Survey on Assurance Case Development and Requirements Engineering

Instrument

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Abstract.

This supplemental material presents the detailed questionnaire used to collect responses from the participants.

1. Introduction

This supplementary material presents the full instrument used in the survey. In Table 1 we indicated the questions reused from other studies.

Study	**Questions reused**
[1]	1, 2, 3, 6
[2]	7

[1] de la Vara, J. L., Borg, M., Wnuk, K., & Moonen, L. (2016). An Industrial Survey of Safety Evidence Change Impact Analysis Practice. IEEE Transactions on Software Engineering, 42(12), 1095–1117. https://doi.org/10.1109/TSE.2016.2553032

[2] Fernández, D. M., Wagner, S., Kalinowski, M., Felderer, M., Mafra, P., Vetrò, A., … Wieringa, R. (2017). Naming the pain in requirements engineering. Empirical Software Engineering, 22(5), 2298–2338. https://doi.org/10.1007/s10664-016-9451-7

A. Instrument

Group 1 – Professional Profile

1. How did you find this survey?

- Post on LinkedIn
- Invitation via LinkedIn
- Post on a mailing list
- Invitation via Email
- Post of Research Gate
- Invitation via Research Gate
- Other - please specify:

2. How long have you been working on development of safety-critical systems?

- Less than 1 year
- 1 to 2 years
- 3 to 5 years
- 6 to 10 years
- More than 10 years

3. What is your current main role in the organization?

- [open text]

4. How many projects that involved Assurance Cases for safety-critical systems have you participated in?

- Less than 5 projects
- 5 to 10 projects
- More than 10 projects

5. In which country(ies) have you principally worked upon Assurance Case or Requirements Engineering for safety-critical systems??

- [open text]

6. What is the main role of the organization for which you have worked regarding the development of safety-critical systems?

- Certification authority
- Component supplier
- Consultant
- Developer/manufacturer of final systems
- Development tool vendor
- Independent safety assessor
- Regulation authority
- Research institution
- System user
- Other - please specify:

Group 2 – Requirements Engineering Practices

Please answer the questions below taking into account your experience in the past 5 years.

7. Which are the requirements documentation techniques used?

- Activity diagrams
- Business process models

- Class diagrams
- Goal models
- Natural language / plain text
- Prototypes/User screens
- Requirements diagrams
- Sequence diagrams
- Sketches
- State machines
- Structured lists of requirements
- Use case diagrams
- Use cases
- User stories
- Other: please specify

8. Which kind(s) of requirements tools are used?

- A purpose-specific tool for requirements management (e.g. DOORS)
- A diagramming tool for requirements (e.g. Enterprise Architect)
- Application Lifecycle Management or Issue Tracking System (e.g. Jira)
- Spreadsheets or documents (e.g. Word/Excel)
- Content Management Systems (e.g. Confluence)
- Other: [please specify]

9. Considering the management of traceability among requirements and safety analysis information, which of the following scenarios best describes the **most used practice** in your projects?

- A matrix or tool is used to manage only the trace links.
- A tool is used to manage both artifacts and trace links.
- Trace links are stated inside the requirements and safety analysis artifacts.
- Trace links are maintained directly in the certification documents (including assurance cases).
- Trace links are only recovered to produce final documentation.
- Other:

10. Considering the most used traceability scenario indicated in the previous question, please indicate the tool(s) used to support it.

- [open text]

Group 3 – Assurance Case Development Practices

Please answer the questions below taking into account your experience in the past 5 years.

11. Is the development of assurance cases a mandatory, recommended or optional activity?

- Mandatory by regulations
- Mandatory by my organization policy/process
- Recommended by regulations
- Recommended by my organization policy/process
- Optionally performed by the project team
- Don't know

12. How often have you been involved in these following Assurance Case Development activities?

- Construction
- Review
- Assessment
- Rebuttal
- Approval

For each activity, the options are: Every project, Most of the projects, Some projects, Few projects, Never have been involved.

13. Which of the following statements apply to how Assurance Cases (ACs) are developed in your projects?

- ACs are constructed pre-development
- ACs are reviewed pre-development
- ACs are constructed during development in a parallel process/lifecycle
- ACs are reviewed during development in a parallel process/lifecycle
- ACs are constructed incrementally according to project iterations/sprints/milestones
- ACs are reviewed incrementally according to project iterations/sprints/milestones
- ACs are only constructed post-development
- Other practice: [open text].

14. We refer to **Assurance Argument** as the structured argument explaining how items of evidence supports the main goals/claims of the assurance case. Which is the main notation used to construct the **Assurance Arguments**?

