlled experiments with the same independent and dependent variables.
- **Meta-synthesis:** Also known as thematic analysis, narrative synthesis, meta-ethnography, and interpretive synthesis, this approach involves aggregating qualitative studies. Meta-synthesis serves as the constructivist counterpart to meta-analysis.
- **Case Survey (aka Case Meta-analysis):** These reviews convert qualitative accounts (i.e., case studies) into a quantitative dataset for null-hypothesis testing.
- **Critical Reviews:** These reviews analyze a selection of primary studies to support an argument or critique. They mainly contribute to the meta-scientific discourse, which involves the internal discussions within a scientific community about research practices.
- **Scoping Reviews (aka Systematic Mapping Studies):** These reviews aim to understand the current state of research on a particular topic, typically by categorizing primary studies. Scoping reviews are generally mostly descriptive.

Ralph and Baltes (2022) defined RRs as a form of meta-analysis that *"makes methodological compromises to reduce completion time"*. They argue that RRs are only justifiable if waiting for a full review would be harmful, and that such circumstances are rare in software engineering.

2.2 RRs in Health Field

In the absence of a consensus, the Cochrane Rapid Review Methods Group proposed the following definition of an RR: *"A rapid review is a form of knowledge synthesis that accelerates the process of conducting a traditional systematic review through streamlining or omitting various methods to produce evidence for stakeholders in a resource-efficient manner"* (Hamel et al., 2021).

RR stakeholders (aka knowledge users) are individuals likely to use research evidence to make informed decisions across various fields such as health, education, policy-making, and industry (Garritty et al., 2024). This group includes public partners, practitioners, policymakers, educators, and industry leaders. Their involvement in conducting RRs aims to produce relevant, useful evidence for real-world applications, enhancing evidence integration into practice and decision-making. Moreover, RRs are often commissioned by decision-makers and organizations when urgent decisions are needed, typically due to resource constraints like limited funding (Garritty et al., 2024). Among the stakeholders, requesters are distinguished by their role in requesting the RR, defining the information needs, participating in the RR process (e.g., validating results), and disseminating the results (King et al., 2022).

Several mechanisms can be employed to strike a balance between timeliness and resource constraints when conducting a rigorous knowledge synthesis process to inform practice. Many researchers concur that there is no universally applicable approach to conducting RRs, and often, the choice of mechanisms should be tailored to the specific topic under investigation and the stakeholders' needs (King et al., 2022; Watt et al., 2008). Recent studies surveyed the most commonly used practices in RRs (King et al., 2022; Garritty et al., 2021) and identified the following key characteristics of RRs.

The most fundamental key to success is maintaining early and continuous engagement with the research requester King et al. (2022). This collaboration helps focus the RR and ensures its alignment with the stakeholders' needs. It is also recommended to discuss with stakeholders their expectations for communication in advance and adapt the reporting and dissemination approach to prioritize practical needs (Kelly et al., 2022).

Methods can be streamlined at all stages of the review process, from the initial search to synthesis King et al. (2022). This can be achieved by limiting the search in terms of dates and language, restricting the number of electronic databases searched, assigning a single reviewer for study selection and data extraction (often with verification by another reviewer), limiting risk-of-bias assessment for the most important outcomes, and opting for a descriptive synthesis rather than a quantitative summary.

Like conventional SRs, the protocol serves as the starting point for the review, however, methodological decisions often evolve iteratively, involving requester participation Wilson et al. (2021). Any modifications to the protocol should be reflected in the final report. Researchers must transparently document their methodological choices, which should be communicated to stakeholders, to ensure that the evidence review is suitable for its intended purpose. Since the potential bias introduced by these choices may not be evident, transparency is indispensable King et al. (2022).

2.3 RRs in SE

Cartaxo et al. (2018) proposed RRs as a means to transfer knowledge from research to SE practice. They identified some key characteristics of RRs in SE, which, slightly adapted, are:

- **Timely results and reduced costs:** In general, SRs are produced in relatively long timelines (several months or years) by a team of reviewers. Instead, RRs have shorter timelines that seek a compromise between the needs of practitioners and methodological rigor, considering timelines between days, weeks, and months depending on the stakeholders' needs (Wilson et al., 2021). To achieve these reductions, various strategies can be used, e.g., participation of a single reviewer, not conducting quality assessment, using specific questions, or using tables to quickly map and summarize the findings (Cartaxo et al., 2018; Wilson et al., 2021; King et al., 2022).
- **Collaboration with practitioners:** A key aspect to achieve a successful uptake of the RR results is a close collaboration with the decision makers who

requested the RR (also called review requesters) (Tricco et al., 2022). This collaboration should start at an early stage in order to understand the requesters' information needs and expectations (Garritty et al., 2021; King et al., 2022).
- **Appealing media:** Cartaxo et al. (2018) highlight as another key aspect asserting that the results of an RR should be presented in formats that appeal to practitioners rather than the conventional research paper format. They specifically advocate for the use of evidence briefings, defined as one-page documents summarizing findings from secondary studies (Cartaxo et al., 2016), as a potential method to report the outcomes of an RR.

2.4 Differences between RRs and other types of reviews

First, ad hoc reviews are conducted on an as-needed basis to address specific, often immediate questions across various contexts. They are more flexible, less structured, and can vary widely in methodology and duration. While RRs balance speed with some level of systematic thoroughness, ad hoc reviews prioritize immediate relevance and flexibility over comprehensive rigor.

Second, while RRs focus on quickly synthesizing evidence to meet urgent needs (usually with a concise and targeted scope), often with less methodological rigor and resource investment, SRs generally aim for a thorough and exhaustive synthesis of the literature, ensuring high methodological rigor and comprehensive analysis (Ralph and Baltes, 2022). RRs provide a more limited analysis of the available evidence, focusing on key findings and major trends rather than in-depth synthesis, which is typical of SRs as they seek to compile robust and nuanced evidence.

Third, in the case of mapping studies (or scoping reviews), their aim is to offer a broad overview of the research landscape, identifying gaps and trends in a specific field (Ralph and Baltes, 2022). They typically categorize and map the literature without necessarily synthesizing detailed findings from primary studies. This differs from RRs, which focus on rapidly synthesizing evidence to address urgent decision-making on specific questions.

3 SE Research Using RRs

In order to assess take-up of RRs in SE, we conducted a systematic review of RR research based on citation analysis of two of Cartaxo's papers (Cartaxo et al., 2018, 2020). Our research questions were:

- RQI: What is the extent of take-up of RRs in the SE domain?
- RQII: What was the scope of these studies?
- RQIII: What are the methodological characteristics of the reported RRs?
- RQIV: Which studies contributed to assessing the value of RRs and what have they found?

We searched for citations of Cartaxo et al.'s papers on the publication sites of the two papers in their respective publication sites (ACM and Springer respectively) and Google Scholar. The process of our review had two iterations and its complete details an expanded results can be found in the supplementary material to this paper. The last search took place on November 27, 2023, and identified

150 citations. We found 23 publications of interest, including articles from conferences or journals and book chapters (Ponce et al., 2019; Radu, 2020; Baldassarre et al., 2023; Marchetto, 2023; Matalonga et al., 2022; Abdelfattah and Cerny, 2023; Păvăloaia and Necula, 2023; dos Santos et al., 2023; Hidalgo et al., 2024; Lonetti et al., 2023; Paes et al., 2023; Barletta et al., 2023; Baldassarre et al., 2021; Pizard et al., 2023; Fritzsch et al., 2023, 2022; Rufino Júnior et al., 2023; Furukawa et al., 2022; Song et al., 2022; Loli et al., 2020; Bjarnason et al., 2023; Motta et al., 2023; Rico et al., 2024). Below RQs are answered using tables and summaries. Cross-references to study characteristics are reported in the supplementary material.

3.1 RQI: Extent of take-up of RRs in the SE

We found 23 papers reporting RRs in SE, although one of them analyzed the process used by two previously published RRs (Rico et al., 2024). Since this study includes additional objectives and information to the original studies, we maintain it in our following analysis except in situations where otherwise indicated. 15 of these studies were published in 2023 (prior to Nov 23).

Researchers from 13 countries participated in the studies. Table 1 shows the number of papers and the number of researchers from the different countries of affiliation of the authors (some authors have more than one affiliation). A co-author of the original RR in SE studies participated in one of the studies (Loli et al., 2020).

Country	Number of Papers	Number of Researchers
Brazil	7	24
Italy	6	15
Sweden	3	9
Portugal	2	5
Germany	2	8
Romania	2	3
UK	2	2
Chile	2	4
France	1	2
Uruguay	1	3
USA	1	2
Spain	1	1
The Netherlands	1	1

Table 1 Number of papers and researchers from the countries of authors' affiliations.

3.2 RQII: Scope of the studies

Thirteen of the studies report an RR aimed at acquiring knowledge in a specific field, with some studies explicitly indicating this intent while others do not (though they also refrain from reporting any alternative use or motivation). The remaining 10 studies had broader goals, as shown in Table 2. For example, some of them sought to complement or validate the RRs' results, while others used the RRs' results to develop a model, catalog, or artifact.

Table 2 Scope of SE RRs.

	Number of Studies
Purpose of the study[1]	
Conducting an RR.	13
Creating a model/catalog/artifact using the RR results as input.	3
Conducting an RR and complementing/comparing its results with stakeholders' opinions.	6
Investigating the RR methodology.	1
Type of stakeholders[2]	
Software industry	6
University students	2
Government agency	1
Other industry	1
Stakeholder participation[2]	
RR results are reported as starting point for future collaboration with stakeholders.	2
Stakeholders participated throughout the RR process.	3
Stakeholders validated RR results.	2
Stakeholders validated the model, catalog, or artifact created.	3[3]
Stakeholders participation was used to complement RR results.	2
Stakeholders participation's results were compared to RR results	2

[1] Including all 23 papers reporting SE research using RRs.
[2] Not including (Rico et al., 2024) as it analyzes two previously published RRs.
[3] Two of these studies involved conducting families of RRs.

Nine studies report conducting an RR and complementing/comparing its results with stakeholders' opinions (refer to Table 2). Additionally, in another study, the RR served as a starting point for collaboration with stakeholders, but neither their participation nor feedback is reported.

Table 3 shows topics addressed by RRs in the 22 studies excluding (Rico et al., 2024). The number of topics covered is greater than the number of studies because some studies reported multiple RRs on different topics. Studies that reported multiple RRs on the same topic were counted once only. Table 3 confirms that 13 of the most commonly addressed topics related to the software process (i.e., software construction, software testing and software maintenance), and technology impact was another frequently addressed topic.

The vast majority of RRs included only white literature. However, three RRs include grey literature and another one was conducted in conjunction with a grey literature review. Two studies aimed to search for software tools (the selection ends in Gitlab or Github) and another study searched for both models and tools (both within white literature).

3.3 RQIII: Methodological characteristics of published RRs

Table 4 summarizes the reporting limitations and process changes that we found in the papers reporting RRs.

Topic	Number of Studies
Software construction	5
Technology impact	5
Software testing	4
Software maintenance	3
Software tools	2
SE professional practice	2
SE models and methods	2
Software design	1
Software process	1
Evidence-based practice	1

Table 3 Topics of the RRs conducted in SE, not including (Rico et al., 2024) as it analyzes two previously published RRs.

RR Process Issues	# of Studies
RR Reporting Issues Decreasing Transparency and Reproducibility	
Did not report synthesis methods adequately	18
Did not include the full date of the search	15
Did not report number and roles of reviewers	9
Only reported number and roles of reviewers for some stages	8
Did not cite primary studies	7
Did not mention limitations	6
Reported results only via an Evidence Briefing	2
Process Changes that could Bias RR Recommendations	
Omitted risk of bias evaluation (i.e., quality assessment)	21
Used a single search engine	12
Used a single researcher for 1 or more stages	8
Used a subset of the studies found in searches	4
Included additional studies without explanation	3
RR Risk Reduction Processes	
Used a single search engine complemented with snowballing	4
Used an Evidence Briefing with additional commentary about RQs	2
Used only primary studies cited in related SRs	1
Used tools to assist analysis and classification	1

Table 4 Reporting issues and process characteristics of the RRs conducted in SE, not including (Rico et al., 2024) as it analyzes two previously published RRs.

In most studies, adequately considering the RR process or its results is challenging due to insufficiently reported information. In general, detailed information is provided about the sources used and the information search stage, less information about selection and extraction. But the synthesis stage is the worst reported (only four studies report it adequately).

Additionally, inadequate reporting of synthesis methods hinders reproducibility in most SE RR studies. Barletta et al. (2023) and Motta et al. (2023) are the only exceptions, offering comprehensive details crucial for reproducibility, including details such as the date of search, the list of primary studies, and synthesis methods used.

Finally, there is confusion about the term “protocol”. Some studies use it correctly for the artifact that guided their RR conduct, while others use the term to refer to the generic RR process. Only five studies mention using a protocol (Furukawa et al., 2022; Matalonga et al., 2022; Motta et al., 2023; Rufino Júnior et al., 2023; Song et al., 2022), and only one makes the protocol available to readers(Motta et al., 2023).

3.4 RQIV: Studies assessing the value of RRs

Six studies confirmed the value of RRs by validating their outcomes (or the models created from them) through collaboration with stakeholders outside the review team.

- Furukawa et al. (2022) conducted an opinion survey with IT professionals (75% out of 20 participants having postgraduate level education) to validate the RR outcomes.
- Song et al. (2022) conducted an RR as a starting point in a collaboration with a software company.
- Loli et al. (2020) created a catalog of object-relational mapping code smells in java using results of an RR. The researchers undertook an opinion survey to validate the results (97% out of 86 participants with, at least, a bachelor’s degree).
- Bjarnason et al. (2023) worked collaboratively with a company. In particular, three RRs were conducted to create a software selection model, which was validated with a focus group and an application in the company.
- Motta et al. (2023) conducted seven RRs to develop a roadmap for IoT development. To validate it, an experimental study was carried out where undergraduates used and evaluated the roadmap.
- In Rico et al. (2020), the authors analyzed the artifacts of the RR reported in Song et al. (2022) and one of the RRs reported in Bjarnason et al. (2023). They also conducted interviews with the RR review teams, aiming to gain a better understanding of how RRs were conducted.

Although the feedback reports are not extensive or detailed, in all studies, stakeholders had a positive attitude towards the results confirming the value of RRs. Except for the study with undergraduates, the others included practitioners with education achievements of at least degree level.

In the three studies in which researchers collaborated with companies throughout the RR process (Bjarnason et al., 2023; Song et al., 2022; Rufino Júnior et al., 2023), the practitioners were technology experts who specialized in topics related to RR questions. In two of those studies in which the results were validated with practitioners (Bjarnason et al., 2023; Song et al., 2022), their perceptions of the results were positive, and their feedback was used to improve the RRs results. Despite the fact that in one of the studies, the results were not directly applicable for practitioners (Song et al., 2022), both studies support the view that RRs are useful in industrial contexts.

Rico et al. (2024) analyzed the artifacts of the RR reported in (Song et al., 2022) and the first of the RRs reported in (Bjarnason et al., 2023) to evaluate the application of recent guidelines for conducting RRs in collaboration with practitioners, as well as to comprehend the benefits and challenges associated with RRs. The results confirmed that the guidelines were adequate. Conducting RRs collaboratively benefited the relationship between researchers and practitioners, fostering an understanding of expectations and establishing a common terminology. The main challenges included divergent needs of the review team and the industry collaborators, inadequacy of the evidence found (necessitating the use of broad questions), and concerns about short timelines (RR conduct took a few months but with low weekly effort).

3.5 Conclusions

The majority of papers (13 of 23) did not comment on the validity of the RR process or the risks entailed by process changes made to reduce timescales and/or effort neither did they appear to have a specific knowledge user. Of the remaining papers, the outcomes of the RR were used by the reviewers, or the value of the RR outcomes was assessed by industry collaborators, or the validity of the RR outcomes were assessed by other participants.

Current SE procedures for RR conflict with Healthcare recommendations, as described by Kelly et al. (2022). In particular current RRs often fail with respect to targeting a specific knowledge user and communicating directly with them, working from a protocol, reporting in sufficient detail to support reproducibility, and identifying the methodological strengths and weaknesses of the review. With respect to targeting a specific knowledge users, Rico et al. (2020) proposed guidelines for interactive RRs by revising Cartaxo et al. (2018)'s RR process to include practitioners. His guidelines also include producing a protocol, and reporting to the practitioners involved and disseminating the results to other practitioners and academic audiences. In our opinion, the guidelines identify by Rico et al. (2020) address most of the problems in current SE RRs, but they could be improved by including an assessment of the methodological strengths and weaknesses of the review.

The studies by Bjarnason et al. (2023); Song et al. (2022); Rico et al. (2024) confirm that RRs can support collaborations between industry and academia. However, like the RR conducted by Cartaxo et al. (2018), the industry collaboration was in the context of advanced R&D projects and involved practitioners with experience in SE research —a limitation already identified by Cartaxo et al. (2018). Our study addresses this research gap by undertaking an RR aimed at collaboration with industry participants who had no previous experience with SE research or the use of evidence.

4 Original study on RR in SE

In their study, Cartaxo et al. (2018) not only proposed the use of RRs in SE but also reported an empirical evaluation of the perceptions of practitioners about the outcomes of an RR conducted to address a problem identified in their practice.

