

## Software

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## Web Extra

## Method: How We Selected and Analyzed the Studies

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VOICE OF EVIDENCE

Method: How We Selected and Analyzed the Studies

Oscar Dieste, Natalia Juristo, and Forrest Shull

*This material supplements the Mar./Apr. Voice of Evidence column, " [Understanding the Customer: What Do We Know about Requirements Elicitation?](#) "*

**Oscar Dieste, Natalia Juristo, and Forrest Shull**

We followed general procedures for performing systematic reviews. However, Barbara Kitchenham's suggested meta-analysis techniques<sup>1</sup> can be applied only under certain circumstances (essentially, a large number of replications) that don't generally hold in experimental software engineering. So, we developed our own procedure, inspired by Charles Ragin<sup>2</sup> and Robert Yin and Karen Heald,<sup>3</sup> to aggregate our results.

## Inclusion and exclusion criteria

We included any comparative empirical studies about elicitation techniques that individuals can apply. By "comparative," we mean that the studies compare two or more elicitation techniques (such as protocol analysis versus interviews), but not an elicitation technique versus "nothing" or "the typical way" (as in a paper by Mustapha Tawbi, Camille Ben Achour, and Fernando Vélez<sup>4</sup>). All publications were in English.

We rejected studies in which any of these conditions hold:

- The empirical study describes a case study or singular experience.<sup>5</sup>
- The elicitation technique isn't pertinent for software engineering (such as probability elicitation<sup>6</sup> and decision making<sup>7</sup>).
- Any of the tested techniques is a group technique (such as focus groups<sup>8</sup>).
- Any of the tested techniques requires computing support (such as virtual meetings<sup>9</sup>). This restriction means that we considered only face-to-face interactions between stakeholders.

## Data sources and search strategy

The databases we used were Scopus, IEEE Xplore, and the ACM Digital Library. We performed some Google searches as well.

## Search strategy

For Scopus, IEEE Xplore, and the ACM DL, we used the search string

*(elicitation OR "requirements gathering" OR "requirements acquisition")*

AND

*(capture OR empirical OR experiment OR study OR review OR evaluation)*

To locate unindexed or "grey" literature (such as thesis papers<sup>10</sup>), we searched in Google using the search string

*elicitation ; "requirements gathering" ; "requirements acquisition"*

We also reviewed all the papers referenced by the papers we located using the above-mentioned searches.

## Restrictions

We considered all papers we found using this search strategy, in any venue. We limited our searches to papers published up to and including March 2005.

## Study identification and selection

We applied the search terms to the articles' titles, abstracts, and keywords. We reviewed the titles and abstracts and decided whether the publications fulfilled the inclusion criteria. In the first stage, we quickly reviewed titles and abstracts and selected 74 publications. After reviewing those papers' references, we selected 490 more papers. In the second stage, we reviewed the 564 papers in more detail and excluded 511 of them. The final set had 53 papers, including experiments, case studies, and surveys. We resolved all discrepancies by consensus.

### Data extraction and checking

Twenty-seven of the papers were grey literature or very difficult to get (for example, some conference papers<sup>11</sup>), so we didn't consider them. We read the other 26 papers thoroughly and extracted data (including study type, number and type of subjects, factors, response variables, experimental task, experimental results, and so on) using a standardized extraction form (see <http://grise.upm.es/sites/extras/1/extraction.doc>).

### Aggregation

Our procedure for aggregating the results included a quality rating scheme, which we applied to each paper. We didn't consider lower-quality studies in our aggregation. We drew conclusions by reasoning about whether studies of the same techniques and the same attributes found the same results (similar to "vote counting" approaches in which each study's results count as one "vote" on the issue being investigated).

