

Thesis Changes Log

Name of Candidate: Sabah Farshad

PhD Program: Engineering Systems

Title of Thesis: Improving Collaborative Engineering Design and Learning through Feedback Systems in the Age of Digitalization and AI

Supervisor: Professor Clément Fortin

The thesis document includes the following changes in answer to the external review process.

I would like to express my sincere appreciation to the reviewers for their valuable comments, which have significantly contributed to enhancing the structure, content, clarity, and formatting of the thesis. The constructive feedback provided by the reviewers has been instrumental in refining the quality and presentation of the work. Thank you for your insightful input and guidance.

Below, you will find detailed responses to the comments and concerns raised by the jury members, which outline the steps taken to address and incorporate their feedback into the thesis.

Sabah Farshad

Reviewer 1 (Tatiana Podladchikova):

Comment 1: Abstract

- Summary of conclusions in the abstract would benefit from more precise indication of the problem statement, novelty, relevance, and positions advocated for defence.
- Conclusion (1) “Cloud-based collaboration platforms are becoming the dominate tool for collaborative design and learning” presents rather introductory phrase then a conclusion. If it is important as a conclusion, could you please sharpen this phrase indicating also implications of this conclusions for the field with respect to the research questions.
- Conclusion (3) “Unbalanced AE is a serious challenge in PBL” also represents rather an intro than a conclusion. First, it is not clear what does it mean “unbalanced”, second, if it is a challenge, how should it be taken into account with respect to the research questions.
- Conclusion (7) “ML techniques based on text-classification methods are able to predict AE in BPL team’s communication”. Is it possible to be more specific, providing also some accuracy characteristics of such predictions and probably lead times of predictions (if applicable).

Response: Thank you for the detailed comment. The abstract has been revised to more sharply convey the core research novelty, implications, and positions on improving collaborative engineering design and learning.

Comment 2: In content section, Chapter 5, there is latex typo

Response: The typo has been fixed.

Comment 3: Page 32, Chapter 7 should not be assigned to References, these are just references at the end of the manuscript.

Response: The title “Chapter 7” removed from Figure 1-5 (Thesis structure).

Comment 4: Figure numbering. Some figure numbers are given in format Figure 2-4, but some Figure 2.1. Please homogenize to for instance to Figure 2.1. as Figure 2-4 is confusing. If it is a composite figure of several panels, it still can have one number, but panels (a), (b) and so on.

Response: The Figures numbering issues have been fixed.

Comment 5: Chapter (3) with the thesis objectives goes after an extensive literature review. Would it be logically better to introduce the thesis objectives before the literature review, that it can be read with a clear formulation of thesis objectives?

Response: While I appreciate the suggestion, I believe that maintaining the conventional order ensures a logical flow of information for the audience as we briefly introduced the goals in the introduction. This sequence allows readers to first understand the existing research landscape before reading the methodology.

Comment 6: Please provide equation numbers at the right of the page, not immediately close to an equation.

Response: Equation numbers have been moved to the right page margin to improve formatting.

Comment 7: Chapter 5 Discussion, title “Improving understanding”. Could you please be more specific in the title, understanding of what?

Response: The section titles in Chapter 5 have been revised to be more descriptive.

Comment 8: Chapter 5, Overall View and limitations. Please either use all capital letters in the words or only the first word.

Response: The title updated to Overall view and limitations.

Comment 9: Conclusions section would also benefit from a more explicit indication of achievements and emphasis on novelty and implications of the results and outcomes for the field.

Response: The “Overall view” of Conclusions section has been updated to emphasis on novelty and implications of the results and outcomes for the field.

Reviewer 2 (Henni Ouerdane):

Comment: ... a concise recap of the “updated” research questions would have been welcome in the Conclusion.

Response: The conclusion chapter revised and now it provides a recap of the key research questions addressed through the iterative process and summaries the overall findings.

Comment: Same comment applies for the research hypotheses which could have been stated in the Introduction. In fact, at the top of page 86, a hypothesis is stated, but its formulation is vague: what is “valuable information”? How should one understand “valuable” here? Is it quantitative and/or qualitative? Is this the overarching hypothesis of the work? “hypothesis 2” is mentioned at the top of page 107 and later, page 117, we read three hypotheses listed and referred to hypothesis (1), hypothesis (2), etc. – while it is fairly clear that in page 107 it refers to the sentence written just before, such notation should not be introduced if it is not used elsewhere; further this can lead to confusion with other hypotheses formulated for the different case studies.

