

Guidance document for performing quick and robust expert knowledge elicitation

Deliverable from the CoVetLab project:

“Expert Knowledge Elicitation: Development of a quick and robust method
for assessing data gaps in risk assessment”

Background

Expert knowledge elicitation (EKE) is a method used to fill knowledge gaps in fields where data are scarce but still needed as input for risk assessment. The European Food Safety Authority (EFSA) defines EKE as “a systematic, documented and reviewable process to retrieve expert judgements from a group of experts (expert panel) in the form of a probability distribution” (EFSA, 2014). For the sake of this guidance document, we would like to expand the definition also to qualitative estimates and define elicitation as “drawing information from one or more experts in a systematic and documented way”.

Performing a formal EKE based on EFSA's guidelines (EFSA, 2014) is a detailed and stringent process. The key feature of this method is that it provides rigid and transparent parameter estimates, which can be used in quantitative and semi-quantitative risk assessments. For the sake of transparency and robustness, the described method is a time-consuming exercise that also requires extensive training to conduct. In many situations, this is not feasible due to time and/or resource constraints, despite the need to conduct EKE-based risk assessments within a short timeframe, for example in outbreak situations. In such situations, time available for a risk assessment is measured in hours/days rather than weeks/months. In research-focussed assessments, there is often insufficient budget to support a full EKE of all parameters. It can also be the case that the experts themselves are too busy to fully engage in a lengthy process. In addition, the complexity of the method can have an adverse effect on the expert's self-perception of their own ability to complete the task.

In practice, a number of *ad hoc* EKE approaches that do not align with formal guidelines have been used to fill in the data gaps in a timely manner, including within the institutions of our consortium. Therefore, a need for a more practical, rapid and robust ('light') EKE method has been identified by our consortium. Such a method could be used to provide a transparent behavioural aggregation of expert knowledge in the event of sparse data, time constraints, and limited availability of experts in the required field. The need for training of those leading the EKE should be minimal, without compromising the robustness and transparency of the expert estimates.

In this guidance document, we present an approach that we consider beneficial for ensuring robust expert input and we outline a framework for selecting an appropriate EKE approach based on the practical context in which the EKE is needed.

Steps of an expert knowledge elicitation

The EFSA process for deciding on and performing an EKE is visualized in Figure 1. This guidance document describes the steps of an EKE, after having decided that it is needed, from the pre-elicitation phase and forward and will give some recommendations on how to make an EKE 'light' (that is: for practical use in the present circumstances). The description of the EKE steps below is based on steps identified in EFSA's guidelines and in published papers, mainly Butler et al, 2015.