Research Question. The researchers asked: *What are practitioners' perceptions on using Rapid Reviews to support informed decision-making in software engineering practice?*

Context & Participants. To answer this question, the researchers introduced RRs to offer empirical evidence aimed at enhancing customer collaboration in agile software development projects conducted by an applied research institution in Brazil, which offers services such as software development, applied research, and consultancy. The project aimed to develop a monitoring system for reusable packages during the production chain of the automotive industry. The practitioners who participated in the research were the project coordinator (who was the leader of all project managers) and one of the project managers. They both had a master's degree in computer science.

Research Design. Action research was used as a research method. In particular, a cycle of the canonical action research process was conducted, as proposed by dos Santos and Travassos (2011a). This process has the following five stages: Diagnosis, Planning, Intervention, Evaluation, and Reflection.

- In the first stage the researchers explored and established the problem practitioners would help address. As an instrument, they used semi-structured face-to-face interviews.
- In the planning stage they decided to use an RR and developed the protocol in collaboration with the requesters.
- The intervention consisted of conducting the RR and transferring the results to the practitioners. The latter was carried out through the preparation of an evidence briefing and a workshop to disseminate the evidence.
- The evaluation stage consisted of two semi-structured interviews, one during the results dissemination workshop and a second interview carried out two months later.
- The reflection stage included reflecting and reasoning about the previous steps.

To report and disseminate the results of their RR, Cartaxo et al. (2018) utilized an evidence briefing. Subsequently, their study examined practitioners' perceptions of both RRs and the utilization of evidence briefings as a means of disseminating their findings. The participants often used scientific papers and were, therefore, able to compare the use of evidence briefings as an alternative means of receiving scientific evidence.

Results. The results show that practitioners had a positive perception of RRs information. They reported benefits such as learning new concepts, reducing the time and cost of decision-making, and improving their understanding of the problems they faced. Two months after transferring the RR results, practitioners had adopted the evidence provided. The study also identified some improvements to the RR process, such as the need for discussing the findings of the RR, avoiding printing the RR report in black-and-white, and including graphical information in the report. However, not all the evidence provided by the RR was found to be useful by the participants, as some strategies were already in place or could not be implemented. Overall, the study demonstrated the potential of RRs in transferring research knowledge to SE practice.

5 Replication Information

As stated above, our study replicates the research conducted by Cartaxo et al. (2018). This involved conducting a Rapid Review (RR) to provide information for a software company addressing a real-world problem. We assessed practitioners' perceptions of considering RR results to enhance their practice, both immediately after sharing them and a few months later.

Reviewing Cartaxo et al. (2018) results, we found that their RR's recommendations were SE concepts rather than direct support for decision-making. For example, a recommendation is *"Customer Proxy: Some agile teams use a customer proxy —a member of the development team coordinating with the customers—to secure requirements and feedback"*. In particular, the recommendations were not presented as a comparative evaluation of a set of alternative methods to address the requesters' problems. So, we consider both the original study and this replication to be an evaluation of the use of RRs to support practice in SE, not an evaluation of RR support for decision-making.

Below, we present the key features of our study, which include the motivation behind conducting the replication, our research objectives and questions, the context and research design, and finally, a summary of the differences from the original study.

5.1 Motivation

Replication of empirical studies is a fundamental activity in the construction of knowledge in all empirical sciences (Da Silva et al., 2014). The significance of replications can be viewed from two angles: first, to validate or broaden the findings of previous studies, and second, to understand the effects of new variables, including those introduced by changes in the environment (Kitchenham, 2008).

However, despite the growing trend in the number of published replications, the actual number of replication reports remains small (Cruz et al., 2020). Consequently, many techniques and methods are proposed for SE based on single empirical studies. This creates difficulties in persuading other researchers, and also practitioners, to adopt our techniques since they have not found substantial empirical evidence and the available evidence may not align with their specific contexts (Weyuker et al., 2011).

Our motivation for undertaking this replication is primarily focused on further investigating RRs. In light of the positive outcomes reported by Cartaxo et al. (2018), we became intrigued by the potential of RRs to support practitioners wanting to address problems that they themselves identified. In particular, we were interested in collaborating with practitioners who did not have experience in scientific research. Our research goals were viable because Pizard and Vallespir worked at the Universidad de la República in Montevideo, Uruguay and, therefore, had links with the Uruguayan software industry, which has the highest per capita turnover in Latin America (Escalante and Fagúndez de los Reyes, 2022). It includes a substantial number of small and medium-sized enterprises, staffed practitioners with different levels of education and training.

5.2 Research Goals and Method

As stated above, this is a replication of Cartaxo et al. (2018)'s study and we have adopted a similar methodology to that used by the original authors, in order to facilitate comparisons of our results. However, we concentrate primarily on the issues arising from collaboration with industry, not those concerned with the format of evidence briefings. This means our research question is limited to the benefits and limitations of RRs as perceived by the review requesters. Arising from this goal our research questions are:

– RQ1: What are the perceptions and attitudes about using a rapid review to support software engineering practice in a software company?
– RQ2: Are there any problems using RR information when collaborator have no SE research experience?

With RQ1 we sought to replicate the objective of the original RR study in SE. Meanwhile, we proposed RQ2 to further study the gap that we identified in the systematic review.

To address these questions, like Cartaxo et al. (2018), we used action research, a method that integrates research with exploratory actions that promote change (Denzin and Lincoln, 2017). In particular, researchers and participants (e.g., company representatives) perform an action or tackle a problem by working collaboratively, and then evaluate and reflect on the results (dos Santos and Travassos, 2011b). Action research supports addressing problems in a pragmatic way without sacrificing scientific rigor. It also promotes reflection and knowledge generation. This makes it particularly useful for conducting field research.

We can define our replication as follows (Ralph et al., 2021):

– A methodological replication - same objectives and research method but a different practitioner problem and a different context (Dennis and Valacich, 2015). Our context, notably, includes practitioners without explicit experience in SE research.
– A partial replication - addresses a subset of the original research question (Carver, 2010). Although the research question seeks the same in both studies, as we mentioned before the original study also sought to evaluate the use of evidence briefings, which we did not replicate.
– An external replication - the replication team does not share members with the original study team (Da Silva et al., 2014). It is also necessary to clarify that we did not have any direct contact with the group of researchers who carried out the original study.

5.3 Research Context

Here we describe certain aspects of the research context.

The company: A UK company specializing in digital out-of-home (DOOH) advertising[1]. The company's IT department, located in Uruguay, was responsible for developing and maintaining a platform to manage advertising campaigns. More information about the company and the software development team is included below (see Table 5.5.1).

The requesters: The technical product leader and the project manager accompanied all the stages of the project, from the diagnosis of the problems to the dissemination of evidence. They answered questions, carried out intermediate validations, and received the recommendations obtained from the rapid review. For the purposes of this study, we have considered them as review requesters. The review requesters were the staff members responsible for identifying and introducing any required changes to the software development process. During the first meeting, the reviewers asked them about their educational level and use of information sources. Their educational level was Intermediate[2] (one with *upper secondary education* and the other one with *post-secondary non-tertiary education*). As sources of information for supporting practice they usually talked to colleagues, read technology forums or blog articles, and watched technology videos (e.g., from the Microsoft youtube channel). Neither of them consulted scientific literature.

Other stakeholders: Three other members of the development team also participated in the dissemination workshop of RR results. At the beginning of the workshop, they were asked what sources of information they usually used, and they indicated that they neither knew nor consulted scientific literature.

The reviewers: Reviewers were Lezama, García and Pizard. Pizard has ten years of industry experience as a technical lead and software quality manager, and twelve years as a teaching assistant at the university. This study is part of his doctoral research that focuses on investigating EBSE adoption. García and Lezama were about to finish their computer science degrees. Participating in the RR was part of their capstone project. Also, both of them had full-time jobs related to software development. In particular, Lezama was also part of the company's development team and was so during the first half of RR conduct. Both of them were trained in EBSE, specifically, in the planning and conduct of SRs. The training was led by Pizard and based on an EBSE and SRs course he teaches (Pizard et al., 2021, 2022).

5.4 Ethical Issues

Our university did not require our study to be approved by an ethics committee. However, given the participatory nature of action research, ethical aspects must be carefully considered, and, in particular, it is imperative to ensure that the processes are transparent to all participants (Stringer, 2007). Both the company members and the students (i.e., García and Lezama) were informed of the purpose and nature of this research prior to their consent to participate.

In addition, two other ethical considerations were:

[1] Digital out-of-home advertising (DOOH) is advertising designed to reach consumers when they are not at home and that is also dynamically and digitally displayed. This includes digital transit, digital billboards, and digital place-based displays.

[2] According to UNESCO's ISCED 2011 classification. https://ilostat.ilo.org/resources/concepts-and-definitions/classification-education/

- Ensuring that the students' education experience was not adversely impacted by the study: (1) Students should not be required to undertake tasks beyond their capabilities. This concern was addressed by appropriate training and supervision. (2) The students were assured that the outcome of the study in terms of whether or not it was favorable to the use of RRs would not impact their capstone project marks.
- Ensuring that the interests of the company are not adversely affected by the study: (1) The company would receive the best scientific information to help them address their process issues. This was assured by the personal experience and supervisory role of the first author. (2) Commercially or personally sensitive information would be kept confidential or anonymous as appropriate. Specifically, only the company and roles are identified, and specific comments are not attributed to specific individuals.

5.5 Research Steps

Our study used the five steps recommended for action research in SE (dos Santos and Travassos, 2011b). These were diagnosis, planning, intervention, evaluation, and reflection.

5.5.1 Diagnosis

In this step, we sought to better understand the company and the knowledgement management (KM) problems they had. We did this by conducting a face-to-face meeting at the company's offices. The meeting, which followed a script[3], had the following parts:

a. We explained the purpose of the study;
b. We briefly presented EBSE and secondary studies.
c. We asked for information from each participant, e.g., their position and seniority in the company.
d. We asked about the project and the team's characteristics.
e. We asked about the KM problems they were facing.
f. Finally, we agreed on how to continue working.

The meeting lasted ∼1h45min and later its recording was transcribed to facilitate our analysis.

In summary, requesters felt comfortable with their software development methodology (Scrum with two-week sprints). They reported that although they had certain KM practices, they faced several problems with the management of knowledge and documentation used in the software development and maintenance process. Furthermore, they had tried some solutions without any significant success.

The company used a continuous improvement process that involved identifying small improvements that were to be introduced in future sprints. Specifically, they told us that the results of our project were going to be incorporated into that improvement process, so they preferred a set of small specific recommendations rather than a single large-scale change.

[3] For a version of the script, in English, contact the first author.

As a validation of this diagnosis activity, we shared a summary of the context of the company and its KM problems with the requesters, who formally approved it. This document is reproduced in Table 5.

Context
The company, a spin-off of a UK advertising agency specializing in digital out-of-home (DOOH), is responsible for the entire life cycle of four products that make up a platform whose purpose is to facilitate the management of the advertising agency's campaigns. The staff is geographically distributed. Outside of Uruguay are the CEO (US) and four account executives (UK), who are the platform users and maintain contact with the end customers. The software development team is located in Montevideo: product owner, project manager, architect, three back-end developers, one front-end, a DevOps manager, and a QA. They use Scrum with two-week sprints. There are daily stand-up meetings and at the end of each sprint, the progress is validated through demos with the stakeholders (the CEO, the account executives, and some employees of the advertising agency). Planning and retrospectives are also carried out. Sprint by sprint, improvements identified during the retrospective meetings are introduced and evaluated experimentally. The team produces and stores a lot of documentation using a variety of different online tools. - GitHub is used to store the code and installation instructions. - Lucidcharts are used to document architecture diagrams, flows, roadmap planning, processes (e.g., service integration), and retrospectives. - To document test cases and test scenarios, the Visual Studio Online (VSO) wiki is used. - To keep the backlog, the VSO board is used. - To track tasks such as integration stages, product discovery, and technical debt, Trello boards are used. - To document the architecture (architecture decision record, ADR) or make spreadsheets (e.g., notification management) Google Docs is used. The responsibility for maintaining each document or tool change according to the needs. The only document that has a pre-defined structure is the ADR. To share knowledge, one or two team members usually prepare internal workshops, which sometimes include coding dojos.
Problems related to KM
Difficulties related to the management of the documentation already created. - It is hard to find the right document (there are duplicates or different ones but with the same purpose, in different media, and from different dates). - It is also complicated to keep the documentation up-to-date and to deprecate, or directly eliminate, unnecessary or out-of-date documents. The decision of what type of document to create usually depends on the person who is going to do it. There are no standard definitions, so it is hard to decide what documentation to produce. An exception to this is ADRs which do have a defined structure and the team agrees that had positive results. The company perceives as a problem the centralization of knowledge in some roles covered by a single person in the team. QA and DevOps manager roles are perceived as riskier, both roles with only one member.

Table 5 Results of the Diagnostic Stage: Context and problems related to KM.

5.5.2 Planning

At this stage, we defined the RR protocol (see Section 6 for more details). In particular, we performed several preliminary searches on Scopus and other search engines to check that appropriate evidence existed to address the issue. As a result of these searches, we selected Scopus as our search engine, refined our search string, and specified our selection criteria. We did not agree on a timeline since the students would only be available on a part-time basis and it was the first time that they would conduct an RR. We stipulated carrying out an intermediate validation so that the requesters could validate a sample of the evidence. We also specified that the dissemination would be done through an evidence briefing and a workshop.

5.5.3 Intervention

In this step, we conducted the RR and disseminated the results. We carried out an intermediate face-to-face validation of an evidence sample and undertook several consultations via email. In addition, because Lezama worked in the company for a while, the requesters answered his queries and asked him questions informally. The RR was done in three and a half months and the total time spent by all reviewers was $\sim$150hs, including team meetings and knowledge dissemination transfer activities with practitioners.

5.5.4 Evaluation

We circulated two questionnaires to assess requesters' perceptions of the RR results and the challenges faced during its conduct, one at the end of the dissemination workshop (in which company software developers also participated) and another follow-up questionnaire eight months later. We also recorded the workshop in audio (with prior approval) to analyze the attendees' initial attitudes. In addition, the reviewers held a retrospective meeting to reflect on the RR process and its results, in which, for example, the stages and activities carried out were recalled, and the main challenges and facilitators were discussed. As the meeting did not directly address the RQS, the insights gathered from this meeting were employed as input to the discussion of results (refer to Section 8).

5.5.5 Reflection

As stated by dos Santos and Travassos (2011b), this step is intended to investigate two issues 1) whether the results of the action delivered the results reported in the literature, and 2) the learning experience of the participants and its impact on the organization.

Because the goal of our study was to assess the value of the RR to support practice, we investigated attitudes of the company staff to the evidence and recommendations provided by the RR, and compared our results with those reported by Cartaxo et al. (2018). Thus, in this study, we only considered the second issue mentioned by dos Santos and Travassos (2011b).

5.6 Variations from the original study

We consider that the most significant difference with the original study by Cartaxo et al. (2018) is that our study considers practitioners lacking experience in SE research. However, there are several differences with the original study, primarily arising from the specific conditions and context of our research. Table 6 provides a concise summary of the disparities between the two studies, with detailed information on each point provided earlier in this section.

5.7 Data Collection & Analysis

Data Collection. Data were collected about the organization, the roles of all participants, the actions of the participants, and the outcomes of the action research process.

In particular, the opinions of requesters and software development team members on the RR results were captured at different instances:

- During the workshop, when one of the requesters and members of the development team openly discussed RR information.
- At the end of the workshop, through a questionnaire circulated to the requesters and members of the development team, which included closed questions and space for additional comments.
- Eight months later, through a follow-up questionnaire to requesters, asking about the use of the RR results.

Additionally, as previously stated, the reviewers held a retrospective meeting in which they revisited the activities carried out during the research, reflected on the usefulness of the RR results, and discussed the challenges encountered during both the RR process and the workshop aimed at disseminating the results.

Throughout the research, audio recordings were made of all meetings, and all emails and communications among reviewers, requesters, and other stakeholders were collected. In addition, internal documents, reports for requesters, and other artifacts (e.g., documents for intermediate validation of evidence) were collected. Finally, the report of the students' capstone project and the video recording of the capstone project defense presentation (including the discussion with committee members) were included in the dataset. All the material is in Spanish.

Data Analysis. Data analysis was strongly based on thematic analysis with a realistic approach (including coding, theme identification, and selection of illustrative quotes) (Braun and Clarke, 2006).

Initially, the audio recordings of the meetings with requesters, the results transfer workshop, and the reviewers' retrospective meeting were completely transcribed.