Response: The main hypothesis of the thesis added to the introduction and have been revisited in the conclusion. However, the mentioned sub-hypothesis in the case studies remained unchanged as they published the same in the papers.

Comment: I recommend proofreading and polishing the text, possibly with tools that can check the syntax and why not the meaning in context...

Response: Additional proofreading has been performed to refine the writing, syntax, and clarity of language throughout the thesis.

Comment: I recommend proofreading and polishing the text, possibly with tools that can check the syntax and why not the meaning in context. For instance, a sentence like:” Our hypothesis is that data logs that record collaborative activates can provide valuable information of active engagement of team members.” Is not clear to me, not only because it is vague, but also, I do not quite get what “activates” means here; should it be “activities” rather than “activates”?

Response: I acknowledge the importance of proofreading and refining the text for clarity. I agree with your observation regarding the sentence in question, and I appreciate you highlighting the confusion caused by the term "activates." It should indeed be "activities," and I've made the necessary correction for better clarity. Regarding the use of AI tools, I've made efforts to limit their application to less than 25% of the text, focusing mainly on rephrasing sentences that may lack clarity. I repeated an extra thorough review to enhance the overall readability of the thesis.

Reviewer 3 (Julie Stal-Le Cardinal):

Comment: The PhD student presents here 3 Research Questions. Two of them are coherent and comprehensive, but the second, on dashboards to improve collaboration, is much more restrictive and already provides a solution. Why restrict the issue? We don't see the justification. Moreover, these questions are different from the 5 research questions presented later on page 85, chapter 3. A clarification is necessary here.

Response: The research questions have been revised; now, we have consistent questions in the introduction and other chapters.

Comment: we don't understand why so much emphasis is placed on the concept of poor collaboration. This might be interesting if a risk analysis were then carried out, but here no conclusions are drawn from the analysis of poor collaboration.

Response: I believe, the emphasis on poor collaboration in the thesis is considered appropriate, as it underlines its significant role in project failures, as discussed in the referenced surveys and examples. While a detailed risk analysis may not be explicitly provided, the thesis aims to highlight the substantial consequences of poor collaboration. The referenced examples, such as the Mars Climate Orbiter project failure, serve to illustrate the practical impact of inadequate collaboration. During the defence presentation, I plan to further explain these aspects, ensuring a balanced understanding of the importance placed on poor collaboration within the context of the research.

Comment: In our view, the scope and relevance sections could be merged. This would simplify the subject and avoid certain redundancies.

Response: I appreciate the reviewer's perspective, however, I believe keeping the scope and relevance sections separate is beneficial to maintain clarity. Merging might introduce complexity. I carefully reconsidered, but I lean towards keeping them distinct for better understanding.

Comment: Figures 1.3 on page 25, 1.4 on page 28 and 1.3 on page 53 add no value to the text and take up a lot of space in the manuscript. Note that figure 1.3 on page 53 is subject to a numbering error.

Response: It is true that these figures may not add substantial value; however, some visual context is better than none in the thesis, as we do not have space limitations. The numbering errors have been fixed.

Comment: Unfortunately, we miss a clear PhD thesis structure in figure 1.5. A way to do it could be to merge DRM (figure 3.1), thesis structure and chapter content in a more complex figure.

Response: Figure 1.5 has been updated to better illustrate the overall thesis structure and flow of information.

Comment: In Chapter 2, key concepts and definitions of collaboration should be clearly outlined for consistency. The glossary is missing some concepts.

Response: The key concepts and definitions of collaboration have been revised. The glossary has been updated.

Comment: Discussion and conclusion could be merged for a more cohesive final chapter. I'm missing the highlight of research value.

Response: While I appreciate the suggestion to merge the discussion and conclusion, I believe keeping them separate contributes to a more structured presentation. However, I adjusted some parts to make sure to highlight the research value more prominently in both sections.

Comment: How can we improve collaborative engineering design and learning? This overarching question could guide the final presentation.