**Table 1. The 30 studies in the aggregation.**

| Code & URL                                                                                                  | Authors & reference                   | Year | Field                 | Design                                                             | Who applied the elicitation technique?                                                                        | Respondent to the elicitation technique                  | Settings                                                                                                                                                                                                                                    | Task                                                                    |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------|------|-----------------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| S01,<br><a href="http://grise.upm.es/sites/extras/1/S01.php">http://grise.upm.es/sites/extras/1/S01.php</a> | Adelman <sup>12</sup>                 | 1989 | Knowledge engineering | Crossover (on technique as usual)                                  | Six knowledge engineers                                                                                       | 28 groups composed of four or five US Marine lieutenants | Lab-like settings. Two questioners elicited information from three groups, and the other four from two groups. The study was repeated twice using different elicitation techniques (crossover). Sessions were carried out over nine months. | Extracting a hierarchy of attributes for a US Marines evaluation system |
| S02,<br><a href="http://grise.upm.es/sites/extras/1/S02.php">http://grise.upm.es/sites/extras/1/S02.php</a> | Agarwal and Tanniru <sup>13</sup>     | 1990 | Information systems   | Randomized 2 × 2 factor design (questioner experience × technique) | 20 graduate business students (inexperienced subjects); 10 experienced knowledge engineers or system analysts | 30 expert practitioners from industry                    | The respondent's work environment. Maximum elicitation time was one-and-a-half hours. All participants received some training before the task.                                                                                              | Capital budgeting/resource allocation decision                          |
| S03,<br><a href="http://grise.upm.es/sites/extras/1/S03.php">http://grise.upm.es/sites/extras/1/S03.php</a> | Bech-Larsen and Nielsen <sup>14</sup> | 1999 | Marketing             | Randomized parallel (that is, one factor with two or more levels)  | Unclear; we guess the experimenters                                                                           | 150 women recruited in a shopping center                 | The same shopping center                                                                                                                                                                                                                    | Choosing among olive oil brands                                         |