In the first stage, Pizard carried out an inductive analysis to identify (i) all stages and activities carried out during the research, (ii) the requesters and stakeholders' opinions on the RR information, and (iii) the challenges faced by the reviewers. First, a subset of the data was coded (i.e., requesters and stakeholders' responses to questionnaires, transcription of the workshop and the retrospective meeting, and the final report of the students' capstone project). Subsequently, all elements of the dataset were reviewed in chronological order to confirm and

	Original Study (Cartaxo et al., 2018)	Our Replication
The company	An applied research institute in Brazil.	A UK company specializing in digital out-of-home advertising with an IT department located in Uruguay.
The project	Developing a monitoring system for reusable packages during the production chain of the automotive industry.	Developing and maintaining a platform to manage out-of-home advertising campaigns.
Participants (requesters)	The project coordinator, the leader of project managers, and one of the project managers, both held master's degrees.	The technical product leader and the project manager, both lack graduate degrees and have no experience in SE research.
Team members (reviewers)	A Ph.D. candidate supervised by two professors.	A Ph.D. candidate and two undergraduate students finishing their 5-year computer engineering program, supervised by a professor.
Issues addressed with RR	Practitioners face issues due to low customer collaboration in their agile software development projects. They seek evidence to enhance customer relationships and mitigate these problems.	Practitioners face challenges in managing knowledge and documentation in software development despite having certain KM practices. They sought proven strategies or ideas to address these issues.
Research goals	To evaluate the perceptions from practitioners on the use of RR to support decision-making in SE practice. Perceptions about using evidence briefings for disseminating scientific results obtained from RR were also evaluated.	To evaluate the perceptions on the use of RR to support SE practice. We did not evaluate participants' perceptions about the use of evidence briefings as an alternative means for disseminating scientific evidence since they did not consume this type of evidence.
Research design	A single cycle of action research was conducted, encompassing diagnosis, planning, intervention, evaluation, and reflection phases. The intervention involved conducting an RR and sharing its results with practitioners through a workshop. The evaluation comprised two semi-structured interviews: the first was conducted during the workshop for disseminating RR results and the second two months later.	A single action research cycle, with the same stages, was undertaken, incorporating an RR as part of the intervention, with results shared among practitioners through a workshop. The evaluation involved observing and analyzing initial perceptions during the workshop and circulating two self-administered questionnaires (one at the workshop's end and another eight months later). A large part of the software development team took part in the workshop, which involved an activity to assess and prioritize the recommendations derived from the RR.

Table 6 Differences between the original RR study in SE (Cartaxo et al., 2018) and our replication.

update the codes. ATLAS.ti was used to assist the analysis (Hecker and Muhr, 2022). A preliminary report was prepared with the identified themes and illustrative quotes, which was translated into English and validated and reviewed by Vallespir and Kitchenham. At their suggestion, Pizard re-examined the dataset to confirm or expand the analysis. This process was repeated until no new themes were identified, achieving the *inductive thematic saturation* applicable to this type of analysis (Saunders et al., 2018). The results of this stage of the analysis were used to prepare sections 6, 5, 8.3, and 8.4 of this document and as input for the next stage of the analysis.

In the second stage, a deductive analysis was conducted to confirm the themes identified by Cartaxo et al. (2018). For this, requesters and stakeholders' responses to questionnaires and representative fragments of the transcription of the workshop were translated to English. Using the list of themes identified by the original study by Cartaxo et al. (2018), Pizard and Kitchenham checked which were confirmed in the replication and identified illustrative quotes. This activity continued until no more themes could be confirmed from the original study's list, thus achieving the *a priori thematic saturation* applicable to this type of analysis (Saunders et al., 2018). Themes identified in the previous stage that were not present in the original list by Cartaxo et al. (2018) (e.g., company situation) were added to the list of themes confirmed by our study. The result of this stage of the analysis was used to answer the research questions. An expert translator helped create the most accurate English versions of the selected quotes.

To increase transparency, the cross-reference between identified themes and the supporting data according to the collection stage is reported in Appendix I.

As suggested by Runeson et al. (2012), we tried to improve reliability by systematically tracking all data. Pizard also kept a detailed journal of the decisions made during the investigation, including the data analysis process. We used the O'Brien et al. (2014) checklist for reporting qualitative research to enhance clarity and completeness. We also considered the eight criteria for the quality of qualitative research proposed by Tracy (2010).

6 Rapid Review Protocol & Conduct

This section presents the RR protocol and the main characteristics of the RR conduct. This includes the details of the problem addressed and the knowledge dissemination activities carried out to share the results of the RR with the company's staff.

The RR was conducted by García and Lezama with supervision and support from Pizard.

6.1 Aim and Research Question

Together with the requesters, we determined that the purpose of the RR would be to find practical and applicable recommendations on KM for the company. For these recommendations to be applicable, the context of the studies must be similar to that of the company, and ideally, the recommendations must have been experimentally validated.

The question that guided our RR was: ***What are some empirically validated recommendations for knowledge management for software development companies?***

In preliminary searches, we encountered some difficulty finding studies on KM with practical recommendations. Thus, we decided to use a broad question and consider a general software development industry context, so we did not restrict the context of our primary studies to small or midsize companies using agile methods.

6.2 Search Strategy

We used a single search engine, *Scopus*, in order to reduce time and effort. We choose Scopus because it is one of the largest repositories of peer-reviewed publications and has been used for other SE RRs (Baldassarre et al., 2021; Cartaxo et al., 2018). We did not consider grey literature to maintain consistency with the original study by Cartaxo et al. (2018).

The search string we used (reproduced below) was obtained after trialing several preliminary searches. These confirmed that our search would retrieve studies with experimentally validated recommendations in industry settings.

TITLE-ABS-KEY((“software engineering” OR “software development”) AND (“knowledge management” OR “knowledge sharing”) AND (industry OR company OR enterprise OR organization OR organization) AND (“case study” OR “systematic review” OR slr OR “scoping study” OR “mapping study” OR “lessons learned” OR recommendations OR survey))

The four sets of terms correspond to the following concepts: software engineering, knowledge management, industry context, and experimental validation. The search string is quite complex, but, unlike many digital search engines, Scopus respects the rules of Boolean algebra, so does not generally produce large numbers of spurious results.

6.3 Study Selection

The inclusion criteria used were: (1) studies in English, (2) with practical recommendations, (3) full text available, (4) about KM in software development companies. In addition, the exclusion criteria were: (5) publications that were not articles (books, technical reports, etc.), and (6) studies about KM theoretical models or frameworks.

Initially, we attempted to incorporate selection criteria to exclude studies that lacked applicability. Specifically, we sought to limit the results to industrial evaluations of small companies as needed by the requesters, but there were insufficient papers available.

We do not explicitly exclude secondary studies. We identified them just in case the primary studies did not include useful evidence. In this situation, we planned to use information from the secondary studies or consider them for snowballing.

This was not necessary and we were able to obtain practical recommendations from the selected primary studies.

Each reviewer assessed the eligibility status of half of the candidate primary studies obtained from Scopus. To validate an adequate level of agreement, they reviewed the first 30 candidate primary studies together, and the kappa statistic was calculated (the obtained value was 0.618, which indicates a good level of agreement). Subsequently, the reviewers used two rounds: (1) checking titles and abstracts and (2) reading the full text. From the 425 studies returned by Scopus, we identified 21 primary studies (Birk and Dingsøyr, 2005; Viana et al., 2013; Yglesias, 1998; Matturro and Silva, 2010; Viana et al., 2015; Vasanthapriyan et al., 2017; Gervigny and Nagowah, 2017; Soini et al., 2007; Santos et al., 2014; Smite and Dingsøyr, 2012; Khan et al., 2012; Kammani et al., 2013; Pulkkinen. et al., 2007; Soini, 2008; Heredia et al., 2017; Šmite et al., 2017; Heredia et al., 2014; Humayun et al., 2013; Jurado et al., 2015; Milovanović et al., 2012; Chen et al., 2018).

6.4 Data Extraction

In this step, each reviewer extracted data from half of the selected studies and validated the data extracted by the other reviewer. We used a data form that summarized: (i) the context of the study (software development method, year of the study, type of company), (ii) the research method used, (iii) the results of the validation or evaluation, and (iv) recommendations for practice or lessons learned.

6.5 Assessment of the relevance of the evidence

We assessed the relevance of the evidence from the viewpoint of the RR requesters. Our appraisal of the evidence included understanding the context in which the evidence was generated and the research methods used. For example, for organizations that participated in a primary study, we identified in which country they carried out their activity, and their size. This made it possible to validate the evidence with the requesters (as mentioned before) and to select evidence most appropriate to their context. It is important to note that the requesters indicated that these contextual factors should be used. While other factors such as organizational domain or maturity could have been considered for a more nuanced assessment of relevance, only the factors mentioned earlier were employed.

6.6 Synthesis Procedure

Although we explicitly looked for primary studies with experimental validations, most did not include recommendations for practice but rather offered lessons learned, reflections, or certain observed behaviors. We analyzed those observations, as well as the context, and developed practice-oriented recommendations. We understand that this is similar to the process carried out by Budgen et al. (2020). As an example, the extract: *"The findings showed that the motivation for knowledge sharing, a time-consuming and demanding activity, is highly related to the* *awareness that managers and developers have of the benefits associated with this professional practice." (Chen et al., 2018)* was translated into *"It is recommended to emphasize the benefits of sharing and reusing knowledge."* This activity involved continuing with the critical appraisal of evidence since we used our previous analysis of the studies when preparing the final text of the recommendations.

Subsequently, we used content analysis with an inductive approach, adapted from (DeFranco and Laplante, 2017), to synthesize these recommendations. The stages carried out were: labeling of the different types of recommendations using open coding, grouping, and categorization of the fragments according to their codes (e.g., grouping similar or complementary codes), and, finally, creation of descriptions. As a tool to facilitate the coding, we used the freeware tool Saturate (http://www.saturateapp.com/).

In a similar way to the previous steps, each reviewer worked on one-half of the studies and validated the other half. In particular, they both did some initial coding. Subsequently, in two meetings with Pizard, all the recommendations and their coding were reviewed, and the categories and descriptions of the final recommendations were created.

The recommendations to improve KM obtained as outcomes of this stage are presented below in the Report/Diffusion section. The cross-reference between recommendations and primary studies from which they emerged is reported in the Appendix I.

6.7 Intermediate Validations

When starting the study selection, we carried out two validations with the requesters to assess the evidence. They approved the sample evidence we presented to them. Their main concern was to obtain recommendations from contexts similar to their own. They also indicated that some recommendations of the sample (e.g., a recommendation on defining simple and clear KM processes) seemed useful to them but they did not know how to put them into practice. Based on this, we decided that we would include if necessary, examples or brief guidelines to put the recommendations into practice. In addition, we agreed not to consider evidence on KM frameworks or models, as it was preferable to propose recommendations that could be introduced into their improvement process.

6.8 Report/Diffusion

We developed an evidence briefing with the RR results (see Figure 1) and conducted a workshop with the software development team. In the workshop, which lasted ∼1h30min, we presented the recommendations obtained in the RR and proposed a practical exercise in which the participants studied and prioritized the recommendations. The project manager and three other members of the software development team participated in the meeting. Table 7 details the activities of the workshop.

Results of the practical exercise are shown in Figure 2. After placing all the recommendations in the quadrant, the participants discussed which of them they could implement and how. They all agreed that the definition of a KM strategy had

KNOWLEDGE MANAGEMENT IN SW PROJECTS

This briefing presents scientific evidence on strategies to improve KM in software development projects.

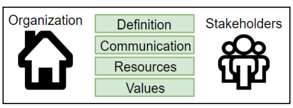
RECOMMENDATIONS

All the recommendations presented in this report are a synthesis of 21 scientific studies. They correspond to different case studies, interviews, surveys, and focus groups in which professionals belong to soft. dev. and telecommunications companies (e.g, IBM, NOKIA, ABB, and Ericsson) participated, some with distributed teams, and the research was Made in Brazil, Uruguay, Sri Lanka, Mauritius, Finland, Sweden, USA, India, Norway, Pakistan, China, and Russia.

KM IN SOFT. DEV. ORGANIZATIONS

Software development organizations may have various problems in KM. Currently, software development projects handle large volumes of information and are integrated by professionals from different areas with different knowledge and skills. Although knowledge is a success factor in software development, many times development methodologies, e.g., agile ones, do not have activities or mechanisms for their effective management.

Recommendations to improve KM found in the literature can be classified into 4 dimensions.



DEFINITION

Certain definitions can help knowledge management in an organization. It should be taken by the senior or middle management.

- **KM strategy:** a defined strategy with objectives allows to align the rest of the KM activities. It is recommended that the strategy seeks to centralize knowledge, and facilitate its access and search.
- **Simple & clear processes:** that establish the objectives of KM, what kind of knowledge is valuable, how it will be stored and how those involved should proceed when interacting with knowledge.
- **Defining responsibilities:** clearly establish who are the referents in each area of knowledge.
- **Metrics:** define and use metrics on the creation, use, and usefulness of knowledge. For example, using a score system, recording the number of accesses or allowing those involved to qualify, respectively.

COMMUNICATION

In order to facilitate the stakeholders' alignment with the established definitions, effective communication is recommended.

- **Communicate strategy:** management must be transparent with its objectives so that everyone involved understands the value of KM to the business.
- **Emphasize benefits:** communicate openly the benefits and profits that are expected and obtained from KM
- **KM Training:** It allows all stakeholders (especially the new ones) to understand how to better perform KM activities.

VALUES

Fostering and developing certain values makes it easier to achieve better KM.

- **Commitment:** A high degree of commitment can be achieved by showing the usefulness of knowledge and using simple KM processes.
- **Communication:** foster communication and cooperation within the organization, in order to increase the trust of stakeholders and promote teamwork.
- **Cooperation:** To facilitate the dissemination of knowledge throughout the organization, it is recommended to generate teams that manage that knowledge with members of various areas of the organization. Highlighting the importance of teamwork and organizational learning is recommended.
- **Trust:** to increase trust, face-to-face project initiation meetings can be organized to help the team to know each other and build trust.
- **Horizontality:** The management of KM should not be vertical but in all directions.
- **Motivation:** Favor the motivation of workers to get involved with KM. A motivated employee will make more and better contributions than one who is not, so the motivational factor is one of the keys to a successful business KM.

RESOURCES

To implement the above dimensions there are several alternatives.

- **Tools:** good criteria for choosing tools includes: an easy-to-use interface, robustness, ease of access, and powerful search functionalities. In addition, the organization must protect and promote its use.
- **Social software:** its use allows to share knowledge in a simple way and encourages socialization among stakeholders. Examples are: wikis, mailing lists, project tracking tools, intranets, and blogs.
- **Categories:** having categorized knowledge facilitates and encourages its access.
- **Gamification:** Using recreational dynamics encourages participation in KM. Examples of this are: having a scoring system, medals, leaderboards, etc.
- **Training:** the training carried out by the organization facilitates knowledge generation because it allows knowledge consolidation by stakeholders and encourages the exchange between them.
- **Rotation of stakeholders:** between different projects or areas it allows to disseminate and generalize knowledge.
- **Rewards:** for stakeholders who perform tasks related to KM. This can be implemented with an increase in their remuneration or by taking into account their contributions to the KM in their performance evaluation.
- **Record of lessons learned:** the use a record of lessons learned, where stakeholders can access to consult about previous experiences. The lessons can be registered during the project, not only after completion.

¿Who is this briefing for?
SE professionals who want to make decisions about KM based on scientific evidence.

¿Where do the discoveries come from?
All the findings of this report were taken from a rapid review.

¿What is included in this briefing?
Recommendations to improve KM with experimental validation in companies or soft. development teams.

¿What is not included in this briefing?
Other information or guarantee of the results of applying the recommendations for non-conformity of the context or variants of its application.

Fig. 1 Evidence briefing with RR results (adapted for inclusion here).

Workshop Activities
The workshop had the following characteristics. - A copy of the evidence briefing (see Figure 1) was given to participants with a reasonable time to read it. - The reviewers present the main concepts of EBSE, listed the characteristics of the RR (mentioning the problem and the methodology used), and finally presented the recommendations obtained. - The reviewers led a practical exercise to promote the analysis of the recommendations. The exercise had the following steps: 1. All the separately printed recommendations were placed on the table. As the only exception to this, all recommendations from the 'Values' category were grouped into one. 2. A quadrant was drawn, with the X-axis representing the ease of implementing a recommendation and the Y-axis its potential benefit. 3. Each participant had a turn (in a pre-established order) to grab a recommendation from the table and put it in a place in the quadrant or to rearrange a recommendation that was already located in the quadrant. In any case, the participant had to explain their action. 4. The previous step was continued until all the recommendations were located in the quadrant and a general agreement had been reached. 5. Finally, the team was asked to choose recommendations that were suitable for implementation.

Table 7 Workshop for the dissemination of results.

the highest priority, and they commented that not currently having KM objectives did not allow them to focus well or obtain good results. They associated the definition of strategy with other recommendations that should also be implemented jointly, these were to communicate the strategy, define categories of knowledge, use social software, and define those responsible (although this was previously out of their initial selection, see the rectangle in the upper right part of the figure).

At the time of the workshop, the company had been recently acquired by a larger company and the participants had started using Atlassian Confluence[4], a KM tool already used by the acquiring company. We believe that the participants associated the recommendation of social software with high benefits and ease of implementation due to this current situation, and because they were beginning to perceive the benefits of this particular tool.

6.9 Threats to RR Validity

The main threats are: (i) we used a single search engine for scientific articles, (ii) although we defined and tested criteria on a sample of studies, the reviewers performed the selection, extraction, and synthesis on a disjoint subset of studies, (iii) we did not perform a formal quality assessment of the studies which could limit

[4] Confluence is a web-based corporate wiki and collaboration tool developed by the Australian company Atlassian. According to its creators, it can be used by multiple teams and organizations to generate and consume content (in order to better manage their knowledge) and allow for better collaboration. It can also be integrated with recognized productivity and tracking tools (e.g., GitHub, Jira). Their website is https://www.atlassian.com/software/confluence.

