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Interactive comment on "Vulnerability of bridges to scour: insights from an international expert elicitation workshop" *by* Rob Lamb et al.

Anonymous Referee #1

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GENERAL COMMENTS

The manuscript prepared by Rob Lamb, Willy Aspinall, Henry Odbert and Thorsten Wagener, provides the context and the outcomes of an elicitation workshop held in London in 2015 with international experts on bridge scour risk assessment. Scour of bridge piers or abutments during severe flood events may lead to infrastructure failure, from lower safety levels to dramatic collapse. Inherently uncertain, scour risk is difficult to quantify from available data, especially for risk analyses where a network of numerous assets is considered. The authors of the manuscript claim that expert knowledge and judgement represent a valuable source of data. With this expert elicitation process, they intend to lay the ground for the development of fragility functions that may be applied for broad scale network risk analysis. During the workshop, the experts were asked to (1) rank the vulnerability factors that should be considered in assessing risk

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of scour, and (2) quantify the failure probabilities of bridge due to scour under a number of loading conditions, with associated uncertainties. The answers were analysed based on a variant of the survey method of paired comparison for (1), and a structured expert judgement procedure for (2). To the authors' knowledge, the formal process of elicitation undertaken is unique in the field of scour risk. The results of the workshop are scrutinised, compared to industry guidance, and the methodology evaluated.

This manuscript provides an interesting approach to inform risk of scour, made possible thanks to a collective endeavour of international experts, and appear to be based on a sound methodology. Overall, it is well written and the results are nicely detailed, nevertheless, minor revisions are necessary to make a few points clearer.

SPECIFIC COMMENTS

The study presented by the authors is based on a formal process of elicitation whose techniques are described in the section 4 'The role of expert elicitation'. However, they are too briefly described and do not allow the reader to fully understand the following section 5 where the results are analysed. In particular, the manuscript would benefit from a more detailed presentation of the Classical Model used to tackle the second question raised in the study. In the section 1, the methods applied to weight information in the group of experts are succinctly mentioned. As these methods were used throughout all the process of elicitation and appear in most of the results and figures, they should be mentioned in the section 4 and further detailed.

In the section 3, it is stated that the first question investigated in the study was "What variables should be chosen to describe the loading conditions relevant to scour risk?". In the section 5.1 'Question (1): Vulnerability factors that should be considered in assessing risk of scour', the first question asked to the expert appeared to be "What are the most important factors that should be considered in assessing scour risk to bridges?". These three different expressions of what was the first question addressed in the study are confusing for the reader. Using the same terminology and defining

which from either the loading conditions and/or vulnerability factors were screened should help to make the aim of the study clearer.

The details of the questions asked to the experts are actually all presented in the section 5, which is the section of the results. This section is thus easy to read, each question is stated in the relevant sub-section and the results directly analysed. However, it makes the methodology and its overall objectives more difficult to understand for the reader. For instance, the question asked and presented in the section 5.2.5 about the triggers for asset inspection almost comes as a surprise, which should not be the case there. Thus, all the questions asked to the experts could be listed in one of the first sections, and their objectives made clearer.

The three above specific comments raise issues regarding the methodological presentation of the study. The manuscript could be improved in providing a clearer, more structured and outlined, description of the methodology. It would help to highlight the fact that the process of elicitation undertaken by the group of international experts is formal and objective, which is a strength of the study. Potentially, the section 4 could be renamed 'Methodology' and adapted accordingly.

The number of experts who contributed to the workshop is not provided in the manuscript. It could be relevant as statistical methods are applied to infer global results from their answers.

It is highly appreciated that the authors mentioned and reported the discussions that took place during and after the elicitation process.

As written in the first few lines of the manuscript, with this study the ultimate goal of the authors is to "inform the development of fragility functions that may be applied within a broad scale risk modelling framework". From the conclusion, it is not clear how in practice the results from the elicitation workshop could be used in order to achieve this goal, or what future work would be required.

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TECHNICAL CORRECTIONS

Page 3, line 28: Replace “sour” with “scour”

Page 5, line 9: Aren’t there any references available for the hazard-vulnerability-loss concepts?

Page 6, line 2: Replace “form” with “from”

Page 6, lines 7-8: Replace “(see, for example Decò and Frangopol 2011)” with “(see, for example, Decò and Frangopol, 2011)

From page 8, line 29, to page 9, line 2: In this paragraph, the intensity indicators flood flow, flood velocity and flood return period are compared, but, the outcome of this comparison is difficult to understand. Besides, I’m curious about the ability of the eliciting method used in the study to deal with dependent or "intrinsically linked" factors, such as these three factors.

Page 10, line 3: Replace “to have to in mind” with “to have to bear in mind”?

Page 11, line 13: Aren’t the lower uncertainty bounds that vary largely?

Page 12, paragraph from line 4 to line 10: The last sentence of this paragraph is hard to understand.

Page 12, line 28: “flood rarity” could be replaced with “flood severity” for more consistent use of the terminology. If so, it could also be replaced in the title of the Figures 3 and 5.

From page 12, line 25, to page 13, line 4: Flood frequencies are expressed under the forms of probability, 1-in-XX AEP, return period and 1/XX AEP. Although they are all equivalent, for the reader it would be more comfortable to get all the flood frequencies detailed in this paragraph under the same form, such as the return period as shown in Table 5.

Author contribution and Acknowledgements: The full name of the authors should be written instead of their initials.

Figure 2: The font size of the labels is rather small and should be increased. Although the ellipses represent a nice graphical way to represent the 95% confidence bounds of the elicited parameters, I'm afraid that there are too many parameters plotted. The ellipses of only a few of them are visible, and not so clearly.

Figure 3: The graphical legend in the top left frame is definitely too small. Instead, the description of the values represented in the figure should be incorporated directly as text in the legend.

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