Response: The conclusion chapter provides a concise response to this framing question by summarizing how the research aimed to identify challenges, propose solutions, highlight cutting-edge technology potential and ultimately contribute to more effective collaborative engineering design and learning.

Comment: We also appreciate the Chapter Summary sub-section, which summarizes the content and contribution of each chapter, although it's a shame this isn't systematic (it doesn't exist for chapter 4, for example).

Response: A summary has been added to the end of chapter 4.

Comment: ... 5 Research Questions (RQ) are proposed. With the exception of RQ3, the link between goals and RQs is clear and unambiguous. On the other hand, QR3 needs to be better introduced, apparently, RQ3 is not goal related... A way to do it might be to present Research Hypothesis... indeed, according to me, one of your research hypotheses is that Feedback systems is a solution.

Response: Research Hypothesis now are presented in the introduction section right after the RQs.

Comment: Concerning case study 2, figure 2.4 already exists and was presented before in the document with another reference number.

Response: Figure 4.2.1 is updated to make it different from Figure 2.4

Comment: Concerning case study 3 about Feedback on active Engagement, we lack definition of engagement compared to motivation for instance. How can you measure engagement? Or motivation?

Response: Active Engagement is a term defined in Definitions and Constructs of Collaboration in Chapter 2, section 3. However, motivation is not a focus of this study; Motivational Interviewing (MI) is a term/name regarding a methodology and not necessarily about motivation.

Comment: ...sometimes the word feedback is written in one word (page 86) and sometimes in two, as in feed-back (page 123).

Response: The typo “feed-back” fixed.

Comment: Finally, the fifth case study is more a proposition and a test of a model created and proposed by Sabah Farshad thanks to the work done through the 4 other case studies. According to me, this part should have been presented as a proposition of a ML-NLP model so as to highlight more the value creation of the research done.

Response: I agree that Case Study 5 is, in essence, a proposition for a ML-NLP model, and I believe that its nature as a proposition is already reflected in the study.

Comment: All the case studies took place in an academic context and in Russia. This raises the question of the generalizability (or genericity) of the research and its conclusions. Could the model proposed in Case Study 5 be applied as it stands in an industrial context and in countries other than Russia?

Response: It is true that the model's generalizability needs to be validated further in an industrial setting, as explained in the discussions. However, since participants came from different countries and the language used was English, it is highly unlikely that conducting the study in Russia would have significantly affected the findings.

Reviewer 4 (Alexey Nikolaev):

Comment: In Case Study #2 the author makes the claim for the finding of a meaningful correlation between Active Engagement and Collaboration. The claim is based on single-time survey having 8 responses where 5 responses in 7 – 9 range and 3 responses in 2 – 5 range (see page 112 of the thesis). Generalization of the claim basing on small group size, one-off experiment, educational nature of the project, potentially not uniform understanding what “collaboration” really mean and takes, require additional justification.

Response: While I acknowledge the limitations, such as the small sample size and potential variation in understanding collaboration, I took measures to mitigate the risk and ensure accurate data collection and analysis. At the same time, these works has undergone thorough review by conferences/journals reviewers, and the limitations section recognizes the constraint of a small sample size. I agree that future studies with larger, more diverse samples would strengthen the generalizability of the findings as noted in the thesis.

Comment: Continuing Case Study #2, the author introduces Active Participation as the combination of (1) The total volume of data in Bytes entered in the time period; (2) The number of days that the contributor recorded an activity in the specified time period; (3) The total number of times that the contributor has edited the document and the log recorded an activity. All these three components look related to solo activities performed by a contributor and do not reflect the level of collaboration. Additional explanations are required to justify that the method suggested by the author in Case Study #2 is relevant and reliable for the measurement of Collaboration but not some other construct of team work. May be, Active Participation (as presented and measured by the author) can be considered as stand-alone parameter or linked to other components of team performance (not Collaboration).

Response: In further elucidating Case Study #2's methodology, an additional figure (containing a visual representation) and an explanation have been included post Table 4.2.1 to enhance clarity.

Comment: Also, in Case Study #2 the author characterizes the team project task as mainly executing one. At the same time team collaboration and collaborative work have higher importance at the phases of decision-making, concepts generation, negotiation, etc. Additional discussion on what parameters could be measured and assessed when teams are dealing with the tasks of decision-making, negotiating, generating would be useful. Would it be Active Participation and Shared Responsibility? Or other parameters?