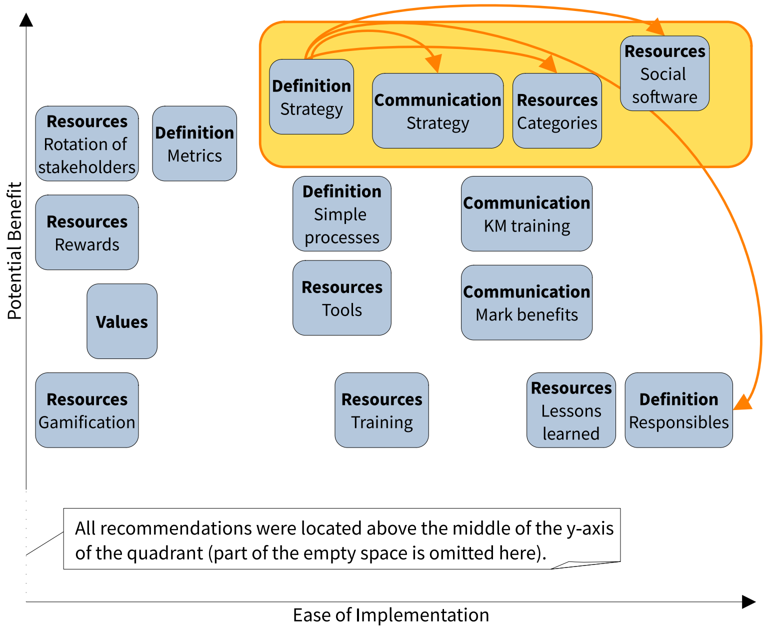


Fig. 2 Result of the workshop exercise: Recommendations placed by the soft. dev. team according to their potential benefit and ease of implementation.

the reliability of the evidence, and (iv) although closely trained and supervised, the reviewers were inexperienced in conducting reviews.

7 Results

In this section, we present the answers to the research questions of our replication.

7.1 RQ1: Perceptions and attitudes about using RR information

Perceptions and attitudes about the RR results were obtained from analyzing the audio recordings of the knowledge transfer workshop and the responses to the questionnaire we circulated that day (which we also sent later to the architect), as well as the responses to the follow-up questionnaire that we conducted eight months later with the requesters. All these activities were conducted in Spanish, thus we present translations of quotes that were reviewed by a translator to ensure they remain faithful to the originals.

We compared our findings with those of Cartaxo et al. (2018), who reported that they were evaluating of the use of RRs as a practice support method in SE, by identifying issues that supported the requesters identify practice changes that could address their specific KM problems and issues that hindered the adoption of the process changes. We present our findings in the same sequence as they were obtained and relate them, where possible, to concepts already proposed by the aforementioned study (indicated in bold).

7.1.1 Early Attitudes

During and after the presentation of the recommendations, some attendees made comments or posed questions about them. The results of the analysis of these interventions seem to support the following previous results on RRs:

Offer reliable content. Some attendees considered that the information was more reliable than others that they used frequently. For example, the project manager said:

> *- Recommendations are good, they are clearly understood and based on scientific articles, which were approved, reviewed, and followed their process. That gives them veracity, another weight, has another value. This has to be a guide for us.*

Applicable to SE practice. All agreed that the recommendations were applicable and seemed to help solve their problems. This was also expressed in the practical exercise since all the recommendations were located above the middle of the y-axis, that is, all of them were perceived as having a medium or high potential benefit if they were applied.

Fostered the learning of new concepts. During the exercise, some attendees asked questions seeking to know about some of the concepts mentioned in the recommendations. These questions were answered by reviewers or other attendees, suggesting that all participants had learned new concepts related to the problems the company was facing.

7.1.2 First Questionnaire

Table 8 shows the answers to the questionnaire the five company attendees completed at the end of the workshop. Some clarifications are necessary. First, although all participants responded to the survey, they answered only the closed questions and did not include any additional comments. Second, regarding E3, only the requesters who participated in the project agreed with us on what we were going to consider as a similar context and were also aware of the literature that we were finding and its characteristics. Furthermore, the focus of the requesters was to find some strategies to address their problems. We could only expect them to identify approaches they felt were plausible solutions (or solution approaches) and practical in their own circumstances.

Even considering this, we believe that the responses confirmed the adequacy of the definition of the problem we addressed, the research question, and the studies selected (based on what we explained to the workshop attendees). They also confirmed the following results on the RRs: **Problem-oriented** (i.e., the RR provides evidence to address the problem they are facing), **Improve problem comprehension** and the need to **Discuss the findings of the RR** (i.e., use face-to-face transfer activities and not just to present results in reports).

Question ID	Totally agree	Somewhat agree	Neutral / Disagree
E1	5	0	0
E2	3	2	0
E3	1	4	0
E4	3	2	0
E5	1	4	0
E6	3	2	0

E1: The defined problem corresponds to a real problem that we have in knowledge management (KM).
E2: The question that guided the investigation is suitable to help us address the problems in KM
E3: The studies found in the literature review seem adequate, that is they have contexts and problems similar to ours.
E4: The recommendations that were found to improve KM seem useful to help solve our problems.
E5: The project helped me to understand problems from another perspective or understand approaches to their treatment.
E6: Today's meeting to present the results of the review was very good.

Table 8 Opinions of the participants of the dissemination workshop.

7.1.3 Follow-up Questionnaire

Eight months after the workshop, we tried to find out if the recommendations obtained through the RR had been put into practice and if they had helped to solve the problems. Below are the findings obtained by analyzing the responses of both requesters. Two of the findings (indicated with *) do not correspond to direct comparisons with the work of Cartaxo et al. (2018) but they are relevant.

***Company situation.** One requester gave us more explanations about the situation of the company. Certainly, this information should be considered when interpreting the results.

> *- Unfortunately, while this investigation was being carried out and even after it ended, the company underwent many very important changes. It was bought by another company, several important roles were changed or eliminated, the hierarchy of the organization changed, the priorities changed, and finally, the company closed.*

Applicable to SE practice & **Problem-oriented**. One of the requesters considered that the results seemed adequate and evidenced a mature understanding of KM.

> *- I think KM is a complex issue. But looking at the recommendations and comparing them with companies I have previously worked for, those that were good at KM and those that were not. I believe that this research has really managed to capture and show the critical parts of the problem and presents a very interesting approach. It's easy to understand and, at the same time open to different specific solutions that the organization and/or team may want to adopt.*

Offer reliable Content & Novel approach to support decision-making. Both requesters highlighted the value of scientific evidence and its differences from other types of information. Their comments also support the view that the evidence provided by RRs provides a better method for supporting decisions.

- I think that lately, we've become used to solving problems with the first two Google results, with the first two most popular papers that we find, we simply want to apply something that Netflix did, or we want to use the same thing as Facebook. Also, the industry almost never allows us to really do an exhaustive search on how to fix a problem. The evidence-based approach is absolutely the opposite and its conclusions are indisputable. I believe that the cost/benefit of applying it depends only on the situation of the company.

***Results in a timely manner.** We received a negative opinion about our RR conduct. One requester considered that shorter deadlines would have allowed for better use of the results.

- Although the project had a certain dynamic proposed by you, I think that given the particular situation of the pandemic that we faced and hence the definitive closure of the company... I have the feeling that if we had shorter execution times we could all have had a different view of the results. Currently, any development team using agile methodologies runs work iterations of one or two weeks maximum, with which it should be possible to run short experiments and analyze their results in less time than we currently have.

We had not agreed on a timeline for the RR with the requesters nor discussed whether we needed to consider any deadlines for delivering our recommendations. However, their comment makes it clear that short timeframes are important in industry collaboration. In addition, this comment supports Cartaxo et al. (2018)'s view that reducing timescales, and not only reducing effort (an issue that we did prioritize given the reviewers' restrictions), is an important benefit of using RRs (*Reduce time and cost to conduct decision-making process*.

Use of the results. The requesters confirmed that they appreciated the results and had started to use part of them. In particular, they indicate having (1) started the definition of processes and responsibles for the areas of QA and DevOps, (2) encouraged certain values that they already had, (3) decided to stop using Google Drive, (4) begun to use better knowledge categorizations, (5) considered using social software. Unfortunately, the major changes the company underwent prevented it from continuing in that direction. Even so, the following comments show that the RR results helped to make some of those changes less traumatic.

- [...] the acquisition of our company by a larger one forced our team to use Atlassian Confluence as the main tool for KM. [...] Given this scenario and the opportunities for improvement that our team had detected during the workshop, the use of Confluence was naturally adopted, thus covering several of the points mentioned in the evidence briefing (e.g., the definition of simple and clear pro-

cesses, the definition of metrics and responsibles, the values of cooperation and horizontality, and the resources of tools and record of lessons learned)

7.2 RQ2: Using RR outcomes without experience in SE research

During the intermediate validations, practitioners noted that while the identified recommendations appeared beneficial, they did not know how to implement some of them. In response, we chose to refine the recommendations to enhance clarity. Moreover, during the workshop, we shared examples with practitioners that illustrated how some of these recommendations could be practically implemented. Given the current state of evidence provided by SE scientific publications, it appears that understanding the reported recommendations and possessing the knowledge required for their implementation may pose challenges for practitioners without academic experience in SE.

We also implemented some other actions to facilitate practitioners' participation in the RR process and ensure they understood the results appropriately. These measures included:

- Delivering a concise introduction to research and scientific articles, focusing on empirical SE and EBSE during the initial meeting with the requesters and at the beginning of the dissemination workshop.
- Providing condensed information at all times to eliminate the necessity for direct handling of scientific articles by practitioners. For instance, during the intermediate validation, we supplied a summary of the context of selected papers and their recommendations.

8 Discussion of Findings

It is necessary to discuss various aspects of our study. This section presents broader reflections on the answers to the research questions (Section 8.1). Additionally, we provide a comparison of the results of our replication with those of the original study conducted by Cartaxo et al. (2018) (Section 8.2). Furthermore, we delve into the significant challenges encountered by the review team and outline the strategies employed to mitigate them (Section 8.3). Subsequently, we present certain issues related to the RR process (Section 8.4). It is noteworthy that many insights presented in this section, in particular in the latter two points, stem from the retrospective meeting conducted by RR review team. In all mentioned subsections, we have included recommendations for the use of RR in SE to complement our reflections (see light blue boxes). Finally, we discuss on the weaknesses of our work (Section 8.5).

8.1 Attitudes about the use of RR results

Both our review requesters and other team members highlighted that RRs offer reliable content and that this differentiates them from other types of information sources that they commonly used. This is also consistent with the results of our recent study on attitudes towards EBSE and SRs at a government agency (Pizard et al., 2023).

Requesters also agreed that the recommendations provided by the RR were applicable to their problem and that putting them into practice would bring benefits. Finally, collaborating in an RR (or at least participating in the activities of dissemination of its results), helped the team improve their understanding of the problem and learn new concepts.

Despite not stipulating it beforehand, one of the requesters would have preferred a shorter timeline. His argument was that with results in less time, they could have applied more recommendations before the closure the company. However, we were in a low-resource setting, Lezama and García could only dedicate a limited effort per week. For that reason, and also because we did not understand that it was a priority to obtain results in a short time, our RR was conducted in three months. The current effort used would have been mapped to about two weeks if reviewers worked full-time. Therefore, two aspects are important to highlight: that practitioners do appreciate short processes to obtain results and that all the requesters' needs are important, not just those about the problem to be addressed.

Recommendation 1. Consider adequately the needs of RR requesters and the context in which the evidence will be used.

8.2 Comparison with Cartaxo et al. (2018) study results

The findings from our study about the perception of the use of RRs align closely with those reported by Cartaxo et al. (2018) (refer to Table 9). Notably, despite differences in the educational backgrounds of our requesters, our results remain consistent with the original study, whose participants held master's degrees and were employed in an applied research institute. In contrast, our requesters lacked academic education, had no prior experience in SE research, and were employed in a software development company. This contrast underscores that the value of RR is not confined to practitioners with a background in research, highlighting its adequacy as a valuable tool for enhancing collaboration between academia and industry.

Our findings seem to indicate that collaborating in the conduct of an RR, or at least participating in the dissemination activities, allows practitioners to approach scientific evidence with a positive attitude, even when they are not used to using it or lack an academic educational level. When we undertook the study, there were no other studies than Cartaxo et al. (2018)'s that described the use of RRs to support practitioners. More recently papers by Song et al. (2022) and Bjarnason et al. (2023) have confirmed the values of RRs in the context of R&D collaboration with industry experts, however, our paper is the only example of using RRs in collaboration with non-expert requesters.

Recommendation 2. Conducting collaborative RR is recommended as an effective method to introduce practitioners to scientific evidence.

Cartaxo et al. (2018) Results	Confirmation
Benefits of the RR	
Applicable to software engineering practice	Yes
Novel approach to support decision-making	Yes
Fostered the learning of new concepts	Yes
Offer reliable content	Yes
Problem-oriented	Yes
Improve problem comprehension	Yes
Increase team confidence	No
Reduce time and cost to conduct decision-making process	No, but of importance[1]
Fast and easy way to find information	Evidence briefing (EB) issue[2]
Avoid reading multiple sources	EB issue / No
Flexible knowledge transfer medium	EB issue
Non-applicable evidence can support other problems	No
Interest to receive briefings regularly	EB issue
Recommend Rapid Reviews to other practitioners	No
Improvements to the Rapid Review	
Discussing the findings of the RR is needed	Yes
Present the primary studies' context near their findings	EB issue
Avoid printing the RR report in black-and-white	EB issue
Graphical information is needed	EB issue

[1] Discussed and clearly an issue of importance to requesters, even though they didn't specify it upfront.
[2] *Evidence briefing issue*: As we stated above, our study focuses on issues related to RR conduct and not those about evidence briefings.

Table 9 Results of Cartaxo et al. (2018) confirmed by our study.

Based on the recommendation of Cartaxo et al. (2018) to incorporate discussions of the results as dissemination activities, we not only prepared an evidence briefing with the RR findings, but we also held a workshop in which the attendees began to discuss the evidence. This combination worked very well for the dissemination of our results. From the results of both studies, it seems clear that a single-page evidence briefing report is insufficient to ensure that the results can be used in practice. In our experience, it might be useful to include (1) information on how to put each recommendation into practice, (2) dependencies between recommendations, (3) indications of the strength of evidence supporting each recommendation. In our study, the requesters were (slightly) interested in knowing more about point 3, and we discussed this with them. We suggested ideas or examples for points 1 and 2 during the workshop, and the development team discussed them by choosing suitable alternatives for their context.

Recommendation 3. To ensure that evidence can be effectively used in practice, it is essential to plan and implement appropriate dissemination activities with practitioners. Relying solely on a single evidence briefing appears to be insufficient.

8.3 Major Challenges and Mitigation Strategies

The biggest challenges encountered by the review team were: (i) the lack of guidelines and examples of using an RR in the software industry and (ii) the difficulty in finding adequate evidence. The implications of these issues are discussed below.

At the time of our study, Cartaxo et al. (2018)'s study was the only example of the application of RR to support SE practice. Since we had no experience in conducting this type of secondary study, we considered that there was a high risk of not being able to produce recommendations based on scientific evidence that would effectively help requesters to address their KM issues. To mitigate this, we worked cautiously at each stage, e.g., verifying each step of the process and its results. For example, to put together the research question and the protocol, we carried out several preliminary literature searches and verified that some of the retrieved studies had adequate recommendations for our RR. We also carried out intermediate validations with the requesters to verify that the evidence we were finding was adequate. The second issue was detected precisely in those preliminary searches, in which very few studies had adequate evidence to address our problem. To mitigate this, and knowing that very few SE studies usually include recommendations for practice (Da Silva et al., 2011), we decided to also consider those that included lessons learned or experimentally validated observations.

The limitations of SE evidence, also noted by Rico et al. (2024), could impact the RRs as follows:

1. Lack of empirical studies in SE means we are forced to rely on the use of less reliable results such as opinions and lessons learned.
2. Lack of clear recommendations in SE papers means that the results of individual papers may need to be restructured or re-analysed in order to deliver well-specified process change recommendations.
3. Lack of common research approaches and standardized research questions means that results from different studies may require qualitative aggregation.

Point 1 reduces the strength of evidence. Points 2 and 3 are risky exercises for an RR that relies on a single researcher because there is a danger that personal biases and prejudices may adversely affect the recommendations.

First, the challenges we faced suggest that researchers need to lead RRs conduct, a view consistent with the studies of Cartaxo et al. (2018) and Rico et al. (2024).

Recommendation 4. Researchers need to take the lead in conducting RRs.

Second, both challenges and the strategies we adopted make us reflect on whether it would be appropriate to use a multi-stage strategy to conduct RRs in SE. In their recent work on selecting RR methods for complex questions in the health field, Wilson et al. (2021) proposed a two-stage process that consists of *(1) scoping the literature*, i.e., understanding the needs of the requesters and conduct preliminary searches to understand the available literature, and *(2) selection of an optimal approach*, i.e., further consultations are made to the requesters to tailor questions and identify relevant studies. This approach, the authors pointed out, makes it possible to consider the available literature together with the timelines required to choose an appropriate RR strategy.

One issue that affected our timescales was that we had to go back to earlier stages of the RR several times, e.g., when trying to perform the synthesis it was necessary to extract more information from the primary studies. In this sense, we agree with King et al. (2022) that *"the customized and iterative nature of rapid reviews means that some flexibility may be required"*. Although of course, as these authors also indicated, changes made beyond the protocol and the rationale for making them must be transparent and adequately reported. Moreover, the aim of RRs to be applicable in low-resource settings also implies that they can be suitable for participation by non-experts in their conduct.

Recommendation 5. RRs require some flexibility (e.g., a preliminary stage to evaluate the existing literature, or some form of iteration in the stages), but it is important to be transparent and detailed during the dissemination of their results.

