

## ***Interactive comment on “Systemic hazard analysis of offshore service operations” by Romanas Puisa et al.***

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The response to Reviewer 3 is attached as a pdf, and also pasted here.

Interactive comment on “Systemic hazard analysis of offshore service operations” by Romanas Puisa et al. Anonymous Referee #3 Received and published: 27 July 2020  
Major comments: 1. About the objective, as stated in abstract and line 60, the objective of the paper is 1) to bring awareness of hazards that may have not been captured in earlier assessments, and 2) allow for a preliminary comparison of various operational stages of SOV. The second objective is clearly addressed in the paper. However, the first one: capturing hazards that may have been overlooked by earlier assessments, the so-called earlier assessments are not specific enough in the paper. There is no way

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to judge whether those identified hazards were overlooked in earlier assessments. The only place that mentioned earlier assessments is part 2 related work. However, the review work does not seem to be complete or provide enough evidence that identified hazards in this work is more complete than others. My arguments are 1) defined scope of hazard analysis are different, therefore resulting different hazards identified, for example, both Presencia and Shafiee, Dong et al. focused on collision, Rokseth et al. focused on DP system. 2) The depths of hazard analysis are different. The definition of hazards is relative, for example, the occurrence of an event can be considered as an accident in one analysis however can be defined as a hazard in another analysis. We can always find root causes after root cause if we dive deeper. If the authors want to compare with earlier assessments, you need to compare with the assessment which considered the same system or scope of analysis. I suggest the authors delete “that may have not been captured in earlier assessments” from your objective. 1. Author’s response to the preceding paragraph

Indeed, the paper doesn’t provide an explicit, systematic comparison with the state of the art. And so is not claimed in the paper. Such a comparison is only possible if, as rightly pointed by the reviewer, there a hazard analysis conducted in similar settings to compare with. The authors have not come across such an analysis.

This and other comments by the reviewer, prompted us to revise the paper and introduce significant changes in to the objectives/scope as well.

2. System description. There is no description about the system to be analyzed in the work. To conduct hazard analysis by STPA, the first step is to define system. However, the author did not clearly specify the system boundaries and components included, even though the authors described the different phases of operation in 4.1.

2. Author’s response to the preceding paragraph

We agree with the comment concerning the insufficient of system description in terms of boundaries and components. The revised version will have more detail on this.

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However, the paper will be limited to a high-level description, given that hazardous scenarios are outwith this paper. We also limit the description to one of the operational phases only.

In Figure 3, shore station is included, however the control loops between shore station and SOV, and shore station and turbine are not part of your analysis. This is fine. It could be better to mark that shore station is not within your defined system scope.

3. Author's response to the preceding paragraph

Actually it was a part of the analysis. The analysis was under Hazard 3 in Table 4. We had scenarios of miscommunication between shore and SOV, leading to this hazard. We've added extra text for this hazard.

The authors did not specify what accident (unwanted losses) were considered in the analysis either. This is the very important part when applying STPA method. Using "For instance. . ." in Line 176 may not be enough to specify targeted accidents (Loss). Especially the authors wanted to focus on "to bring awareness of hazards that may have not been captured in earlier assessments". Without being specific, readers need to assume that your work covered all accidents and incidents, such as a heart attack of a personnel during operation. The example I gave here is bit too extreme but is within the definition of accident (unexpected and unwanted loss of life).

4. Author's response to the preceding paragraph

We agree. However, as the revised manuscript shows, this become irrelevant. The study focusing on hazards and their scenarios only. There is no ranking based on risk.

3. Comparison of different operational phases. There are several issues here. First, the authors chose median value for comparison without providing argument to support that the median value is a proper choice.

5. Author's response to the preceding paragraph

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The revised manuscript proposes a systemic indicator for this comparison. The median is not used anymore.

Second, the authors assumed that 1) all hazards are equally intolerable, and 2) number of hazardous scenarios present the occurrence probability. These two assumptions are not widely accepted. This is fine since the authors clearly stated that those are assumptions. However, the authors did not discuss the inaccuracy of the conclusion due to these assumptions.

6. Author's response to the preceding paragraph

The revised manuscript (thanks to the comments by this reviewer) has significant changes and does not refer to probabilities and provides a different interpretation of hazardous scenarios.

Third, obviously, there are other quantities that can be used for ranking as well. The ultimate objective is to compare different operation phases. If we median value, then the rank (high to low risk) is transit and maneuvering > Interface turbine via gangway > interface with daughter craft. If we use the total number of hazardous scenarios of each phase, then the rank (high to low risk) is Interface turbine via gangway (474 hazardous scenarios) > transit and maneuvering (452) > interface with daughter craft (344). However, if we use the total number of hazards of each phase, then the rank (high to low risk) is interface with daughter craft (11) > Interface turbine via gangway (8) > transit and maneuvering (4). Different quantities can provide different results, and I can make reasonable assumptions to support the rationality of all these quantities. Since ranking is a focus of the paper as stated in the objective, the authors need to provide enough supportive arguments for their choice and discuss other opposite possibilities as well.

7. Author's response to the preceding paragraph

This is a very good observations. This comment is the main cause for substantial

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changes the paper has undergone. We now use a different measure and provide a detailed rationale why it makes sense.

4. Limitations of the method. The authors did not specify the limitations of using STPA methods for hazard analysis. A method is not almighty, limitations of the method applied should be specified as well besides the biases and knowledge limitation from the analyzers.

8. Author's response to the preceding paragraph

References to other publications which address the STPA limitations will be added.