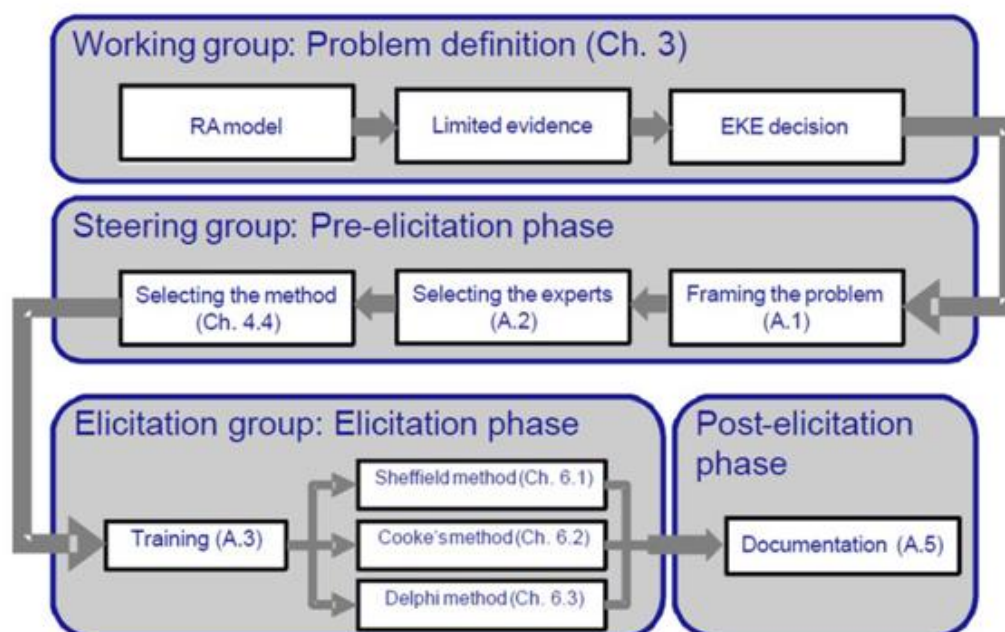


Figure 1: The EFSA process for deciding on and performing an expert knowledge elicitation (EFSA, 2014).

Steps within an EKE, as identified for this document:

1. Ask yourself if an EKE is needed
2. Framing the question(s)
 - 2a. Rephrase the question with experts
 - 2b. Pilot questions
3. Recruit expert
4. Method selection
 - 4a. Calculation methods for analysis of results
5. Pre-elicitation material
6. Elicitation material
7. Setup of the elicitation / Elicitation rounds
8. Analysis of results
9. Reporting

Some steps should always be carried out, regardless of the EKE method that is selected. Some steps can be left out.

All steps will be briefly described below. Different scenarios in which a light EKE may be needed have also been identified and are described alongside suggested minimum requirement for each scenario and step, as well as guidance on the choice of method.

1. Ask yourself if an EKE is needed

We assume the readers of this guidance document already have thought about this. The EFSA guidelines for EKE gives a detailed description of reasons to perform an EKE.

2. Framing questions

Careful thought should be given to which information is needed from the experts in the EKE and how the questions should be framed to get a valid and useful answer. Using natural frequencies or percentages when formulating estimates requires little understanding of the underlying uncertainty and probability theory among experts answering the questions. Confidence intervals around these estimates are a good way to characterise experts' certainty in their estimates.

When needed, qualitative categories (e.g., negligible–very high) with descriptions could be offered. Main questions could be refined into sub-questions.

Ensure that questions can be understood regardless of expertise level. This can be further developed by testing the questions on experts (others than those recruited for the EKE, step 2a) or by piloting the questions among colleagues (step 2b) to ensure there are no ambiguities.

3. Recruit experts

Recruit a diverse, task-relevant panel of experts (not necessarily with prior EKE experience). Small, manageable groups are preferred to large expert groups. Use known expert pools, if available, for speed and engagement. Snowball recruitment could be used (a recruited expert is asked to recruit another expert and so on until the desired number of experts is recruited).

Recruiting experts can preferably be done in parallel to the other pre-elicitation steps to speed up the process.

The number of experts needed (or that can be recruited) depends on:

1. Your own time and budget
2. Availability of experts before the deadline
3. Availability of experts: number of hours to spend on the elicitation
4. Availability of experts: at one/more selected dates/time for a physical/online meeting
5. Method for elicitation (step 4)
6. Level of expertise/quality of experts

4. Method selection

The “method” is the technical way to get your answers. This could be one of the methods in the EFSA guidelines: Sheffield method, Cooke’s method, Delphi method, or an adapted version of these methods. Or any other method that has been described or of your own design (for example conjoint analysis or other methods to prioritize factors/parameters).

Method selection depends on:

1. Type of answer/result that you need (qualitative/quantitative, point estimate/distribution, etc)
2. Available budget/hours (experts and elicitors)
3. The deadline (when results of the EKE is needed)
4. Type of experts (used to EKE and/or probabilities or not)
5. Availability of (simple) software to analyse results
6. If weighing of experts is going to be used (This means asking experts for their specific area of expertise and/or using seed questions, with the aim to give the answers of the expert that performs best more weight.)
7. If the EKE includes asking for uncertainty
8. If the EKE will include asking experts for reasoning for their answers

When selecting a method, the method for calculation of the results should also be considered and decided on. It saves time if an easy-to-use tool or calculation method is already available for the selected method.