| Code & URL                                                                                                  | Authors & reference                  | Year | Field                 | Design                                                                                | Who applied the elicitation technique?                                     | Respondent to the elicitation technique                                           | Settings                                                                                   | Task                                                                |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------|------|-----------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| S04,<br><a href="http://grise.upm.es/sites/extras/1/S04.php">http://grise.upm.es/sites/extras/1/S04.php</a> | Breivik and Supphellen <sup>15</sup> | 2003 | Marketing             | Randomized 2 × 2 × 2 factor design (type of product × presentation order × technique) | Unclear; we guess the experimenters                                        | 160 consumers recruited by phone                                                  | Unclear; we guess that the experiment was carried out in the respondent's home.            | Choosing among restaurants and car brands                           |
| S05,<br><a href="http://grise.upm.es/sites/extras/1/S05.php">http://grise.upm.es/sites/extras/1/S05.php</a> | Browne and Rogich <sup>16</sup>      | 2001 | Information systems   | Randomized parallel                                                                   | Unclear; one or several interviewers, blind to the experiment's objectives | 45 nonfaculty employees from two universities with user-level computer experience | Lab-like settings                                                                          | Developing an Internet-based food-shopping system                   |
| S06,<br><a href="http://grise.upm.es/sites/extras/1/S06.php">http://grise.upm.es/sites/extras/1/S06.php</a> | Burton et al. <sup>17</sup>          | 1987 | Knowledge engineering | Crossover (on technique)                                                              | Unclear; we guess the experimenters                                        | 32 undergraduate geology students                                                 | Lab-like settings                                                                          | Identifying igneous rocks                                           |
| S07,<br><a href="http://grise.upm.es/sites/extras/1/S07.php">http://grise.upm.es/sites/extras/1/S07.php</a> | Corbridge et al. <sup>18</sup>       | 1994 | Knowledge engineering | Randomized parallel                                                                   | Unclear; we guess the experimenters                                        | Eight postgraduate or higher-level experts on metallurgy                          | Lab-like settings. There were six elicitation sessions of 10 minutes each.                 | Classifying the corrosion of metals                                 |
| S08,<br><a href="http://grise.upm.es/sites/extras/1/S08.php">http://grise.upm.es/sites/extras/1/S08.php</a> | Corbridge et al. <sup>18</sup>       | 1994 | Knowledge engineering | Crossover (on technique)                                                              | Unclear; we guess the experimenters                                        | 32 final-year medical students                                                    | Lab-like settings; maximum elicitation time was one hour.                                  | Diagnosing acute abdominal conditions                               |
| S09,<br><a href="http://grise.upm.es/sites/extras/1/S09.php">http://grise.upm.es/sites/extras/1/S09.php</a> | Corbridge et al. <sup>18</sup>       | 1994 | Knowledge engineering | Crossover (on technique)                                                              | Unclear; we guess the experimenters                                        | 16 drivers with at least two years' experience                                    | Probably lab-like settings; maximum elicitation time was half an hour.                     | Perceiving driving hazards                                          |
| S10,<br><a href="http://grise.upm.es/sites/extras/1/S10.php">http://grise.upm.es/sites/extras/1/S10.php</a> | Crandall <sup>19</sup>               | 1989 | Knowledge engineering | Randomized parallel                                                                   | Unclear; we guess the experimenters                                        | 20 experienced fireground commanders                                              | Lab-like settings                                                                          | Making decisions on simulated fire incidents                        |
| S11,<br><a href="http://grise.upm.es/sites/extras/1/S11.php">http://grise.upm.es/sites/extras/1/S11.php</a> | Moore and Shipman <sup>20</sup>      | 2000 | Software engineering  | Randomized parallel                                                                   | 10 non-computer science graduate students                                  | Didn't exist; a description of the future system was used instead                 | Lab-like settings                                                                          | Designing a new university course registration system               |
| S12,<br><a href="http://grise.upm.es/sites/extras/1/S12.php">http://grise.upm.es/sites/extras/1/S12.php</a> | Larsen and Naumann <sup>21</sup>     | 1992 | Information systems   | Randomized parallel                                                                   | 24 university teachers                                                     | 14 university teachers                                                            | Lab-like settings. A one-hour presentation explained each group's roles in the experiment. | Unclear; we guess a typical information systems development problem |