5. Language check is required. There are many misspellings in the paper, for example, "Specufic control actions" in Figure 4, Line 72 "Section 0".

9. Author's response to the preceding paragraph

The language will be checked and improved.

Minor comments: 1. Line 164-166, about the definition of incident and accident. 1) Even though the authors referred Rausand's differentiation between incidents and accidents, this differentiation is not used anywhere in the paper at all. From my point of view, authors focused on possible accidents. However, incident is the term showed up in many places in the paper which actually means accidents (if I understand it correctly). 2) If the authors defined incident as a materialized hazard with insignificant consequences, how can accident be incidents with significant consequences? I suggest the authors either delete this differentiation or be more precise when using these two terms if such a differentiation is made in the paper. In addition, a thorough check of where accident and incident are used is necessary. 10. Author's response to the preceding paragraph

The used understanding is that depending on consequences of an untoward event, it is called a near-miss, incident or accident. Near-misses would not have consequences at all, incidents will have insignificant ones, whereas accidents will have significant

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consequences. The term incident is also used to refer all untoward events when consequences are assumed unknown, but this is indeed confusing and a stricter definition should be used. Corrections will be made.

2. Line 181, Line 269 Table 3, Line 282, Table 4. "3. SOV does not operate on DP class 2 or above" etc. Therefore, I do not think this can be considered as an operational hazard. Or at least, the way the authors phrased it does not seem right. DP failure sounds more like a hazard.

11. Author's response to the preceding paragraph DP class 2 or higher introduces redundancy against thruster and other component/sub-system failures. It is a safety procedure that has to be followed when the ship is engaged in safety critical tasks. Therefore, operating without redundancy on, represents a hazard. Text will be added to explain all this.

3. Line 208, Figure 4. The author did not explain why there are black box and white box in the figure. I think Figure 4 can be deleted. The information from Figure 4 is already covered by Figure 4. Figure 4 does not provide any new information from my point of view.

12. Author's response to the preceding paragraph

Figure 4 clarifies the input for the analysis, as indicated on Line 206. But it is indeed redundant and will be removed.

4. Line 293, Table 6. It is a bit strange that during transit and maneuvering phrase, there is no inadequacy in control actions & feedback and/or process model. A simple scenario can be the collision accident between installed turbine (if there are some other turbines which have been installed in the field) and vessel, or vessel and ice. A possible hazard is "the vessel does not keep a min safe distance to turbine or its blades. Possible hazardous scenario can be that the vessel stops too slowly (especially in manual navigation), turbine(blade) is not noticed etc. The same applies to that there

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is no inadequacy in handling external disturbances during interface with turbine via gangway and interface with daughter craft.

13. Author's response to the preceding paragraph

The hazard "the vessel does not keep a min safe distance to turbine or its blades" was assigned to the phase when the vessel is interfaced with the turbine. During transit and manoeuvring, other hazards were considered (Table 3) and amongst them, credible causal factors were not related to control and feedback channels. This clarification will be added into the text.

5. The second and third paragraph in the discussion part. Well, the appearance of these two paragraphs is a bit abrupt. In addition, it does not highlight the necessary/advantage of conducting such a hazard analysis as the authors did. The authors first argued that analyzed hazards should be already covered by existing safety rules or regulations, however it is not guaranteed those rules can be followed in practice. Well, this can be true that rules may not be followed in practice, therefore there is still residual risk during the operation. However, residual risk also exists after a hazard analysis (risk analysis) is conducted. Hazards are identified does not mean that hazards are eliminated. The authors also judged that some hazardous scenarios are not addressed by regulations for certain reasons. However, in my opinion, those reasons also apply to the hazard analysis that the author conducted. Rule/regulations are not perfect, so is your hazard analysis. If you want to compare the hazards you identified with those stated by rules/regulations, at least you should start with the same defined scope of analysis, the same type of accident (loss), the same hazards. I suggest that the authors rephrase these two paragraphs or can simply delete them.

14. Author's response to the preceding paragraph

The issues of imperfect analysis and comparison is correct. However, the paper doesn't attempt to provide comparisons with the rules or other analyses. As discussed in the earlier response, such comparison is indeed not possible because the input used for

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drafting the rules is unavailable for public use.

However, this becomes irrelevant in the revised paper, which has slightly different scope.

6. The first paragraph in the conclusion part. I already stated my argument in the first comment about the objective. There is not enough evidence showing that risk assessments are done piecemeal and potentially lacking completeness. . . . It may sound better if you simply say that no such risk assessment has been conducted in the industry (only if experts from industry told you so). The value of academic work is not to conduct a specific risk assessment, sure you cannot find such from published papers. Conducting hazard analysis/risk assessment is an industrial practice which do not necessary provide enough academia value.

15. Author's response to the preceding paragraph

Agreed, the academic value from a hazard analysis is limited, if any. The response #7 alludes to the academic value of this work. The text throughout the paper will be updated accordingly.

7. The detailed intermediate results and final results from the STPA can be added in the appendix. For example, the control diagrams, identified unsafe control actions.

16. Author's response to the preceding paragraph

We have reduced the amount of graphics and the paper itself. Other results than those published cannot be shared due to PR constraints.

Please also note the supplement to this comment:

<https://wes.copernicus.org/preprints/wes-2020-15/wes-2020-15-AC3-supplement.pdf>

Interactive comment on Wind Energ. Sci. Discuss., <https://doi.org/10.5194/wes-2020-15>, 2020.

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