5. Pre-elicitation material

Pre-elicitation material is information sent to the experts ahead of the EKE to prepare them for the task. The pre-elicitation material could include aim, questions to be answered, background information on the subject and facts that are known that might be helpful in estimating answers in the coming EKE. Provide concise materials: objectives, key definitions, instructions, and examples. Adapt the material to the audience and method. Include visual aids, such as diagrams and visually attractive summary tables of the main data required for the EKE and to standardize main concepts. Embed materials into tools (e.g., questionnaires) if possible.

6. Elicitation material

The type of elicitation material to prepare depends on the selected method, but it could for example consist of:

- A document with questions
- A digital table to fill in
- An online survey (Google forms, Jotform, many others.....)
- Any other (online) tool

7. Set-up of the elicitation/elicitation rounds

Based on the selected method, time frame and availability of experts, decide on:

1. Number of rounds
2. Aim of each round (explanation, elicitation, discussion, adjust individual estimates, come to consensus)
3. How is each round going to be carried out? (Via email, online survey, online meeting, live meeting/workshop, hybrid meeting, one on one interview)

Use at least one round with optional additional rounds. Facilitation by an experienced moderator is ideal. Adaptive rounds may reduce burden and clarify disagreements. Allow experts to revise answers after feedback from elicitors if this is part of the elicitation method chosen.

8. Analysis of results

Development of a calculation model or other method for analysing results could be needed if no software is available or when analysis is so simple that a software solution is not necessary

If an expert assessment (objective and/or self-assessment) has been performed, inputs in the analysis could be weighted based on expertise. Automated outputs and figures could be used where possible to ensure standardized outputs.

A format for collecting results and/or calculation tool (in R/Excel/other) can be built while the elicitation phase is carried out and after the questions are rephrased (might not be possible for the short deadline scenario). For some methods, tools are already available.

9. Reporting

The report from an EKE could vary from a simple half page report to an extensive report of hundreds of pages with all kinds of appendices depending on the question, the situation, the method and time available. The report should be transparent concerning the design including the strengths and weaknesses of the EKE. In general, the lighter the method, the smaller the resulting report will be.

Guidance for performing an appropriate “light” expert knowledge elicitation

Based on prior experiences in the consortium and experiences from the case study performed within the project, different scenarios when a light EKE might be needed were identified.

The identified scenarios are:

- Very short deadline (<1 week)
- Limited budget – no deadline
- Limited budget and fairly short deadline (< 1 month)
- Few experts
- Limited knowledge on the subject in the research/elicitation team.

Table 1 gives an overview of these scenarios, and the steps required for each scenario.

Based on these scenarios, a guide with the aim of helping individuals or groups to design a feasible EKE approach given these identified scenarios has been developed and is presented in Appendix 1. This guide provides suggested minimum requirement for each scenario and step, along with guidance on method selection.

In summary, when **time is a constraint**, the aim would be to reduce scope and effort: to use fewer experts ($\approx 2-3$), to limit to one elicitation round, to skip non-essential steps, and to use minimal/prepared materials. When **budget is a constraint**, it is worth investing in expert quality, prioritizing recruiting strong experts over complex methods and to keep methods and materials simple to save resources. When **few experts are available**, heavy quantitative methods should be avoided. Instead, use adapted or qualitative approaches; focus on discussion, rationale, and consensus rather than formal statistical elicitation. Lastly, when **low subject-matter knowledge**, engage experts early (especially for framing questions), validate assumptions, and include iterative discussion/refinement to ensure correct interpretation.