| Code & URL                                                                                                  | Authors & reference                     | Year | Field                 | Design                                                    | Who applied the elicitation technique? | Respondent to the elicitation technique      | Settings                                                                                                                                                               | Task                                                                                                       |
|-------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|-----------------------|-----------------------------------------------------------|----------------------------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
|                                                                                                             |                                         |      |                       |                                                           |                                        |                                              | Additionally, questioners received 45 minutes of training. Elicitation was carried out in continuous sequence.                                                         |                                                                                                            |
| S13,<br><a href="http://grise.upm.es/sites/extras/1/S13.php">http://grise.upm.es/sites/extras/1/S13.php</a> | Fowlkes, Salas, and Baker <sup>22</sup> | 2000 | Knowledge engineering | Randomized parallel (on subject's experience)             | Unclear; we guess the experimenters    | 10 instructor pilots and 10 student aviators | Lab-like settings. Elicitation sessions lasted one-and-a-half hours.                                                                                                   | Identifying strategies to respond to situations in a night flight (a videotape simulated the night flight) |
| S14,<br><a href="http://grise.upm.es/sites/extras/1/S14.php">http://grise.upm.es/sites/extras/1/S14.php</a> | Goodrich and Olman <sup>23</sup>        | 1990 | Information systems   | Randomized 2 × 2 factor design (type of task × technique) | Eight high school students             | Eight high school students                   | Lab-like settings. Five elicitation sessions were carried out, each one-and-a-half-hours or shorter. Students received half an hour of training before the experiment. | Designing a reservation system and a decision support system                                               |
| S15,<br><a href="http://grise.upm.es/sites/extras/1/S15.php">http://grise.upm.es/sites/extras/1/S15.php</a> | Hudlicka <sup>24</sup>                  | 1996 | Software engineering  | Randomized parallel                                       | Unclear; we guess the experimenters    | 17 FAA inspectors                            | Lab-like settings. Sessions lasted between 30 minutes and two hours.                                                                                                   | Identifying attributes for an FAA safety performance analysis subsystem                                    |
| S16,<br><a href="http://grise.upm.es/sites/extras/1/S16.php">http://grise.upm.es/sites/extras/1/S16.php</a> | Jones and Miles <sup>25</sup>           | 1998 | Knowledge engineering | Randomized parallel                                       | Unknown                                | Unknown                                      | Unknown                                                                                                                                                                | Designing an expert system for text processing                                                             |
| S17,<br><a href="http://grise.upm.es/sites/extras/1/S17.php">http://grise.upm.es/sites/extras/1/S17.php</a> | Burton et al. <sup>26</sup>             | 1990 | Knowledge engineering | Crossover                                                 | Unclear; we guess the experimenters    | 16 professional archaeologists               | Lab-like settings                                                                                                                                                      | Analyzing flint artifacts and pottery shards                                                               |
| S18,<br><a href="http://grise.upm.es/sites/extras/1/S18.php">http://grise.upm.es/sites/extras/1/S18.php</a> | Burton et al. <sup>26</sup>             | 1990 | Knowledge engineering | Case study                                                | Unclear; we guess the experimenters    | Five professional archaeologists             | Lab-like settings                                                                                                                                                      | Analyzing the appropriateness of clauses in an expert system                                               |
| S19,<br><a href="http://grise.upm.es/sites/extras/1/S19.php">http://grise.upm.es/sites/extras/1/S19.php</a> | Moody, Will, and Blanton <sup>27</sup>  | 1996 | Knowledge engineering | Randomized parallel                                       | Unclear                                | 42 experienced librarians                    | Lab-like settings                                                                                                                                                      | Identifying search strategies to locate specific literature                                                |