Finally, as recommended by King et al. (2022), we engaged with the requesters early and throughout the review process. This was crucial in achieving results that met the requesters' needs. It involved detailed surveying information needs, validating problems and research questions, and confirming selection criteria with the requesters. We also conducted an intermediate validation where we not only validated the evidence collected up to that point but also aligned the recommendations with the client's expectations, which influenced, alongside available primary studies, the synthesis approach. Lezama's dual role brought several advantages, including a deeper understanding of the company context that could simplify certain stages of the process, particularly the evaluation of evidence relevance. His involvement with both the research team and the organization receiving the evidence appears to have facilitated the conduct of an RR and the application of its results, reflecting effects similar to those observed in our previous study on EBSE within government agencies Pizard et al. (2023).

Recommendation 6. Engage with the requesters in the early stages and throughout the review process to understand their needs and discuss decisions about the RR process.

8.4 Reflections on Rapid Review Nature and Process

Some issues about the RR nature and process deserve reflection.

8.4.1 Rationale for conducting RRs

As Ralph and Baltes (2022) point out, RRs should not be used to *"legitimize bad systematic reviews when there is no pressing need for immediate results"*, something our results suggest is happening in SE (refer to Section 3). In our opinion, timely collaboration with industry practitioners is a reasonable justification for conducting an RR. However, 13 out of the 23 papers we found did not appear to have direct industry collaborators. We disagree with Ralph and Baltes (2022)'s conclusion that fewer RRs are needed. If we limit the use of the term RRs to studies that involve collaboration with industry (which is consistent with Rico et al. (2020)'s guidelines) and ensure that any identified process changes are monitored by the review team, this may lead to more industry case studies reporting evaluations of process changes introduced by scientific evidence. More industry case studies might improve the availability of primary studies for case surveys, which is critical in systematic reviews aiming to influence industry practice (Kitchenham et al., 2023a).

Recommendation 7. Limit the use of RRs to collaborations with a defined requester or knowledge user (i.e., to use the evidence in a particular situation) in low-resource settings, and ensure that any identified process changes are monitored by the review team.

Finally, with regards to the decision between conducting an RR or an SR, opting for a full SR should be considered when stronger evidence is necessary. However, this might be deemed inappropriate if the requesters consider it crucial to minimize timescales or are in a low-resource setting. In such cases, it would be prudent to assess which SR processes can be restricted (see Section 8.4.4). Finally, even in the context of collaboration with requesters or other stakeholders, it is possible to consider conducting an RR as a preliminary stage to a full systematic review.

8.4.2 Low-resource settings and use of existing secondary studies

Although existing literature about RRs in SE emphasizes that they mainly seek to address a requirement within a short timeframe (Cartaxo et al., 2018; Rico et al., 2024), it could be argued that its primary goal is to aggregate evidence in a low-resource setting. This encompasses scenarios such as our replication or one of the RRs reported by Rico et al. (2024), where the RRs were conducted over several months but with very limited dedicated effort throughout that period. However, the need for scientific evidence in a resource-constrained setting cannot be solely addressed by conducting a RR.

In our case, as our intention was to conduct a replication as close as possible to the original study by Cartaxo et al. (2018), we directly considered conducting a RR without explicitly searching for possible previous SRs conducted on the topic of interest. The secondary studies we found in our search did not directly answer the research questions but we planned to consider them if we did not find suitable primary studies to answer the research questions. However, after analyzing the results of our study and previous studies on RRs in SE, with the aim of minimizing effort and timescales, we suggest researcher utilize secondary studies if relevant ones are available, as we explain below.

From the viewpoint of practitioners, they have a question or problem they need to address. An RR can provide an answer in situations where low cost and speed are critical. However, if the initial search, finds a good quality, and relevant, SR or mapping study, that may be sufficient to address the problem directly or at least identify some relevant primary studies. It may also present a mature (i.e. well-understood, well-tested answer) which would be of particular value to small IT companies (although the results might need to be refined and interpreted to provide actionable process change recommendations). For R&D organizations who want “state of the art” results, updating a good quality SR might be quicker and might provide more valuable information than conducting a RR.

For inexperienced researchers it may be difficult to consider how to use an already published SR or mapping study. In our opinion this could be done in a variety of ways:

- To answer questions or problems directly if the SR answers the same questions and has adequate quality.
- To reduce the effort needed for the RR by basing the selection on the set (or a subset) of the primary studies of the previous SR. This was the method used in the RR conducted by Song et al. (2022).
- As a means of improving or validating the RR:
  - Improving the search process, since a previous SR can provide validated search strings and/or ideas for keywords.
  - Validating the search strategy, i.e., by checking whether the RR search process found all the relevant primary studies found by the previous SR.
  - Validating the results, i.e., assessing whether the previous SR raised any issue that the RR has not? Assessing whether results agree, and if investigating why they do not. This type of analysis presuppose that both secondary studies are addressing very similar research questions.
- Justifying the publication of the RR, i.e., identifying the additional results that the RR provides compared with the previous SR(s).
- In general only in the case of updating an existing SR, can the results from a new search process be fully integrated with the existing results. An example is the study by Da Silva et al. (2011).

Recommendation 8. Before deciding to conduct an RR, consider using an existing SR (or other secondary study) if available.

8.4.3 Quality Assessment

None of the RRs previously reported in the field of SE (refer to Section 3), nor Cartaxo et al. (2018)'s original paper, nor the recent guidelines by Rico et al. (2020), included quality assessment of primary studies. However, Cartaxo et al. (2019)'s study indicates that some researchers believe that RRs without quality evaluation are not useful. In our study, the requesters were interested in evidence from studies of companies similar to their own in terms of staffing levels and use of SE methods. More generally, we would expect practitioners to be interested in information that provides insights into (1) the methods and limitations of the studies, to better determine the reliability of the evidence and the extent of support for specific process changes, and (2) the applicability of the evidence to the specific context in which they are working. To address the latter, incorporating selection criteria to exclude studies that do not show applicability could be a more direct approach, however, the limitations of the evidence in SE research can often make that option infeasible (as happened in our case).

Recommendation 9. Do not rule out quality assessment stage prematurely. Requesters might be interested in the strength and applicability of evidence for recommendations, which requires evaluating methodological weaknesses of primary studies.

8.4.4 Process shortcuts, deviations and risks

Several researchers indicate that minimum standards are necessary for RRs (Cartaxo et al., 2019). We agree with this and believe that Rico et al. (2020)'s guidelines for conducting RRs collaboratively with practitioners are a good reference.

The specific RR process needs to be designed to meet the specific requirements of requesters. No step in the SR process can be omitted without risking the reliability of the RR conclusions. We agree with Rico et al. (2020) and King et al. (2022) that producing a protocol is important because it defines the roles and responsibilities of the review team and the company participants. However, regarding other SR processes, the review team and requesters need to discuss the risks associated with any proposed deviation from the standard SR process.

Recommendation 10. The specific RR process should be tailored to meet the specific requirements of requesters. Adhering to Rico et al. (2020)'s guidelines may be helpful. Maintaining a protocol is essential. Any shortcut or deviation in the SR process must be carefully studied and discussed with requesters, as they introduce risks to the reliability of the RR conclusions.

Our systematic review (refer to Section 3) suggests that the most common process changes involve omitting quality evaluation of the literature, searching a single digital library, or using a single researcher for one or more of the search, selection, and aggregation processes. In terms of risk minimization, searching a single source such as SCOPUS might often be the best option, as SCOPUS covers most of the important SE journals. Furthermore, it would be relatively easy for academics wishing to update the RR to broaden the search process. However, if requesters require the most up-to-date information, the review team may need to search for articles published in specialist workshops or archive sites, which may not be indexed by SCOPUS.

Recommendation 11. To minimize risks, opting to search a single source such as SCOPUS can be the best approach to streamline the SR process.

Finally, regarding rigor, we believe that for RRs, the issue is not completeness but reproducibility and transparency in reporting. An RR could serve as a starting point for further research if it addresses issues likely to affect other companies. If the RR proposes options to address a problem, the success or failure of the adopted process change could provide valuable insights for other companies. Moreover, an RR could serve as a valuable starting point for a full SR if its scope, limitations, and results are well-documented, potentially extending beyond initial constraints to provide comprehensive insights. Reporting on the process changes and their impacts would make for an interesting case study on specific process change recommendations.

Recommendation 12. When it comes to rigor in an RR, the primary concern is not completeness but rather ensuring reproducibility and transparency in its report, with consideration for the future use of its results.

8.4.5 Dissemination of RR results

The dissemination of the results of a RR is an essential stage of the process. Requesters do not necessarily need a full academic-style report, but they do need to understand the results and recommendations well enough to make informed decisions. Rico et al. (2020) suggests that the results of the review must be reported to the requesters, and that a separate activity should consider dissemination to other stakeholders and academics. We agree and note that both Cartaxo et al. (2018) and our studies found that a meeting with the requesters and other company staff was useful. Such a meeting allows company representatives to discuss the recommendations with the review team and identify the best options for any required process change. This suggests that dissemination efforts such as workshops or hands-on activities facilitate the reception and incorporation of evidence from RRs. Additionally, it would seem sensible for the review team to provide a preliminary report of the main conclusions and recommendations of the review prior to the meeting (though we consider an evidence briefing is insufficient).

Cartaxo et al. (2018) argue for the use of appealing media to present results to practitioners, this perspective is applicable mainly to RRs that are formally requested or conducted in close collaboration with the practitioners utilizing the results. In such cases, requesters may not necessarily need access to detailed information such as search methods, search terms, selection processes, etc. In these cases, where requesters actively participate in the entire process and are familiar with and have validated the decisions of the reviewing team, the additional information may not be essential.

However, unless this more detailed information about the SR process is reported somewhere, regardless of the importance of the results, their value to other researchers or practitioners will be limited. For example, researchers will not know which recommendations require further research, hindering the ability to update or extend the results systematically. Practitioners will not be aware of the extent to which RR results have been tailored to the specific context of the original requesters, potentially omitting important findings that might not be relevant in the requester's specific situation. An overemphasis on evidence briefings for dissemination, without a recommendation to report basic RR process information in ancillary materials, could reduce the scientific and practical value of RRs. Although it should be relatively simple to increase its value by including the additional information (or a reference to it) in any externally published RR report.

Despite a recent increase in the publication of RRs in SE, our systematic review indicates that these reports are often incomplete and lack the necessary information for a comprehensive understanding of the RR process or its results. To address this, it may be beneficial to consider the use of SEGRESS guidelines for reporting secondary studies (Kitchenham et al., 2023b) and the list of core reporting & dissemination principles for rapid review prepared by Kelly et al. (2022). Importantly, it should be noted that the expedited nature of RRs, where certain stages are omitted or shortened to provide quicker results, does not justify inadequate or incomplete reporting.

Recommendation 13. The dissemination of RR results should consider the target audiences. Activities that facilitate discussions on evidence and its practical application are most suitable for the RR requesters. Meanwhile, an academic report must be sufficiently comprehensive to enable appropriate use of the results by those not involved in the RR conduct.

8.5 Trustworthiness of this study

It is necessary to reflect on the weaknesses of our work. For this, we used the proposal made by Krefting (1991), which is based on Guba (1981)'s model of trustworthiness of qualitative research. We evaluated the following aspects:

— ***Credibility*** is a measure of whether the study's findings are correct and accurate. It relies on the credibility of the researchers themselves, as well as their research methods and the reflexivity used to evaluate their research.

From this perspective, we detected one issue related to the ability of the research team to conduct an RR. Specifically, although they were previously trained and worked closely with Pizard, for Lezama and Garcıa this was their first participation in conducting an RR or SR. To mitigate possible deviations from the RR methodology, we worked following the RR guidelines (including, among other things, developing a protocol prior to conducting), and we consulted doubts and decisions with Vallespir throughout the process. Pizard took the lead in the aggregation process, one of the most difficult RR stages for novices to understand (Pizard et al., 2021), by supervising the elaboration of the process recommendations from the primary studies.

In addition, we identified two issues that might have introduced bias into the study outcomes:

- Lezama worked in the company and the requesters and members of the company knew that the RR conduct was part of his capstone project. Thus, they could have been tempted to give positive comments. We sought to mitigate this by repeating many times to them that positive or negative results were equally important to our study and obtaining their perceptions of the RR results on different occasions and by different methods.
- Pizard sought to complete his research on the adoption of EBSE, which could be thought of as more valuable with positive results. To mitigate the risk of possible bias in this direction, Pizard kept a detailed journal of his decisions and actions, he also reported and consulted his decisions with Vallespir and Kitchenham at different times throughout the planning and the conduct of the study, and analysis and reporting of the results.

— ***Transferability*** refers to the degree to which the results of qualitative research are applicable in other contexts or settings. From a qualitative perspective, the context in which the results were obtained, along with any atypical factors, events, or behaviors of the participants and their possible influence on the transfer of results to other settings, must be adequately analyzed and reported.

Thus we attempted to assessed the limitations of various aspects of study that might impact transferability:

- We cannot adequately assess the efficacy of the recommendations for process change identified by the RR because the situation in the company did not allow us to follow up how well the process changes introduced by the requesters worked out. This is a major limitation of our study and it limits the overall research value of our study. It should also be noted that we did not plan in advance how to assess the impact of any process changes which is an essential issue for researchers and practitioners who would like to know how effective specific recommendations were at addressing the specified company problems. The only approximation to an evaluation of the results was the follow-up questionnaire conducted a few months after the closure of the company with the requesters. During the time the requesters indicated using the results of the RR, they also reported using the Confluence tool for KM activities (as requested by the firm that had acquired the company), which may also have influenced their opinions about the results of the RR.
- With respect to collaboration between academics and small companies staffed by practitioners without SE research experiences, our results are encouraging, but it is possible that Lezma's personal relationship with the company had a significant contribution both to the collaboration process and to the attitude of the company staff to the RR method and its recommendations.
- With respect to the use of RRs to support industry-academia collaboration, our results generally support Cartaxo et al. (2018)'s conclusion that RRs can support practitioners to select process changes to address SE process problems. Our results are also consistent with the experiences of other researchers that have used RRs in such collaborations, see (Rico et al., 2024). However, in the context of collaboration with companies with little research experience, we believe it is important that the researchers take care to present the RR recommendation carefully, and provide explanation of how the recommendation can lead to specific process changes. Also, the company's positive attitude to the RR results may have been partly due to the fact that they were accustomed to embedding process change in their two-week sprint cycle and asked us to deliver recommendations that suited that process.

— ***Confirmability*** of qualitative data is assured when data are checked and rechecked throughout data collection and analysis in order to ensure results are likely to be auditable by others. This can be documented by a clear description of the analysis process, including approach strategies, roles of researchers, coding schemes that were applied, and strategies for verifying results. We have reported our data collection, analysis and synthesis processes including our internal validation processes with the goal of being as transparent as possible. Of particular note are the following validation processes:

- Validating the proposed information sources with the requesters during the RR process.
- Obtaining feedback on the RR conduct from Fernando Acerenza (a researcher with some EBSE knowledge and experience).
- Assessing the attitudes of company staff to the RR recommendations both by analysis of the comments made in the dissemination meeting and the post-meeting questionnaire.
- Vallespir and Kitchenham providing a critique of Pizard's thematic analysis process and results.

In addition, to provide readers with additional confirmation of the qualitative results mentioned in this report, as suggested by Braun and Clarke (2006), we provide specific quotes from our meetings with the company staff to support our analysis and interpretations of their comments.

However, the uses that the two requesters claim to have made of the results were obtained solely from the follow-up questionnaire carried out a few months after the closure of the company.

— ***Dependability*** is important to trustworthiness because it establishes the research study's findings as consistent and auditable. Thus, dependability has some overlap with confirmability. However, dependability also requires that researchers should aim to verify that their findings are consistent with the raw data they collected.

Our validation procedures were intended to ensure that our findings remained consistent with our raw data. In addition, we report specific quotes from our meetings with the company staff to confirm consistency between our findings and the raw data.

9 Concluding Remarks

Our study provides support for the value of rapid reviews in the software industry. Specifically, our results confirm that the benefits of RRs are not limited to practitioners with research expertise. Most of the practitioners' perceptions about RR outcomes were positive and strongly consistent with previous research (Cartaxo et al., 2018). All practitioners agreed that the RR results were more reliable than the information they usually used. They also highlighted the recommendations seemed useful and beneficial to address the problem they were facing, and, some months later, they reported having used some of the recommendations. In our application, we prioritized reducing the effort although due to the availability of the reviewers the RR took three months. One of the requesters has preferred shorter time scales, which confirms that practitioners appreciate results in a short time and that it is also necessary to carefully prioritize all requesters' needs.

The major novelties of our study are that it:

- Assesses the previous research on RRs in SE. This includes an investigation into the scope of RR adoption, main shortcuts and deviations used in the review process, and the reporting of RRs. Furthermore, it includes a detailed analysis of studies contributing to understanding the value of RRs in our field.
- Evaluates practitioners' perceptions on using RRs to support software engineering practice in the context of a software company. Unlike previous studies, the practitioners who participated in our research had no prior experience in SE research and they were not experts on the topic of RR.
- Provides evidence that RRs can support the SE industry practice. Specifically, it validates various benefits outlined by Cartaxo et al. (2018) during the initial assessment of RRs in SE, and confirms the need to translate broad RR recommendations into actionable process changes and the importance of ensuring practitioners comprehend the results, e.g., through face-to-face activities like dissemination workshops.