Step	Description of step	Scenario				
		Short deadline (< 1 week)	Limited budget (no deadline)	Limited budget (short deadline)	Few experts (< 3)	Limited knowledge on the subject
1	Ask yourself: is an EKE needed?	✓	✓	✓	✓	✓ (only if 2nd round possible)
2	Framing question(s)	✓ (focus urgent questions)	✓	✓ (focus urgent questions)	✓ (critical)	✓ (validate with experts)
2a	Rephrase question with experts	X	✓ (recommended)	X	✓ (recommended)	✓ (critical)
2b	Pilot questions	✓ (colleague)	✓ (expert/colleague)	✓ (colleague)	✓ (expert from similar field)	✓ (expert)
3	Recruit experts	min 2-3	4-8 high quality	4-8 high quality w/i 2 weeks	Use all available include different field or countries	4-8 consult early
4	Method selection	adapted Sheffield and Cooke include uncertainty estimates include weighting of experts	omit seed questions for Cooke adaptation two rounds if Delphi adaptation include uncertainty include expert weighting	omit seed questions for Cooke adaptation two rounds if Delphi adaptation include uncertainty include expert weighting	one meeting with discussions qualitative preferred	familiar method Cooke is discouraged
4a	Calculation method for analysis of results	✓	✓	✓	✓	✓
5	Pre-elicitation material	brief background + EKE objective	additional background + EKE objective	additional background + EKE objective	additional background+ EKE objective ensure common baseline	additional background+ EKE objective ensure common baseline b/w expert and elicitor extensive literature review advised
6	Elicitation material	✓ (simple)	✓ (simple)	✓ (simple)	✓ (fit for purpose)	✓ (more effort ok)
7	Setup of the elicitation ('performance')	1 round online meeting online questionnaire	1-2 rounds 1 physical meeting if possible online questionnaire	min 1 round (2 if possible) online meeting online questionnaire	2+ rounds 1 physical meeting if possible	2+ rounds discussion essential physical meeting preferred
8	Analysis of results	pre-formatted input	bespoke analysis pre-formatted input	pre-formatted input	bespoke analysis pre-formatted input	pre-formatted input
9	Reporting	brief description of steps and results one page suggested	brief description of steps and results one page suggested full report if possible	brief description of steps and results one page suggested full report discouraged	brief description of steps and results one page suggested full report if possible	brief description of steps and results one page suggested full report if possible include detailed information provided by experts

Table 1: Description of EKE steps, light approaches, and the scenarios in which they are most appropriate.

References

- EFSA, 2014. Guidance on expert knowledge elicitation in food and feed safety risk assessment. EFSA Journal 2014; 12(6):3734
- Hemming V, Burgman MA, Hanea AM, McBride MF, Wintle BC. A practical guide to structured expert elicitation using the IDEA protocol. *Methods Ecol Evol.* 2018;9:169–180. doi.org/10.1111/2041-210X.12857
- Adamchick J, Pérez Aguirreburualde MS, Perez AM, O'Brien MK. One Coin, Two Sides: Eliciting Expert Knowledge From Training Participants in a Capacity-Building Program for Veterinary Professionals. *Front Vet Sci.* 2021 Oct 25;8:729159. doi: 10.3389/fvets.2021.729159. PMID: 34760954; PMCID: PMC8573137.
- Hadjigeorgiou E, Clark B, Simpson E, Coles D, Comber R, Fischer ARH, Meijer N, Marvin HJP, Frewer LJ. A systematic review into expert knowledge elicitation methods for emerging food and feed risk identification. *Food Control* 2022; 136:108848.
- M.G. Morgan, Use (and abuse) of expert elicitation in support of decision making for public policy, *Proc. Natl. Acad. Sci. U.S.A.* 111 (20) 7176-7184, doi.org/10.1073/pnas.1319946111 (2014).
- Butler AJ, Thomas MK, Pintar KD. Systematic review of expert elicitation methods as a tool for source attribution of enteric illness. *Foodborne Pathog Dis.* 2015 May;12(5):367-82. doi: 10.1089/fpd.2014.1844. Epub 2015 Mar 31. PMID: 25826450.
- Van der Fels-Klerx IH, Goossens LH, Saatkamp HW, Horst SH. Elicitation of quantitative data from a heterogeneous expert panel: formal process and application in animal health. *Risk Anal.* 2002 Feb;22(1):67-81. doi: 10.1111/0272-4332.t01-1-00007. PMID: 12017363.
- O'Hagan, A. (2019). Expert Knowledge Elicitation: Subjective but Scientific. *The American Statistician*, 73(sup1), 69–81. doi.org/10.1080/00031305.2018.1518265
- Yamada K, Elith J, McCarthy M, Zenger A. Eliciting and integrating expert knowledge for wildlife habitat modelling. *Ecological Modelling* 2003; 165:2-3. doi.org/10.1016/S0304-3800(03)00077-2,
- Colson AR, Cooke RM, 2018. Expert elicitation: using the classical model to validate experts' judgments. *Review of Environmental Economics and Policy* 2018; 12(1):113–132. doi.org/101093/reep/rex022

