

Supplementary Material to the Paper "Towards a Goal-Centric Assessment of Requirements Engineering Methods for Privacy by Design": Methodology Description

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Methodology

We formulated the following research questions to achieve the goal of identifying a suitable approach to the assessment of RE methods for PbD:

- RQ1.1: What are the characteristics of RE methods for PbD reported in the literature?
- RQ1.2: What are the reported evaluation criteria for RE methods for PbD?
- RQ2.1: How do practitioners assess the importance of characteristics of RE methods for PbD?
- RQ2.2: What are the goals of practitioners in the process of RE for PbD?
- RQ3: How useful and feasible goal-centric approach to the assessment of RE methods for PbD is according to practitioners?

To answer the research questions we executed a literature review and synthesized five RE method characteristics (MCs) essential for PbD. Next, we conducted interviews with practitioners engaged in RE for PbD and identified eleven method goals (MGs) to which method characteristics contribute. Next, we synthesized the first version of the assessment approach for RE methods for PbD and validated it with practitioners (see Figure 1 for a visual overview).

Literature Review (LR)

We executed the following query in Scopus and Google Scholar (without filters):
gdpr AND ("software engineering" OR "requirements engineering") AND (evaluation OR validation)

We checked the search results and extracted all 1777 results from Scopus and the first 700 results from Google Scholar. After removing 217 duplicates from the integrated dataset we obtained **2260** unique primary studies. After scanning through the search results, we identified three main types of relevant studies which were (1) secondary studies on PbD/GDPR compliance, (2) primary

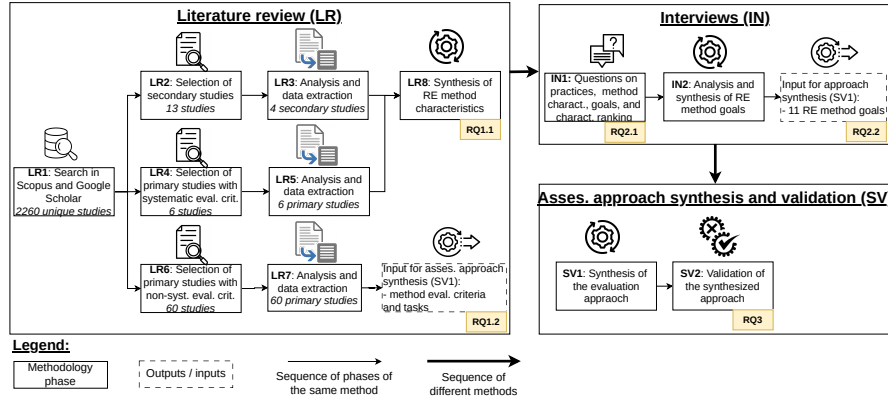


Fig. 1: Visual overview of the methodology

studies with a systematic and tailored evaluation of methods for PbD/GDPR compliance, (3) primary studies with non-systematic (e.g., reused) evaluation. Next, we report the literature review process for each of these types of studies (see inclusion criteria and other details in the open data set).

Review of secondary studies (LR2-3) We reviewed secondary studies containing a relevant synthesis of primary study results. We have not found any systematic approaches to RE methods, but extracted related relevant data (e.g., challenges) for the synthesis of RE method characteristics (LR8).

Review of primary studies with a systematic and tailored evaluation approach (LR4-5) Next, we selected the primary studies with a tailored evaluation approaches. Due to the absence of criteria specific to PbD or conjoint requirements and system specification for GDPR compliance, we extracted GDPR compliance-related criteria for the synthesis of the RE method characteristics (LR8).

Review of the primary studies with non-systematic evaluation approach (LR6-7) Next, we analyzed the primary studies applying non-systematic and/or non-tailored evaluation criteria. We extracted the data about evaluation criteria and tasks used for evaluation (e.g., requirements conflict identification), and used it as a source of information for the synthesis of the assessment approach (SV1).

Analysis and synthesis of RE method characteristics (LR8) Our literature review has not resulted in finding systematic approaches to RE methods for PbD. Due to this, we added three publications that cover systematic evaluation of RE methods for system specification [1,3,5]. We conducted a thematic analysis of the data collected during the literature review steps LR2-5, and three additional publications according to Braun&Clarke [2] and applied meta synthesis [7] to synthesize the essential RE method characteristics. We used data collected during the steps LR6-7 for the synthesis of the evaluation approach (SV1).

Interviews Methodology (IN)

To answer RQ2.1, RQ2.2 we conducted semi-structured interviews [6] and analyzed the practitioners’ perspective on the RE method characteristics and goals. We applied purposive sampling with snowballing to select participants involved in RE for PbD/GDPR compliance with both technical insights and experience with GDPR. We explicitly invited both engineering roles (e.g., architects) and roles collaborating with them (e.g., lawyers). We conducted interviews with 15 individuals representing 11 companies (see Table ??). During the data collection, we adapted the Goal Question Metric (GQM) approach [8] to structure the interviews and further analysis. The GQM is an approach to defining and measuring software quality. It includes three levels at which quality measurement is defined: (1) conceptual level defining goals to be achieved, (2) operational level defining questions for evaluating the achievement of goals, and (3) quantitative level defining metrics or data required to answer the questions. For each RE method characteristic (“class of goals” in the interviews), we formulated open-ended questions about goals, questions, and metrics that practitioners use in RE for PbD. At the end of the interviews, we asked interviewees to rank method characteristics (from 1—most important to 5—least important, each ranking assigned once only). All interviews were recorded using Microsoft Teams or Zoom.

To analyze the collected data, the first author of the study transcribed the interviews and applied the qualitative data analysis tool Taguette for deductive coding using the topics of the interview questions. Next, we conducted a thematic analysis of the goals to synthesize RE method goals for PbD.

Synthesis & Validation of the Assessment Approach (SV)

Our RE method assessment approach was mainly inspired by the Goal Question Metric approach for measurement and improvement of software quality. To synthesize the first version of the approach we used the RE method goals identified in the interviews (IN2) as pivotal for the development of the approach. We once again analyzed the goals, questions, and metrics related to each RE method goal. Next, we formulated subgoals when methods goals could be broken down further. After that, we added the corresponding questions and metrics from the original interview data. Next, we refined the questions and metrics identified during the interviews taking into account the ranking of RE method characteristics assigned during the interviews, additional comments of interviewees about RE methods for PbD, and the relationship between method characteristics and method goals. Next, we added metrics and evaluation tasks extracted in the review of the primary studies without a systematic evaluation approach. As the last step, the first author of the study refined the approach on the basis of his knowledge of GDPR and privacy and added more questions and/or indicative metrics to ensure that there is at least one metric for each question.

We validated our approach with two interviewees and three practitioners who didn’t take part in the interviews. We used screening of the assessment of the approach [4] focused on validating the usefulness and feasibility of the

components (subgoals, questions, and metrics) of the approach and approach as a whole. In this context, we define usefulness as a quality of the components of our approach of being useful for RE method assessment purposes. We define feasibility as the quality of the components of our approach being reasonable and likely to be applied for RE method assessment in practice.

For validation, we conducted a walkthrough of the approach and asked the participants to evaluate the usefulness and practical feasibility of each subgoal, question, and metric as positive or negative. At the end, we also asked participants about their overall opinions about the approach. To analyze the results we calculated the number of positively assessed subgoals, questions, and metrics and compared it to the total number of corresponding elements (see ??).

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