Our main recommendations on the use of RR in SE are:

- Following practices in healthcare Kelly et al. (2022), recommendations from Ralph and Baltes (2022), and guidelines by Rico et al. (2020), the term Rapid Review should be restricted to cases where researchers have a defined requester/knowledge user (or are themselves the knowledge user in a specific situation) and face requirements with short timescales or are in low-resource settings.
- SE researchers should adhere to Rico et al. (2020) guidelines, but should not arbitrarily dismiss the idea of quality assessment of primary studies.
- SE researchers should remain flexible regarding specific methods to streamline the SR process. In particular, they should utilize existing SRs wherever possible.

10 Declarations

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- Conflicts of interest/Competing interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
- Availability of data and material: An extended report of the systematic review can be found as supplementary material. Data sets generated during the current study (without sensitive information from organizations or participants) are available from the corresponding author on reasonable request.
- Code availability: Not applicable.
- Authors' contributions: Author's contributions are explained in different sections of the paper to discuss possible research bias. Pizard wrote the first draft of the paper and thereafter Kitchenham and Vallespir assisted with restructuring and refining the structure and contents of the original draft and its subsequent revision. All authors reviewed the original draft and the final revision.

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I Complementary Information on the RR

For the purpose of increasing traceability and reproducibility, this section includes additional information on the rapid review presented in Section 6.

- Studies supporting RR recommendations. Table 10 report the primary studies associated with the recommendations for improving KM practices obtained as RR results.

II Complementary Information on the Data Analysis

To enhance traceability, this section provides additional details on the data analysis described in Section 6. Specifically, Table 11 reports the themes resulting from the analysis and the data from which each theme was identified.

Recommendations	Studies that support each recommendation
Definition	
KM strategy	(Yglesias, 1998; Santos et al., 2014)
Simple & clear processes	(Birk and Dingsøyr, 2005; Khan et al., 2012; Heredia et al., 2014)
Defining responsibilities	(Smite and Dingsøyr, 2012; Šmite et al., 2017)
Metrics	(Soini, 2008; Jurado et al., 2015)
Communication	
Communicate strategy	(Yglesias, 1998)
Emphasize benefits	(Soini, 2008; Heredia et al., 2014; Chen et al., 2018)
KM Training	(Matturro and Silva, 2010; Viana et al., 2015; Vasanthapriyan et al., 2017)
Values	
Commitment	(Khan et al., 2012; Heredia et al., 2014)
Communication	(Khan et al., 2012)
Cooperation	(Khan et al., 2012; Pulkkinen. et al., 2007; Soini, 2008; Šmite et al., 2017; Humayun et al., 2013)
Trust	(Khan et al., 2012; Soini, 2008; Humayun et al., 2013)
Horizontality	(Yglesias, 1998)
Motivation	(Soini et al., 2007; Khan et al., 2012; Chen et al., 2018)
Resources	
Tools	(Birk and Dingsøyr, 2005; Gervigny and Nagowah, 2017; Santos et al., 2014; Smite and Dingsøyr, 2012; Kammani et al., 2013)
Social software	(Santos et al., 2014; Heredia et al., 2017)
Categories	(Milovanović et al., 2012)
Gamification	(Jurado et al., 2015)
Training	(Viana et al., 2015; Khan et al., 2012)
Rotation of stakeholders	(Khan et al., 2012)
Rewards	(Vasanthapriyan et al., 2017)
Record of lessons learned	(Viana et al., 2013; Matturro and Silva, 2010)

Table 10 Studies supporting RR recommendations.

Theme	**Early attitudes** *Comments from the workshop participants (one requester and three members of the development team) during the discussion of the evidence.*	**First Questionnaire** *Participants' responses to the questionnaire circulated at the end of the workshop.*	**Follow-up Questionnaire** *Response of the requesters to the questionnaire circulated eight months after the workshop.*
Applicable to software engineering practice[d]	Mentioned by all participants.		Mentioned by one of the requesters
Novel approach to support decision-making[d]			Mentioned by both requesters.
Fostered the learning of new concepts[d]	Expressed in attitudes of all participants.		
Offer reliable content[d]	Mentioned by two participants.		Mentioned by both requesters.
Problem-oriented[d]		Question E4: Do the recommendations seem useful for solving the problems? - 3 participants totally agreed - 2 participants somewhat agreed	Mentioned by one of the requesters
Improve problem comprehension[d]		Question E5: Did the project help to better understand the problems? - 1 participant totally agreed - 4 participants somewhat agreed	
Discussing the findings of the RR is needed[d]		Question E6: Was the workshop to present the results good? - 3 participants totally agreed - 2 participants somewhat agreed	
Company situation[i]			Mentioned by one of the requesters
Results in a timely manner[i]			Mentioned by one of the requesters
Use of the results[i]			Mentioned by both requesters.

[d] Themes identified during the deductive stage of analysis.
[i] Themes identified during the inductive stage of analysis.

Table 11 Data by collection stage supporting the themes identified in the analysis.

Software Engineering Research Using Rapid Reviews: A Systematic Review

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Supplementary materials to the paper *"Using Rapid Reviews to Support Software Engineering Practice: A Systematic Review and a Replication Study"*. It includes an extended version of the systematic review of rapid review research in SE presented in the referred paper. August 2024.

I. GOAL AND METHOD

In order to assess take-up of RRs in SE, we conducted a systematic review of RR research based on citation analysis of two of Cartaxo's papers ([7] and [8]). Our research questions were:

- RQI: What is the extent of take-up of RRs in the SE domain?
- RQII: What was the scope of these studies?
- RQII: What are the methodological characteristics of the reported RRs?
- RQIV: Which studies contributed to assessing the value of RRs and what have they found?

We conducted searches for citations of Cartaxo et al.'s works on the respective publication sites (ACM and Springer) and Google Scholar. The first search took place on February 1, 2023, during which we examined 117 citations and identified 12 publications of interest. A second search was conducted on November 27, 2023, resulting in the identification of 150 citations. After removing duplicates, we found 23 publications of interest, including articles from conferences or journals and book chapters [1, 3–6, 9–12, 15–19, 21–23, 25, 26, 28–31].

The analysis was performed by Pizard under the supervision of Kitchenham. Both authors discussed the results of the analysis, identifying new information of interest that was subsequently extracted by Pizard. The exception to this process was Table VI, which was developed by Kitchenham and reviewed by Pizard.

II. RESULTS

A. RQI: Extent of take-up of RRs in the SE

We found 23 reporting RRs in SE, although one of them analyzed the process used by two previously published RRs [28]. Since this study includes additional objectives and information to the original studies, we maintain it in our following analysis except in situations where otherwise indicated. 15 of these studies were published in 2023 (prior to Nov 23).

Researchers from 13 countries participated in the studies. Table I shows the number of papers and researchers from the different countries of affiliation of the authors (some authors have more than one affiliation). A co-author of the original RR in SE studies participated in one of the studies [15].

B. RQII: Scope of the studies

13 of the studies report an RR aimed at acquiring knowledge in a specific field, with some studies explicitly indicating this intent while others do not (though they also refrain from reporting any alternative use or motivation). The remaining 10 studies had broader goals, as shown in Table II. For example, some of them sought to complement or validate the RRs' results while others used the RRs' results were used to develop a model, catalog, or artifact.

Nine studies report conducting an RR and complementing/comparing its results with stakeholders' opinions (refer to Table II). Additionally, in another study, the RR served as a starting point for collaboration with stakeholders, but neither their participation nor feedback is reported.

Table III shows topics addressed by RRs in the 22 studies excluding [28]. The number of topics covered is greater than the number of studies because some studies reported multiple RRs on different topics. Studies that reported multiple RRs on the same topic were counted once only. Table III confirms that 13 of the most commonly addressed topics related to the software process (i.e., software construction, software testing and software maintenance), and technology impact was another frequently addressed topic.

The vast majority of RRs included only white literature. However, three RRs include grey literature [4, 5, 30] and another one was conducted in conjunction with a grey literature review [15]. Two studies aimed to search for software tools (the selection ends in Gitlab or Github) [10, 30] and another study searched for both models and tools (both within white literature) [11].

C. RQIII: Methodological characteristics of published RRs

Before analyzing the review processes used to conduct RRs, it is necessary to consider the quality of their reports. The studies report the RRs with varying levels of detail and completeness. Table IV presents our assessment of these reports against the SE Guidelines for

Country	Papers	# of Papers	# of Researchers	Researchers
Brazil	[11, 15, 18, 19, 21, 29, 30]	7	24	Alan Lyra, Andrea Doreste, Bruno Cartaxo, Carlos Eduardo Barbosa, Cassio Andrade Furukawa, Clinton Hudson Moreira Pessoa, Débora Maria Barroso Paiva, Guilherme H. Travassos, Herbert Salazar, Jano Moreira de Souza, Leopoldo Teixeira, Maria Istela Cagnin, Matheus Argôlo, Michele dos Santos Soares, Rebeca C. Motta, Roberto Rufino Júnior, Rodrigo Pereira dos Santos, Rodrigo Pereira Pagliusi, Rogério P. dos Santos, Samuel Loli, Sean Wolfgand Matsui Siqueira, Tadeu Moreira de Classe, Vítor de Castro Paes, Yuri Oliveira de Lima
Italy	[3–5, 16–18]	6	15	Alessandro Marchetto, Anna Rita Fasolino, Antonia Bertolino, Azzurra Ragone, Berenice Fernández Nieto, Danilo Caivano, Domenico Amalfitano, Domenico Gigante, Felicita Di Giandomenico, Francesca Lonetti, Giovanni Dimauro, Giuseppe Scanniello, Maria T. Baldassarre, Simone Romano, Vita Santa Barletta
Sweden	[6, 28, 31]	3	9	Elizabeth Bjarnason, Emelie Engström, Håkan Ardö, Markus Borg, Martin Höst, Nauman bin Ali, Patrik Åberg, Qunying Song, Sergio Rico
Portugal	[10, 30]	2	5	Filipe Correia, Marko Beko, Nuno Fachada, Rogério P. dos Santos, Valderi R. Q. Leithardt
Germany	[9, 10]	2	8	Ana Cristina Franco da Silva, Carolin Rubner, Horst Sauer, Jonas Fritzsch, Justus Bogner, Markus Haug, Matthias Saft, Stefan Wagner
Romania	[25, 26]	2	3	Laura-Diana Radu, Sabina-Cristiana Necula, Vasile-Daniel Păvăloaia
UK	[18, 22]	2	2	Barbara Kitchenham, Santiago Matalonga
Chile	[12, 23]	2	4	Francisco Ponce, Gastón Márquez, Hernán Astudillo, Mauricio Hidalgo
France	[19]	1	2	Rebeca C. Motta, Káthia M. de Oliveira
Uruguay	[22]	1	3	Diego Vallespir, Fernando Acerenza, Sebastián Pizard
USA	[1]	1	2	Amr S. Abdelfattah, Tomas Cerny
Spain	[12]	1	1	Laura M. Castro
The Netherlands	[10]	1	1	Justus Bogner

TABLE I. Number of papers and researchers from the countries of authors' affiliations.

Reporting Secondary Studies (SEGRESS) [14].

Table V summarizes the reporting limitations and process changes that we found in the 22 papers reporting RRs (i.e, not including [28] as it analyzes two previously published RRs).

In most studies, adequately considering the RR process or its results is challenging due to insufficiently reported information. In general, detailed information is presented about the sources used and the information search stage, less information about selection and extraction. But the synthesis stage is the worst reported (only four studies report it adequately).

Table VI presents the motivation for the RR conduct and the reported use of protocols by the authors. Looking at the primary studies, there appears to be some misunderstanding about the term "protocol" within the context of an RR. Some studies acknowledge that an RR protocol is utilized to outline the organization of their specific RR, while others seem to use the term "RR protocol" to refer to the generic RR process.

It is noteworthy that only the authors of five of the studies reporting RRs explicitly indicate having used a protocol to guide the RR conduct and only one study makes it available.

Reproducibility is a desirable characteristic of secondary studies. The lack of proper reporting poses a threat to achieving it. Specifically, the failure to report synthesis methods hinders reproducibility in most studies reporting RRs in SE. Only two studies, namely [5, 20], include the date of search, the list of primary studies, and details of the synthesis methods used. Furthermore, only the latter study included the full protocol. Additionally, [5] utilized Google as a search engine, which may pose challenges for reproducibility due to its inherent characteristics. Despite this, the authors of [5] have provided supplementary material detailing the outcomes of the different stages. To our understanding, these two studies are the only ones offering characteristics that enable their reproduction.

D. RQV: Studies assessing the value of RRs

Six studies confirmed the value of RRs by validating their outcomes (or the models created from them) through collaboration with stakeholders outside the review team.

- In [11], the authors conducted an opinion survey with IT professionals (75% out of 20 with postgraduate studies) to validate the RR outcomes.
- In [31], an RR is conducted as a starting point in a collaboration with a software company.
- In [15], a catalog of object-relational mapping code smells in java was created using an RR results. An opinion survey is done to validate the results (97% out of 86 with a bachelor's degree or more).
- In [6], researchers worked collaboratively with a company. In particular, three RRs were conducted

Study	[23]	[26]	[4]	[17]	[18]	[1]	[25]	[30]	[12]	[16]	[21]	[5]	[3]	[22]	[10]	[9]	[29]	[11]	[31]	[15]	[6]	[19]	[28][1]
Publication year	19	20	23	23	22	23	23	23	23	23	23	23	21	23	23	22	23	22	22	20	23	23	23
Purpose of the study																							
Conducting an RR.	●	●	●	●	●	●	●	●	●	●	●	●	●										
Creating a model/catalog/artifact using the RR results.[2]																				●	●	●	
Conducting an RR and complementing/comparing its results with stakeholders' opinions.														●	●	●	●	●	●				
Investigating the RR methodology.																							●
Stakeholder participation																							
Type of stakeholders (P-Software industry practitioners, S-students, O-Practitioners from other industry)													O	O	S	P	P	P	P	P	P	S	P[1]
RR results were a starting point for collaboration with stakeholders.													●	●									
Stakeholders participated throughout the RR process.																	●		●		●		●[1]
Stakeholders validated RR results.																		●	●				●[1]
Stakeholders validated the model/catalog/artifact created.																				●	●	●	●[1]
Stakeholders participation was used to complement RR results															●			●					
Stakeholders participation's results were compared to RR results														●		●							

[1] This study investigates the RR reported in [31] and the first RR of the three reported in [6].
[2] Two of these studies involved conducting families of RRs [6, 19].

TABLE II. Research Using RR in SE: Citation Analysis of [7, 8] conducted in Nov 2023.

Topic	# of Studies	Studies
Software construction	5	[1, 9–11, 15]
Technology impact	5	[3, 4, 21, 25, 26]
Software testing	4	[16–18, 31]
Software maintenance	3	[9, 10, 23]
Software tools	2	[10, 30]
SE professional practice	2	[12, 29]
SE models and methods	2	[5, 6]
Software design	1	[1]
Software process	1	[19]
Evidence-based practice	1	[22]

TABLE III. Topics of the RRs conducted in SE (not including [28] as it analyzes two previously published RRs).

to create a software selection model, which was validated with a focus group and an application in the company.

- In [19], seven RRs were conducted to develop a roadmap for IoT development. To validate it, an experimental study was carried out where undergraduates used and evaluated the roadmap.
- In [27], the authors analyzed the artifacts of the RR reported in [31] and one of the RRs reported in [6]. They also conducted interviews with the RR review teams, aiming to gain a better understanding of how RRs were conducted.

Although the feedback reports are not extensive or detailed, in all studies stakeholders had a positive attitude towards the results confirming the value of RRs. Except for the study with undergraduates, the others included practitioners with education achievements of at least degree level.

In the three studies in which researchers collaborated with companies throughout the RR process [6, 29, 31], the practitioners were technology experts who specialized in topics related to RR questions. In two of those studies in which the results were validated with practitioners [6, 31], their perceptions of the results were positive, and their feedback was used to improve the RRs results. Despite the fact that in one of the studies, the results were not directly applicable for practitioners [31], both studies support the view that RRs are useful in industrial contexts.

In [27], the authors analyzed the RR reported in [31] and the first of the RRs reported in [6] to evaluate the application of recent guidelines for conducting RRs in collaboration with practitioners, as well as to comprehend the benefits and challenges associated with RRs. The results confirmed that the guidelines were adequate. Conducting RRs collaboratively benefited the relationship between researchers and practitioners, fostering an understanding of expectations and establishing a common terminology. The main challenges included divergent needs, inadequacy of the evidence found (necessitating the use of broad questions), and concerns about short timelines (RR conduct took a few months but with low weekly effort).

III. SUMMARY OF STUDIES, RR SHORTCUTS, & COMMENTS ON REPORTING

This section presents an individual analysis of each paper that includes a very brief summary of the study, comments on the RR process conducted and comments on the report that complement the information presented in Table IV.

A. Migrating from monolithic architecture to microservices: A Rapid Review [23]

The paper presents an RR conducted to learn techniques to migrate monolithic architecture to microservices.

RR shortcuts. Scopus is used as sources and Google Scholar for snowballing. Selection was done by a single reviewer, extraction was done by two reviewers (no process or agreement statistics are indicated). There is no quality assessment of the studies.

Comments on the report.

- It has six pages, not including those that contain references..
- The abstract is not structured but includes the necessary information.
- The problem and the rationale for the study are described, but not so much why the study is necessary (knowledge gap).
- It includes supplementary material with information on the results of the selection and data extraction.
- The synthesis carried out is more in the form of a mapping study. It is easy to clearly trace the presented results back to the extracted data (included in the supplemental material).