Appendix 1: Suggestions on minimum requirements of steps to design a feasible EKE approach given some identified scenarios

Step	Description of step	Limited budget (no deadline)	Limited budget (short deadline < 1 month)	Few experts (max 3)	Research team has limited knowledge on the subject
1	Ask yourself: is an EKE needed?	Include	Include	Include	Include (and only do an EKE if the experts can be involved in the 2nd round; see step 7). If not, EKE is not the best approach.
2	Framing question(s)	Include (spend time on question framing to avoid that experts do not provide a useful/valid answer)	Include (spend time on question framing to avoid that experts do not provide a useful/valid answer); limit question(s) to the most urgent questions	Include (spend time on question framing to avoid that experts do not provide a useful/valid answer); if question is not interpreted correctly, the impact of outliers will be more severe	Include (spend time on question framing to avoid that experts do not provide a useful/valid answer); reach out to some experts in the field to ensure the problem definition and questions are in alignment with the topic/current knowledge (see also 2a)
2a	Rephrase question with experts	Consider to ensure questions can be answered by the experts	Omit	Consider to ensure questions can be answered by the experts	Required to ensure questions can be answered by the experts
2b	Pilot questions	Include; if sufficient experts available consider to ask a single expert rather than a direct colleague. Please note that this expert can not be included in the final EKE.	Include, as a sanity check with a direct colleague as a minimum	Include (but no option to include direct experts; might consider an expert in a slightly different field)	In this scenario, the experts are needed for question framing. It is preferred to do some pilot questioning, but direct colleagues are not the right pilot persons in this scenario. If sufficient experts available consider to ask a single expert rather than a direct colleague. Please note that this expert can not be included in the final EKE. If not enough experts available, then this step should be omitted.
3	Recruit experts	Spend sufficient time/effort on finding experts and try to include high quality experts; preferably 4-8 experts	Spend sufficient time/effort on finding experts and try to include high quality experts; preferably 4-8 experts. However, compromise on number and/or quality after a 2-week period if not sufficient experts found yet	Spend sufficient time/effort on finding experts and try to include high quality experts. Try to reach all experts you know and ask them if they know other experts that could be of help. However, compromise on number and/or quality if no more experts can be identified. Consider to include experts from different geographical regions or that are experts in a slightly different field (e.g. similar disease).	Spend sufficient time/effort on finding experts and try to include high quality experts; preferably 4-8 experts. A short meeting/interview with the first identified expert(s) might be useful for question framing and identifying additional experts.
4	Method selection	Full Sheffield not feasible. Consider to omit seed questions for Cooke if this requires a lot of efforts. If Delphi, maximize to two rounds. Type of information elicited: quantitative estimates, inclusion of uncertainty intervals, ranking, etc. Dependent on question/objective and experts selected, uncertainty can be asked for. Weighting of experts also possible.	Full Sheffield not feasible. Consider to omit seed questions for Cooke. If Delphi, maximize to two rounds. Type of information elicited: quantitative estimates, inclusion of uncertainty intervals, ranking, etc. Dependent on question/objective and experts selected, uncertainty can be asked for. Weighting of experts also possible.	If 2 or 3 experts available: a quantitative method is discouraged. A "light adapted method" can be done. Minimum of one meeting (dependent on experts' availability/location online or physical) in which results are discussed, rationales given and/or consensus reached; individual estimates can be asked during this meeting or in a 1st round via email/survey. Weighing experts only if real difference in expertise identified. If only 1 expert identified, an in-depth interview can be held; consider to have more researchers in the meeting to ensure correct interpretation of expert's knowledge.	Select a method that you are familiar with, and that fits the project's objective. Cooke's method might not be preferable, because the difficulty of preparing seed questions on a subject you don't have enough knowledge on yourself
4a	Calculation method for analysis of results	Include (fit for purpose for selected method)	Include (fit for purpose for selected method)	Include (fit for purpose for selected method)	Include (fit for purpose for selected method)