- ARM
- ASCAD
- Bowtie
- CAE
- Claims table
- EUROCONTROL
- GSN
- KAOS
- MDD (MultiMarkdown doc.)
- Narrative
- SACM
- Tabular
- TRUST-IT Argument Representation
- WeFA
- Structured textual
- Textual (plain text)
- Other: specify

15. Which is the most used tool to specify the assurance cases?

- General purpose diagramming tool (e.g. Visio, Lucidchart)
- Word processor (e.g. MS Word, Google Docs)
- ACBuilder
- ACCESS
- ACEdit
- AdvoCATE
- AGSN
- ASCE
- Assure-It
- Astah GSN

- Artisan GSN modeler
- AutoFOCUS3
- CertWare
- D-Case Communicator
- D-Case Editor
- D-Case Weaver
- D-MILS
- Eclipse & Papyrus Extension
- eDependabilityCase
- ENTRUST
- eSafetyCase Toolkit
- ETB (Evidential Tool Bus)
- Event-B extension
- EviCA
- GAGE
- HiP-HOPS extension
- ISCaDE
- MMINT-A
- Modus
- NOR-STA
- OpenCERT
- Resolute
- SafeEd
- Safety.Lab
- SAM
- SCT: Safety Case Toolkit
- SBVR/GSN Editor
- TurboAC
- Other: specify

16. We refer to **Assurance Case Report** as the documented account of the assurance case. Which of the following scenarios best describe how **Assurance Case Reports** are organized considering only one system to be certified:

- One assurance case report containing only one comprehensive assurance argument.
- One assurance case report containing multiple assurance arguments.
- Multiple assurance case reports, each containing only one assurance argument each.
- Multiple assurance case reports, each containing more than one assurance arguments.
- Other: [please specify]

17. Is there any kind of automation in the creation or maintenance of Assurance Arguments and Reports? If so, please provide a brief explanation. If not, leave this question empty.

- [open text]

Group 4 – Integrated Development Practices

Please answer the questions below taking into account your experience in the past 5 years.

18. How often are Assurance Cases consulted during Requirements Engineering activities?

- Elicitation
- Analysis and negotiation
- Specification
- Customer/stakeholder validation
- Change request analysis

For each activity, the options are: Always, Very Often, Sometimes, Rarely, Never, Don't know.

19. How often does your team consider the safety assurance (i.e., how a system safety will be demonstrated) when performing Requirements Engineering activities?

- Always
- Very Often

- Sometimes
- Rarely
- Never
- Don't know

20. Which of the following collaborations between requirements and safety specialists occurs and in which frequency?

- Requirements engineers participate in assurance case development activities.
- Requirements engineers participate in other safety analysis activities.
- Requirements engineers review safety engineering results/artifacts.
- Safety engineers participate in requirements engineering activities.
- Safety engineers review requirements engineering results/artifacts.

For each collaboration scenario, the options are: Don't know, Never, Few projects, Some projects, Most of the projects, Every project.

Group 5 – Personal Opinion on Integration

21. What are the benefits of **Requirements Engineers participation** in assurance case development or safety analysis development activities?

(This question appeared only for those who selected "Few projects" or above in any of the sub-questions 23.1, 23.2 and 23.3)

- [open text]

22. What are the benefits of **Safety Engineers participation** in requirements engineering activities?

(This question appeared only for those who selected "Few projects" or above in any of the sub-questions 23.4 and 23.5)

- [open text]

23. How much do you agree with the development of Assurance Cases during Requirements Engineering activities?

- Strongly agree
- Agree
- Undecided
- Disagree
- Strongly disagree

24. To what extent do you believe the development of Assurance Cases during Requirements Engineering activities could mitigate the following problems in SCS development?

- Late rework due to impossibility to build a compelling assurance case.
- Poor quality (incompleteness or inconsistency) of assurance cases.
- Loss of requirements and design rationale.
- Late discovery of safety requirements or constraints.
- Lack of integration between safety engineering and software development.

For each problem, the options are: To A Great Extent, Somewhat, Very Little, Not At All, Undecided.

25. In your opinion, in which Requirements Engineering activities do you think the development or sketching of Assurance Cases could be combined with? Mark all that apply. You may provide an explanation in the open text field.

- Elicitation [open text]
- Analysis and negotiation [open text]
- Specification [open text]
- Customer/stakeholder validation [open text]
- Change request analysis [open text]

For each option, participants could check or leave it blank. If checked, an optional text field is available for explanation.