B. Disruptive Technologies in Smart Cities: A Survey on Current Trends and Challenges [26]

The paper presents a RR conducted to understand disruptive technologies used for the development of smart cities.

RR shortcuts. They are not explicitly indicated nor is it clear what is omitted or adapted from the SR process. Search is done in IEEE Xplore, Web of Science and Scopus (which in total return less than 100 papers). The quantity or roles of the reviewers are not explained. But it is a single author. There is no quality assessment of the studies.

Comments on the report.

- The problem is described, but not so much why the study is necessary (knowledge gap) nor is the rationale explained well.
- Only the quantity of studies obtained in each search/source is included.

Study	[23]	[26]	[4]	[17]	[18]	[1]	[25]	[30]	[12]	[16]	[21]	[5]	[3]	[22]	[10]	[9]	[29]	[11]	[31]	[15]	[6]	[19]	[27][1]
Title	●	◐	◐	●	●	●	◐	●	●	●	◐	●	◐	●	◐	●	◐	●	●	●	●	●	●
Abstract	●	◐	◐	●	●	◐	◐	●	●	●	◐	●	◐	●	●	●	◐	◐	●	●	●	●	●
Introduction	◐	◐	●	●	●	◐	◐	●	◐	●	◐	●	●	●	●	●	◐	●	●	●	●	●	●
Methods																							
Eligibility criteria	●	○	●	●	●	◐	●	●	●	●	◐	●	●	◐	○	●	◐	●	●	●	●	●	-
Information sources	●	●	●	●	●	◐	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	-
Search strategy	●	◐	●	●	●	◐	●	●	●	●	◐	●	●	●	◐	●	●	●	●	●	◐	●	-
Selection process	●	◐	◐	◐	◐	◐	◐	◐	◐	●	◐	●	●	◐	◐	●	◐	●	◐	◐	◐	●	-
Data collection process	●	○	●	○	●	◐	○	◐	◐	○	◐	●	○	○	◐	●	◐	●	◐	○	◐	●	-
Data items	●	○	○	○	●	○	○	●	●	○	●	●	○	○	○	○	○	●	●	○	◐	●	-
Study risk of bias assessment[2]	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	◐	○	○	-
Effect measures	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Analysis and synthesis methods	○	○	●	●	◐	○	◐	◐	◐	○	○	●	◐	◐	○	◐	○	○	◐	○	◐	●	-
Reporting bias assessment[2]	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	-
Certainty assessment[2]	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	-
Results																							
Study selection	●	◐	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	-
Study characteristics	●	○	○	●	●	○	○	●	●	●	○	●	○	●	●	●	●	●	●	◐	○	●	-
Risk of bias in studies[2]	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	-
Results of individual studies	●	○	○	●	●	○	○	●	●	●	○	○	○	◐	●	●	○	●	●	○	○	●	-
Results of analyses and synthesis	●	◐	●	●	●	◐	◐	●	◐	●	●	●	◐	●	●	●	●	●	●	●	○	●	-
Reporting bias[2]	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	-
Discussion																							
Discussion	●	◐	◐	●	●	◐	◐	●	◐	●	◐	●	◐	◐	●	●	●	●	●	●	○	●	-
Registration and protocol[3]	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	-
Support/Funding	●	●	●	○	●	●	●	●	●	●	●	○	○	●	○	○	●	○	●	●	●	●	-
Availability of data, code and other materials	●	○	○	●	●	◐	○	○	○	○	○	●	○	●	○	●	○	○	●	●	○	●	-

Categories: ●indicates "Acceptably reported", ◐indicates "Poorly/partially reported", ○indicates "Not reported" and - is used for "Not applicable".

[1] This study analyzes two previously reported RRs [6, 31]. Therefore, many items of the SEGRESS guidelines do not apply and must be read in those studies previously presented.

[2] Its report depends on the stages actually carried out in the RRs. Usually their omission is considered within the shortcuts in the RR process.

[3] There is usually no secondary studies protocol registration in SE, although this is starting to change with the "Registered Protocols" tracks at several conferences.

TABLE IV. Verification of studies against SEGRESS guidelines for reporting secondary studies.

RR Process Issues	# of Studies	Studies
RR Reporting Issues Decreasing Transparency and Reproducibility		
Did not report synthesis methods adequately	18	[1, 3, 6, 9–12, 15, 16, 18, 21–23, 25, 26, 29–31]
Did not include the full date of the search	15	[1, 3, 6, 9–12, 15, 17, 18, 21, 25, 26, 29, 31]
Did not report number and roles of reviewers	9	[1, 10, 12, 15, 17, 18, 21, 25, 26]
Only reported number and roles of reviewers for some stages	8	[3, 4, 6, 9, 11, 29–31]
Did not cite primary studies	7	[3, 4, 6, 15, 21, 25, 26]
Did not mention limitations	6	[4, 6, 21, 22, 25, 26]
Reported results only via an Evidence Briefing	2	[3, 15]
Process Changes that could Bias RR Recommendations		
Omitted risk of bias evaluation (i.e., quality assessment)	21	all studies except [15]
Used a single search engine	12	[3, 4, 6, 15–17, 19, 21–23, 25, 29]
Used a single researcher for 1 or more stages	8	[3, 9, 11, 19, 22, 23, 29, 30]
Used a subset of the studies found in searches	4	[5, 9, 15, 25]
Included additional studies without explanation	3	[6, 12, 26]
RR Risk Reduction Processes		
Used a single search engine complemented with snowballing	4	[16, 19, 21, 23]
Used an Evidence Briefing with additional commentary about RQs	2	[19, 29]
Used only primary studies cited in related SRs	1	[31]
Used tools to assist analysis and classification	1	[25]

TABLE V. Processes adopted in SE RRs (not including [28] as it analyzes two previously published RRs).

Study	Rationale for RR conduct	Specific client	Using a protocol is reported
[1]	RR applies to practical problems	No	No
[3]	Fast delivery of results	Project researchers	No
[4]	No specific discussion	No	No - Generic process
[5]	RR benefits explained	No	No - Generic process
[6]	Supported close collaboration	Yes	No
[9]	Industry relevance and efficiency	No	No - Generic process
[10]	Fast delivery of results	No	No
[11]	RR benefits explained	No	Yes - Protocol not included
[12]	Fast delivery of results	No	No[1]
[15]	RR related to decision making & practical problem	Project researchers	No
[16]	Speed up knowledge transfer	No	No - Generic process
[17]	Fast delivery of results	Project researchers	No
[18]	Quick & resource efficient	No	Yes - Protocol not included
[19]	No specific discussion	Project researchers	Yes - Protocols included in supplementary materials
[21]	Fast delivery of results	No	No - Generic process
[22]	Fast delivery of relevant evidence	Project researchers	No
[23]	RR benefits explained	No	No - Generic process
[24]	RR benefits explained	No	No
[26]	RR benefits explained	No	No
[29]	Fast delivery of results	Yes	Yes - Protocol not included
[30]	Scoping review	No	No
[31]	Practitioners context & knowledge exchange	Yes	Yes - Protocol not included

[1] Although the authors indicate using a protocol, they do not appear to have produced it prior to conducting the RR steps.

TABLE VI. Rationale for RR and use of protocols (not including [28] as it analyzes two previously published RRs).

- The quantity or roles of the reviewers are not clear.
- It is not indicated the date of the searches. It is said that information from other sources (without more details) is added to complement information.
- The limitations of the evidence or the process are not discussed.

C. The Social Impact of Generative AI: An Analysis on ChatGPT [4]

The paper presents a RR conducted to understand the social impacts of ChatGPT. The RR considered two different searches, one on grey literature (blogs and news articles) and another on white literature (using Google Scholar).

RR shortcuts. The shortcuts considered are not explicitly indicated. But only consider a search engine and do not make quality assessment of the studies.

Comments on the report.

- It is not explicitly stated that it is a rapid review, although it says “we followed the protocol proposed in (Cartaxo, 2018), and we complemented the review process with the strategies presented in (Kitchenham and Charters, 2007)”.
- No quantity or roles of reviewers for selection or synthesis are indicated. Data extraction was carried out by two reviewers and a third resolved differences.
- The authors include a link for supplementary material on extracted data but it does not work (accessed 1/9/2024).
- Limitations of the evidence or the process are not

discussed.

D. A Rapid Review on Fuzz Security Testing for Software Protocol Implementations [17]

The paper reports a RR conducted to study fuzz security testing for software implementations of communication protocols.

RR shortcuts. The shortcuts considered are not explicitly indicated. But they only considered one search engine (Scopus). It is not known if they made shortcuts in the selection because the process is not explained. There is no quality assessment of the studies.

Comments on the report.

- The abstract is not structured but includes the necessary information.
- The search returns 48 studies and the accessible full papers, which are 45, are selected. The selection process is not explained, although the criteria are.
- No roles or more elaborate selection process are indicated.
- Limitations of the RR process are included.
- Includes supplementary material with a list of selected studies and their classification.
- There are no references to primary studies in the results (but they can be traced in the supplementary material). It is rather the analysis of a mapping study.

E. Alternatives for testing of context-aware software systems in non-academic settings: results from a Rapid Review [18]

The paper reports a RR conducted to understand how non-academic software projects deal with content variation when testing Context-Aware Software Systems. There were three interactions of the protocol conduction in 2019, 2020 and 2022 respectively.

RR shortcuts. Shortcuts are not explicitly stated. Although the authors used only Scopus and ACM Library. They say they have invested time in achieving consistency in the selection of papers, but it is not clear if this was a stage prior to the selection and then each reviewer had a group of papers or if they did it simultaneously. There is no quality assessment of the studies. However, study limitations reported by the authors of the studies are extracted and analyzed to answer one of the RQs.

Comments on the report.

- The process report is quite detailed, but does not indicate the number or roles of the reviewers. Although details of how they improved the consistency of their criterion are explained, that is, that the RR was done by more than one.
- The results begin with a narrative summary of the studies. Then, some questions are answered with categorization of the papers while others include themes that emerge from the studies (although it is not specified what method is used to obtain them).

F. Roadmap to Reasoning in Microservice Systems: A Rapid Review [1]

The paper presents a RR conducted to understand the microservice-based reasoning process (i.e., analysis and reasoning of microservice-based systems).

RR shortcuts. Shortcuts are not explicitly stated. Although only Scopus is used. There is no quality assessment of the studies.

Comments on the report.

- The background and need for the RR, nor its rationale, are not fully described.
- The RQs are composed and complex, they cover 8 or 9 items instead of 3.
- The number of reviewers or their roles during the stages of the process are not indicated.
- It is said that snowballing was done but not of what type or on what papers. The authors also indicate that they supplemented with ad hoc searches that are not explained.
- Collaboration from experts is reported but it is not indicated which ones or their role.
- There is a spreadsheet as supplementary material but it only seems to have search and selection results.
- Ten papers were found before snowballing, but although additional information was included in the snowballing, it is not detailed.
- Results are grouped into themes and stages of a map but no method or process of synthesis is explained. The list of selected papers is not indicated. And the answers to the RQs have entire paragraphs without references that it is not clear what evidence supports them.
- An analysis of the limitations of the study is included but not a discussion of the results (o this could be mixed with the results, it is not clear).

G. Artificial Intelligence as a Disruptive Technology—A Systematic Literature Review [25]

The paper reports a RR conducted to learn more about artificial intelligence as a disruptive technology and its effects on different domains.

RR shortcuts. The authors do not explicitly explain shortcuts used. But only one search engine (Web of science) was used. They excluded papers from authors with only 1 publication on the topic, they considered that "they did not have a serious approach toward this topic."

They used tools to automate analysis of the text of the studies. There is no quality assessment of the studies.

Comments on the report.

- In the title it is indicated that it is an SR, but in the paper the authors stated that their objective was to make a RR.
- No information is included about the knowledge gap or the background of the topic investigated. Research is carried out on AI as a disruptive technology, only an introduction to disruptive technologies is included and not on AI. Furthermore, the introduction given is quite simple.
- The number of reviewers or their roles is not included.
- The list of primary studies considered is not included.
- The authors used MonkeyLearn (a natural language processing software with AI) and VOSViewer to automate the classification and analysis of papers (without indicating much detail about that). Nothing more about synthesis, it seems too poor to me. Although then they not only present results from those tools but also more content grouped into topics that it is not known where it came from.
- An analysis of the limitations of the process or the evidence is not included.

Additional comments.

- The RQs do not seem appropriate for the search conducted. The authors say they survey disruptive technologies (DT) and compare with AI (as another disruptive technology), for example RQ1 aims to understand how DTs evolved over time. However the search string includes the term AI.
- The authors consider that RR is a problem-oriented method unlike SRs. The authors stated: "Among the advantages of using a rapid review, as mentioned by (Cartaxo, 2018), we contend that it provides reliable content while fostering the discovery of new additional concepts (1); Thus, it is considered a problem-oriented method that supports a flexible knowledge transfer environment (2)."

H. A Rapid Review on the Use of Free and Open Source Technologies and Software Applied to Precision Agriculture Practices [30]

The paper presents an RR conducted with the goal of identifying free and open-source software capable of solving real-world problems in precision architecture.

RR shortcuts. Shortcuts used are not indicated nor do they justify why they use an RR. The authors searched using Google Scholar, GitHub, and GitLab. One reviewer conducted searches. There is no quality assessment of the studies.

Comments on the report.

- Although the abstract is not structured, it has appropriate information.
- The introduction to the background and rationale of RR is adequate.
- One reviewer carried out the searches and another reviewed his work, but it is not clear whether this also applied to other stages such as selection or extraction.
- The data items collected are explained quite well but the synthesis process is not explained. The results involve classifications but also a narrative description of each study.
- A discussion of the results is reported, including an analysis of the limitations of the study.

I. Challenges to Use Role Playing in Software Engineering Education: A Rapid Review [12]

The paper presents an RR undertaken with the objective of providing a comprehensive perspective on the challenges associated with the utilization of Role-Playing in Software Engineering Education.

RR shortcuts. No shortcuts used are indicated and the justification for using a RR is not convincing (see additional comment below). The authors use Scopus, Web of Science and IEEE Xplore. The results are complemented with suggested sources by the research team (without more information). The number or roles of the reviewers are not explained. There is no quality assessment of the studies.

Comments on the report.

- It has 13 pages (Springer format), not including those that contain references.
- Although the abstract is not structured, it includes adequate information.
- Although the background and rationale of the study are described very well, the knowledge gap is not entirely clear nor are there any previous studies.
- No number or roles of reviewers are indicated.
- The explanation of the synthesis process is very brief. The papers were classified and a descriptive synthesis of each one was made. But the results include challenges grouped into certain categories, this is not explained how it was elaborated.
- There are results (see, e.g., 5.1) that include themes and explanations without references to primary studies.
- The discussion includes a (brief) analysis of the limitations of the process. Interpretation of the evidence in relation to background or other evidence is not included.

Additional comments.

- The authors consider that RR is a problem-oriented method unlike SRs. The authors, when explaining

RRs, stated: “Rapid Reviews (RR) are practice-oriented secondary studies, and their main goal is to provide evidence to support decision-making towards the solution, or at least attenuation, of issues practitioners face in practice [1] (Cartaxo, 2020, Book Chapter)”. They also pointed out that RRs deliver evidence in less time and justify their use of an RR with these both arguments.

J. Model-based security testing in IoT systems: A Rapid Review [16]

The paper reports an RR conducted to understand the use of Model-based security testing in Internet-of-Things systems.

RR shortcuts. The authors used a single search engine (Scopus) in two rounds: until 2021 and then adding until April 2022. They complemented with “backward and forward snowballing procedure on a balanced and randomly chosen subset of selected papers.” They do not indicate how the extraction and synthesis were done so there could be other shortcuts. There is no quality assessment of the studies.

Comments on the report.

- The questions were answered mainly with classification of the selected studies and with a narrative synthesis of some particular information from the studies gropued in some categories. In some questions, e.g. RQ6 on challenges or future directions themes used seems to be elaborated through some type of synthesis of the primary studies, but is not indicated how it is done.
- The discussion is brief but seems complete, including limitations, keyfindings and future research. There are no reflections about previous works but it seems that there were no works that cover all the concepts of the RR, that is, the results are not comparable.

Additional comments.

- Although the authors correctly explain RRs stating that they are complementary to the SRs, they also report the following, which it seems to apply currently only in the health field: “However, it has been shown that Rapid Review complemented by a rigorous snowballing process, can achieve as good results as Full Systematic Reviews” (10.1016/j.jclinepi.2017.12.001).

K. Analyzing the Challenges for Future Smart and Sustainable Cities [21]

The paper reports an RR undertaken to analyze approaches of Smart Cities implementation and main challenges.

RR shortcuts. No shortcuts used are explicitly indicated. But the authors used only one search engine (Scopus). The number or roles of the reviewers are not explained. There is no quality assessment of the studies.

Comments on the report.

- It is not indicated in the title that it is an RR.
- The abstract is not structured and does not include information on results or conclusions.
- Although some background is included, the knowledge gap is not made explicit.
- The authors report a mixture of of process definition and and process execution in places. Thus it seems that they have used a generic process to guide their planning, but then report the specific processes that they used in the paper.
- The number or roles of reviewers are not indicated.
- The results are presented using some classifications, but also some dimensions and challenges are presented (the qualitative synthesis technique used is not indicated).
- No limitations of the process or evidence are included in the discussion. Although related works are reviewed, they are not discussed against the evidence of the RR.