Step	Description of step	Limited budget (no deadline)	Limited budget (short deadline < 1 month)	Few experts (max 3)	Research team has limited knowledge on the subject
5	Pre-elicitation material	Minimum requirement: background and objective of elicitation. Depending on time/budget of researcher and question, some background information can be prepared and provided. This might also be made dependent on the question, especially if the experts are expected not to have all the same background knowledge level	Minimum requirement: background and objective of elicitation. Depending on time/budget of researcher and question, some background information can be prepared and provided, considering also limited time of expert to prepare him/herself. This might also be made dependent on the question, especially if the experts are expected not to have all the same background knowledge level	Minimum requirement: background and objective of elicitation. If experts were sourced from different geographical regions or slightly different fields, some background information is also essential to ensure that all experts start with the same background knowledge level	Minimum requirement: background and objective of elicitation. Ensure to provide the minimal information required to bridge the knowledge gap between the elicitor and the expert. If the expert is from a different field/area, he/she might have limited knowledge of the research topic in which his/her estimates will be used. If time and budget permits, it is recommended to perform an extensive literature review.
6	Elicitation material	Include (fit for purpose for selected method); keep it as "simple" as possible (don't spend much time/budget on development of a fancy survey etc)	Include (fit for purpose for selected method); keep it simple (don't spend much time/budget on development of a fancy survey etc)	Include (fit for purpose for selected method). Can be more fancy/extensive as no limit on budget/time, but it is not efficient to spend much time and money on it when there are only a few experts.	Include (fit for purpose; if needed, more time can be spent on development, especially with many experts)
7	Setup of the elicitation ('performance')/elicitation rounds	Minimum is a single round for explanation and elicitation. However, a second round for refinement (rationale of estimates; discussion; adjustment of individual estimates, consensus) can be considered. Maximum one physical meeting depending on method selected and availability of experts. Consider to have the questionnaire/survey filled out by the experts in own time.	Single round for explanation and elicitation. If time permits, a second meeting for refinement (rationale of estimates; discussion; adjustment of individual estimates, consensus) can be considered. No physical meeting, but online meeting, questionnaire/survey in own time or one-to-one interviews.	More rounds is possible, depending on the selected method, but it might not be a necessity if explanation, elicitation and refinement (rationale of estimates; discussion; adjustment of individual estimates, consensus) can be reached in a single round. It might be more easy to pick a date for a physical meeting, because there are not so many experts, and the deadline is not soon. However, this is highly dependent on the experts' location (national or international).	Number of rounds depending on selected methods. Minimum is two rounds: 1st round for explanation and elicitation and a 2nd round for refinement (rationale of estimates; discussion; adjustment of individual estimates, consensus). The discussion with experts on their reasoning is essential here to ensure correct understanding of results. Physical meetings are preferred.
8	Analysis of results	Include; based on 4, 4a and 7.	Include; based on 4, 4a and 7. Suggested to	Include; based on 4, 4a and 7. Suggested to use a	Include; based on 4, 4a and 7. Suggested to use a
9	Reporting	Include; minimum description of each step and results (can vary between < 1 page and a full report)	Include; minimum description of each step and results (can vary between < 1 page and a full report; however a full report not realistic here)	Include; minimum description of each step and results (can vary between < 1 page and a full report). In this scenario there is no limitations with respect to deadline or budget, so reporting can be more extensive also depending on objective of the project and agreement with client	Include; minimum description of each step and results and a detailed description of the additional information on the subject as provided by the experts.