| Code & URL                                                                                                  | Authors & reference                    | Year | Field                 | Design                                                                    | Who applied the elicitation technique?                                                                              | Respondent to the elicitation technique                                                                               | Settings                                                                                                                                     | Task                                                                                  |
|-------------------------------------------------------------------------------------------------------------|----------------------------------------|------|-----------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| S20,<br><a href="http://grise.upm.es/sites/extras/1/S20.php">http://grise.upm.es/sites/extras/1/S20.php</a> | Rowe et al. <sup>28</sup>              | 1996 | Knowledge engineering | Nonstandard design                                                        | 19 experienced US Air Force technicians                                                                             | Unclear; we guess the experimenters                                                                                   | Lab-like settings                                                                                                                            | Identifying problems in an F-15 flight device                                         |
| S21,<br><a href="http://grise.upm.es/sites/extras/1/S21.php">http://grise.upm.es/sites/extras/1/S21.php</a> | Zmud, Anthony, and Stair <sup>29</sup> | 1993 | Information systems   | Randomized parallel                                                       | Four research assistants in management or information systems                                                       | 100 senior undergraduate business students                                                                            | Lab-like settings                                                                                                                            | Identifying elements that a handbook for job recruiting activities should include     |
| S22,<br><a href="http://grise.upm.es/sites/extras/1/S22.php">http://grise.upm.es/sites/extras/1/S22.php</a> | Eva <sup>30</sup>                      | 2001 | Information systems   | Survey                                                                    | N/A                                                                                                                 | N/A                                                                                                                   | N/A                                                                                                                                          | N/A                                                                                   |
| S23,<br><a href="http://grise.upm.es/sites/extras/1/S23.php">http://grise.upm.es/sites/extras/1/S23.php</a> | Marakas and Elam <sup>31</sup>         | 1998 | Information systems   | Randomized 2 × 2 factor design (subject's experience × technique)         | 20 students in last year of an undergraduate MIS program and 20 professional system analysts and software designers | Unclear                                                                                                               | Lab-like settings. Questioners received one hour of training before the experiment and had unlimited time to prepare the elicitation session | Designing an order receiving and processing system                                    |
| S24,<br><a href="http://grise.upm.es/sites/extras/1/S24.php">http://grise.upm.es/sites/extras/1/S24.php</a> | Rugg et al. <sup>32</sup>              | 1992 | Knowledge engineering | Randomized parallel                                                       | Unclear; we guess the experimenters                                                                                 | 75 subjects of unknown origin                                                                                         | Lab-like settings. Each elicitation session lasted half an hour.                                                                             | Identifying fruit                                                                     |
| S25,<br><a href="http://grise.upm.es/sites/extras/1/S25.php">http://grise.upm.es/sites/extras/1/S25.php</a> | Pitts and Browne <sup>33</sup>         | 2004 | Information systems   | Not factorial design. Analysis carried out using statistical correlation. | 54 practicing system analysts with more than two years' experience                                                  | One person unfamiliar with system development and blind to the experiment's objectives                                | Lab-like settings                                                                                                                            | Designing an online grocery shopping system                                           |
| S26,<br><a href="http://grise.upm.es/sites/extras/1/S26.php">http://grise.upm.es/sites/extras/1/S26.php</a> | Griffin and Hauser <sup>34</sup>       | 1993 | Marketing             | Case study                                                                | Unclear; we guess the experimenters                                                                                 | 30 potential customers of portable food-carrying and storing devices (such as coolers, picnic baskets, and knapsacks) | Unclear; it looks like a real setting                                                                                                        | Identifying potential customer needs about portable food-carrying and storing devices |
| S27,<br><a href="http://grise.upm.es/sites/extras/1/S27.php">http://grise.upm.es/sites/extras/1/S27.php</a> | Griffin and Hauser <sup>34</sup>       | 1993 | Marketing             | Case study                                                                | Seven analysts with different backgrounds                                                                           | Didn't exist; interview transcripts were used instead                                                                 | Unclear; it looks like a real setting.                                                                                                       | Identifying customer needs about portable food-carrying and storing devices           |

| Code & URL                                                                                                  | Authors & reference               | Year | Field                 | Design                    | Who applied the elicitation technique?                                          | Respondent to the elicitation technique       | Settings                                                                                               | Task                                                           |
|-------------------------------------------------------------------------------------------------------------|-----------------------------------|------|-----------------------|---------------------------|---------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| S28,<br><a href="http://grise.upm.es/sites/extras/1/S28.php">http://grise.upm.es/sites/extras/1/S28.php</a> | Schweickert et al. <sup>35</sup>  | 1987 | Knowledge engineering | Case study                | Unclear; we guess the experimenters                                             | One expert                                    | Real settings. Each elicitation session lasted 70 minutes. All sessions were carried out the same day. | Creating knowledge bases on lighting for industrial inspection |
| S29,<br><a href="http://grise.upm.es/sites/extras/1/S29.php">http://grise.upm.es/sites/extras/1/S29.php</a> | Silver and Thompson <sup>36</sup> | 1991 | Marketing             | Case study                | Unclear; author specifies only that questioners were "experienced interviewers" | 17 customers of unknown origin                | Unclear; it looks like a real setting.                                                                 | Identifying requirements and needs for business equipment      |
| S30,<br><a href="http://grise.upm.es/sites/extras/1/S30.php">http://grise.upm.es/sites/extras/1/S30.php</a> | Freeman <sup>37</sup>             | 2004 | Software engineering  | Randomized parallel trial | 24 senior-level undergraduate IS students                                       | 24 senior-level undergraduate non-IS students | Real settings. Questioners received 25 minutes of training before the experiment.                      | Unknown                                                        |

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