L. A Rapid Review of Responsible AI frameworks: How to guide the development of ethical AI [5]

The paper reports a RR undertaken to learn about frameworks proposed to help and speed up the adoption of Responsible Artificial Intelligence practices. They searched for white literature and also grey literature.

RR shortcuts. No shortcuts made are explicit. To search for white literature the authors used Scopus and Google Scholar (of the latter they only kept the first 20 pages). Algorithm Watch, OECD database and Google were used for grey literature. The selection and extraction was done by two reviewers and a third author resolved conflicts. There is no quality assessment of the studies.

Comments on the report.

- Although the abstract is not structured, it includes the corresponding information.
- The selection and extraction stages are very well explained.
- They include supplementary material on extracted data including classification of studies.
- The authors mostly performed categorization of the studies. They indicate in considerable detail the categories used and how they were classified. No methods or statistics of agreement between reviewers when classifying are indicated.
- The supplementary material describes what was found in each study.
- We accessed a preprint but we assume that the following items are met but in the paper published at

the conference: Support & Competing interests of the review authors.

M. On Internet-of-things Devices in Ambient Assisted Living Solutions [3]

The paper reports a RR conducted to learn about Internet-of-Things devices that have been using in Ambient Assisted Living Solutions for elderly people.

RR shortcuts. Shortcuts made are not explicitly reported. The authors used only one search engine (Scopus). A single reviewer performed the selection. The extraction and synthesis processes and the number or roles of the reviewers in these stages are not reported. There is no quality assessment of the studies. To disseminate the results, the authors prepared an Evidence Briefing.

Comments on the report.

- Paper is only five pages, not including those that contain references.
- It does not indicate in the title that it is an RR.
- The abstract is not structured and only presents results and conclusions.
- It is not explained how the extraction and synthesis were done or the number or role of the reviewers.
- They authors reported using thematic analysis but do not indicate whether more information, e.g. whether it was deductive or inductive or how they identified themes.
- The paper do not include the list of selected papers.
- The results are only reported in an evidence briefing.
- There is no discussion as such but limitations of the process and a very brief reflection on the study and its differences from related work are included.

N. Tools for Refactoring to Microservices [10]

The paper presents a RR conducted to learn about tools for refactoring to microservices. Tools (i.e. software) were searched. The paper presents a RR conducted to learn about tools for refactoring to microservices. Tools (i.e. software) were searched. Subsequently, three master's students inspected and tested the tools.

RR shortcuts. Shortcuts made are not explicitly stated. The authors searched in ACM DL, IEEE Xplore, Springer Link, and Google Scholar. The number and roles of reviewers are not explained so there may be other shortcuts. There is no quality assessment of the studies.

Comments on the report.

- It has five pages, not including those that contain references.
- It does not indicate in the title that it is an RR.
- It is not a structured abstract but its information is adequate.
- Although brief, the introduction includes all it should cover.
- It does not say what date the searches were carried out nor adapted search strings or details of the searches beyond a generic search string.
- The number or roles of the reviewers are not stated (only that 3 master's students inspected the tools found).
- A description of each tool and a table with some minimal categorizations is included.
- The discussion is very brief but includes limitations of the process and some few reflections on the results. For each tool there is practical information such as whether they are maintained or not. The discussion seems acceptable according to the objective of the study.
- The authors include supplementary material with selected studies, extracted data and classification of what was found.

O. Adopting microservices and DevOps in the cyber-physical systems domain: A rapid review and case study [9]

The paper presents research on using microservices and DevOps in the Cyber-Physical Systems (CPS) domain, especially when migrating legacy systems. First the authors performed an RR to analyze the scientific state of art for microservices and DevOps in the context of CPS. Second, they conducted an interview-based case study at Siemens AG to compare the literature findings with industry experiences. With the interviews, the results of the RR were not validated with the practitioners, but rather questions were asked to obtain information that was later compared with the results of the RR.

RR shortcuts. Four reviewers participated in the RR and their roles in the process are indicated. Searched in Google Scholar, ACM DL, IEEE Xplore, Science Direct, and Springer Link. They only considered the first 50 results of each search. They also did backward and forward snowballing. The selection was made by pairs of reviewers. Although they did pilot tests of the extraction to agree on criteria, then the extraction of each paper was done by a single reviewer. Although the synthesis process is explained, it does not indicate number or roles of the reviewers. There is no quality assessment of the studies.

Comments on the report.

- Although the abstract is not structured, it has adequate information.
- The selection, extraction and synthesis processes are very well explained, including roles and activities taken by the reviewers (except for the synthesis).
- The authors include supplementary material with information of primary studies (assigned categories) and intermediate and final results of the thematic analysis.

- The discussion includes RR results and results of the interviews with Siemens AG personnel, including comparison with related work. The study also includes main takeaways and their implications. Limitations of the study are included, including the limitations of the RR process.

Additional comments.

- The authors consider that RR is a problem-oriented method unlike SRs. The authors say: “Structured approaches to literature surveys like systematic literature reviews or systematic mapping studies provide a rigorous and reproducible process, but also require considerable effort. Additionally, their results can be hard to integrate into industry practice. We therefore decided to conduct a Rapid Review [...] The protocol of a rapid review is still systematic, but may consciously sacrifice rigor and extensiveness for industry relevance and efficiency.”

P. Current Risk Situation Training in Industry, and Games as a Strategy for Playful, Engaging and Motivating Training [29]

This study investigated Risk Situation Training in Industry and digital games as a strategy to address this training. It includes a survey conducted with training managers to understand training taught via traditional methods, and an RR conducted to examine the literature on the benefits of using games with a purpose to support risk situation training. The RR is done in collaboration with managers from industry with whom the initial problem and results are discussed.

RR shortcuts. A single search engine (Scopus) was used. The complete reading and extraction was done by a single reviewer. The number or roles of the reviewers in the selection are not stated. The results are reported in an evidence briefing (although it is two pages instead of one), although these results are expanded in the paper when answering the RQs. There is no quality assessment of the studies.

Comments on the report.

- It is not indicated in the title that it is an RR.
- The abstract is not structured and does not satisfactorily cover all the information that is necessary, it lacks of information about results and conclusions.
- Although a lot of related work on risk situation training and digital games for training is presented, the need for RR is not made explicit. It is indicated that there is an SR on risk situation training in a specific sector of the industry, although it was not validated with practitioners. The authors of the study do not specify whether this SR or its primary studies are used in any way.
- PICOC is used to define the search string.
- It is not reported number or roles of reviewers, it is only said that a single researcher did the complete reading and extraction.
- The RR’s protocol (comprising planning and execution) and results were validated with the managers.
- The analysis process/method used is not indicated. It seems that categorization of the studies was done.
- The discussion and limitations include all parts of the study (also the RR results).
- Supplementary material is included with selection results and interview data. In addition, the evidence briefing is presented.

Q. Support for Accessible Software Coding: Results of a Rapid Literature Review [11]

The paper presents a study that sought to identify which models and tools support developers in the software coding phase in order to meet accessibility requirements. To validate the results of the RR, the authors conducted an opinion survey with professionals in the technological area.

RR shortcuts. The authors used two search engines (IEEE Xplore and Scopus). A single reviewer conducted the RR and other researchers evaluated what was done. The synthesis process is not explained. There is no quality assessment of the studies.

Comments on the report.

- According to the extraction form and the results, it seems that the papers were classified and in addition to that a summary of each study was included. However, the synthesis process was not explained.
- The link to the supplementary material does not work (Accessed 1/23/2024).
- The discussion included reflections of all stages of the study. It seems complete and also includes limitations of the RR process. Recommendations for practice are also included.

Additional comments.

- The authors stated that it is necessary to validate the results of an RR with practitioners (although this is not strictly necessary) and that is the rationale why they conducted opinion survey to validate the results. The authors specifically say: “As the purpose of the RRs is to provide information and evidence to professionals in a timely manner and thus contribute to solving practical problems faced by them, the evaluation of data extracted from the literature with professionals in the technology area is necessary.”

R. Exploring ML testing in practice – Lessons learned from an interactive rapid review with Axis Communications [31]

The paper presents a RR conducted to establish the state of the art of machine learning (ML) testing. The RR is conducted in collaboration with practitioners from the company Axis Communications and was intended to be the beginning of collaboration on ML testing between the company and the university. The practitioners collaborated throughout the RR and gave feedback on the results.

RR shortcuts. For the search, the authors used three recently published secondary studies on ML testing. The researchers selected from the set of 180 primary studies included in those three secondary studies. They focused on answering a subset of the questions defined together with the company. Studies strongly connected to the company context were selected. Technological rules were extracted as a way to structure the synthesis and facilitate the process and reception of the evidence by the practitioners. As the RR was a starting point for collaboration, no formal dissemination activities were planned. There is no quality assessment of the studies.

Comments on the report.

- The abstract is not structured but contains all the necessary information.
- The search, selection and extraction stages are quite detailed although it is not indicated who the reviewers were. Only for selection the roles are reported.
- The synthesis involved extracting technological rules from the studies. A brief review of each study is also included. It is not reported who made this synthesis or how it was validated. Selected studies were categorized according to the answers to RQs and it is reported which questions could not be answered (they had many).
- Supplementary material is included with the primary studies and their classification according to the RQs they respond to.

S. Assessing attitudes towards evidence-based software engineering in a government agency [22]

In this paper the authors studied the attitudes towards EBSE of stakeholders working in a government agency and to assess whether knowledge of EBSE would impact their working practices. As a starting point, they conducted a RR of secondary studies on evidence-based practice in other disciplines. The RR results were used to complement the discussion of the study results with the government agency.

RR shortcuts. Only one search engine is used (SCOPUS). It is reported that a single author conducted the RR. An RR is conducted on secondary studies, but the authors do not justify their decision or whether this is due to shortening the process. There is no quality assessment of the studies.

Comments on the report.

- It does not indicate in the title that it is an RR, but the RR is conducted and reported as part of the related work.
- It is not explained how the extraction was done.
- They authors reported using thematic analysis but do not indicate whether more information, e.g. whether it was deductive or inductive or how they identified themes.
- Although the results of the empirical study are discussed in the discussion and compared with the results of the RR, there is no fair discussion of the limitations of the RR.
- The authors include supplementary material with search string, selected studies and some of its characteristics.

T. A Catalog of Object-Relational Mapping Code Smells for Java [15]

The paper presents a catalog of Object-Relational Mapping Code Smells for Java extracted from the state of research and practice, through a combination of an RR and a grey literature review. To evaluate the catalog the authors conducted an opinion survey with software developers.

RR shortcuts. A single search engine (Scopus) was used. The Grey literature review (GLR) implied searching with Google, limiting it to the first 50 results according to the page ranking. The other stages of the process were done jointly for both reviews. Sources that did not have a minimum quality standard (sources without sufficient detail or with unclear explanations) were excluded. The authors say that this standard could not be established a priori for the GLR given the nature of the material to be surveyed (no information is given about this for the RR). No number or roles of reviewers are indicated. The results are presented in an evidence briefing, although it seems that the opinion survey included more detail of the catalog for validation (including code examples). There is no quality assessment of the studies.

Comments on the report.

- The title does not include RR but the title seems appropriate since it includes a catalog constructed from the results of the RR.
- The abstract is not structured but contains adequate information.
- The authors conduct the stages of the RR and the GLR from the selection stage together.
- Provided as supplementary material: intermediate and final results of searches and selection. Evidence briefing with the results.
- No number or roles of reviewers are indicated.

- Although there is a subsection titled “Synthesis procedure”, few information is reported about that. It is only reported that some studies explicitly mention problems and in other cases they inferred them.Not including roles or activities conducted.
- The results include a catalog of code smells and a list of primary studies from which they were inferred. In addition to the description of each code smell, notes and additional information are included that seem to be taken from primary studies.
- A validation of the catalog using a survey of practitioners is included. There is no general discussion, but the results are briefly positioned with respect to related work and the limitations of the study are reported.

Additional comments.

- The authors consider that RR is a problem-oriented method unlike SRs. The authors stated: “The use of RR has the main objective of providing evidence to assist decision making regarding problems that professionals usually have. Thus, RR is the best fit in our context, since this research was initially motivated by a problem in a real-world project.”

U. Software selection in large-scale software engineering: A model and criteria based on interactive rapid reviews [6]

The paper presents a model to support software development organizations in selecting and evaluating software components and tools. The model was developed in collaboration with Ericsson AB practitioners using as a basis, in addition to the practitioners’ experiences, the results of three RRs. Two of the RRs investigated software tools (one related to CASE tools and the other related to continuous deployment/Devops) and one investigated methods of assessing the quality of tools. The model has been validated through a focus group with practitioners from Ericsson AB and by practical use also in that company.

RR shortcuts. The first RR was conducted by a single reviewer, the search was done using a single search engine (Scopus). Another author included studies resulting from complementary searches (no further detail on this is added). It appears that the extraction and synthesis involved developing a set of criteria to use in the model (but no further information is provided). Scopus was also used in the second and third RR, but the roles or number of reviewers who participated are not detailed. The results of the three RRs were presented to the practitioners (it is not said how or by what means) to then develop the model. Apparently no quality assessment was carried out on the studies considered.

Comments on the report.

- In the first two RRs, some of the reviewers add papers from “complementary searches” without specifying more information.
- The first RR is described more completely. The others do not indicate who the reviewers were or their roles, or methods of synthesis.
- The results of the RRs were incorporated into the model that was being developed. Results of the RRs as such are not reported.
- The results of the RRs are not discussed either. Nor are limitations of the RRs and their process included.

V. An evidence-based roadmap for IoT software systems engineering [19]

The paper presents an evidence-based roadmap for Internet-of-Things (IoT) development to support developers in specifying, designing, and implementing IoT systems. The roadmap has seven facets and to prepare it, a RR was conducted for each of the facets. To validate the roadmap, an experimental study was carried out that involved a project to create a software system for Oximeter IoT for healthcare domain carried out by seven undergraduate students as part of an assignment in the Software Development course (2021).

RR shortcuts. A metaprocol was developed for all RRs. A single search engine (Scopus) was used, complemented by snowballing. The selection and extraction stages were carried out by a single reviewer (different for each RR), the coding of the results and the synthesis were carried out jointly between two reviewers in meetings. Upon completing the RR of a facet of the roadmap, the results were reviewed and the results of the previous RRs were adjusted. No quality assessment of the studies was conducted.

Comments on the report.

- The title does not include the term RR but they create a roadmap based on the results of the RRs.
- An extensive technical report (147 pages) with the RR report is included as supplementary material. It has a meta protocol and then the RR of each facet of the roadmap is explained. For each of the RRs, their results were reported using an evidence briefing. These reports are quite detailed.
- They also provide much more supplementary material on building the roadmap and studying observations.
- PICOC was used to build the search string.
- In the supplementary material there are conclusions (as a discussion of the results) of each RR. But limitations of the process or the evidence are not included. The paper includes analysis of threats to the validity of the roadmap and the observational study. Limitations of the RR process and evidence are included.

W. Experiences from conducting rapid reviews in collaboration with practitioners — Two industrial cases [28]

In this paper the authors analyzed the artifacts of the RR reported in [31] and one of the RRs reported in [6]. They also conducted interviews with the reviewers, aiming to gain a better understanding of how RRs were conducted. Specifically, they sought to evaluate the application of recent guidelines for conducting RRs in collaboration with practitioners, as well as to comprehend the benefits and challenges associated with RRs.

RR shortcuts. They are those described in the studies considered already reported before.

Comments on the report.

- Some information from the analyzed RRs is added: e.g. background of reviewers or other issues that may not be required by SEGRESS. For example, how the RR questions were selected together with the practitioners, since the study seeks to analyze the collaborative process used to conduct the RRs.

IV. STUDIES EXCLUDED IN LATE STAGES OF THE ANALYSIS

Here we discuss studies excluded in late stages of the analysis and the rationale for the decision.

In [13], the authors present a catalog and taxonomy of code smells prepared from a search in the literature. They do not reported the study as an RR and declare "The literature review was, to a large extent, inspired by the methodology behind rapid reviews". They did 56 searches (including both white and grey literature) for different code smells and then classify and analyze what they find to create a catalog and taxonomy. After searching they read the results to consider which existing taxonomy is the most referenced, to find out if there is a source that aggregates all the code smells and to investigate how the code smells are discussed. These are some of their research questions and although some findings are discussed, it is not clear that the searches they conducted should be considered as RRs. The authors only report information on the search stage, they do not declare having considered protocols or conducted other stages of RR process.

The studies presented in [20] and [2] (the latter is a technical report) are preliminary intermediate works of [19] and [18], respectively. Therefore we considered in our analysis only these last two.

V. LIMITATIONS

Our review is subject to certain limitations. The selection, extraction, and classification of publications were conducted by a single researcher (Pizard), potentially introducing bias into the results of these activities. To address this concern, we implemented two measures. Firstly, Pizard validated the selection, extraction, and classification results some days after their completion. Additionally, after the elaboration of this report, he conducted a further verification of the results against the identified publications. Secondly, alongside this report, we have made the spreadsheet containing information on the selection, extraction, and classification of the articles publicly available.

It is important to note that our results exclusively encompass publications that reference the seminal works on RRs in SE authored by Cartaxo et al. We have not considered potential papers that address RRs but directly cite works or guidelines from the health field, where RRs as a method originated.

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[4] Baldassarre, M.T., Caivano, D., Fernandez Nieto, B., Gigante, D., Ragone, A., 2023. The Social Impact of Generative AI: An Analysis on ChatGPT, p. 363–373.

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