Response: The comment is insightful and the observation raises a valid point about the importance of team collaboration in decision-making, concept generation, and negotiation phases. In Study 5, I address these concerns by shifting the focus to analyse team conversations during these critical phases. Still Active

Participation and Shared Responsibility remain pertinent parameters. The aim is to provide a more comprehensive understanding of team collaboration beyond task execution.

Comment: In Case Study #5, for better understanding of the research design and its justification, I would recommend to add examples of team chat messages that were classified as (1) corresponding to Active Participation and (2) corresponding Shared Responsibility. This would illustrate how the Messages of different format, style, wording, etc. are semantically attributed to Active Participation and Shared Responsibility constructs.

Response: An example of team chat messages that were labelled is added (Figure 4.5).

Comment: The author provides an extensive literature review with the focus on academic research. Given high relevance of the topic to practical application, a short review of emerging commercial services for teams and individuals work performance analysis and improvement would be a good addition to the overall prior art review. (E.g. services offered by corporations like Microsoft and/or startups as Yva.ai and others).

Response: A short review on Emerging Commercial Team Services has been added to the literature Review (Section 2.11) to enrich literature review, without mention a specific company/product.

Comment: As well the review of existing methodologies having components for the team process performance improvement would be a good addition. For example, within widely used SCRUM methodology, such rituals as Sprint planning, Daily stand up, Retrospective meeting have components intended to address and improve performance of the team not only in the output but in the process as well (including collaboration enhancement). A short review of these practices, their mapping into the concepts considered in the thesis would be useful considering connection of the research to practical application..

Response: I added a short review on SCRUM to the literature review (section 2.4 Improving collaboration).

Reviewer 5 (Sebti Fofou):

The review generally offers positive feedback and acknowledges the strengths of the thesis. No specific questions or concerns are explicitly mentioned in the report. However, it does mention potential complexities related to privacy issues when implementing proposed solutions.

I appreciate the thoughtful evaluation and recognition of the contributions made in the thesis. Thank you for your valuable feedback. If there is a need to respond or address this concern, I will respond during the defence presentation.

Reviewer 6 (Andreas Panayi):

Comment: Expand AI abbreviation on the dissertation title.

Response: While I appreciate the suggestion to expand the abbreviation 'AI' in the title, considering the widespread familiarity with the term "Artificial Intelligence" in contemporary contexts, and that "AI" is widely understood, I believe that expanding the abbreviation might make the title longer or less concise without adding significant clarity.

Comment: Search for "error" in the document and fix the places where it appears.

Response: The errors fixed.

Comment: The colon ":" in Contents (after Chapter) is blue and underlined. Why?

Response: The problem with the blue colon “.” in the table of content fixed. It happened due to an error in the Word document.

Comment: Some Table references appear in the List of Figures, and are missing from the List of Tables..

Response: This issue has been fixed, now all the Tables and Figures are listed properly.

Comment: Figure 4.3.3 Sentiment Analysis with Google Cloud Natural Language” is missing the legend.

Response: The legend of Figure 4.4.3 was hidden under the caption; now, it is visible.

Comment: Figure 2.4 and Figure 4.2.1 are the same. Why is the same figure repeated and not referenced? Also in Figure 2.4 there are bold characters in the figure label.

Response: Figure 4.2.1 is updated to make it different from Figure 2.4. The bold text fixed.

Comment: In some figure/table labels a bracket appears after the number, eg. Table 4.13.

Response: The bracket removed from the label.

Comment: Figure 4.3.1 is a bit blurry and hard to read. Figure 4.5.1 also. Most of the figures in Section 4.5 are blurry.

Response: Thank you for bringing this to my attention. The figures appear clear in the Word document, and the perceived blurriness may be attributed to their size or it may be influenced by the format conversion or display settings. I will review and optimize the figures to ensure improved visibility in the final presentation.

Comment: Page 148: “In this concluding section, we summarize the key findings and their implications,” This is your work – “we” should be used in the text. Check for other instances and remove.

Response: The writing style in the mentioned text has been updated.

Comment: In some place there are extra line breaks. Please check and remove.

Response: The extra blank lines have been removed.

Additional changes:

- I expanded the acknowledgments section to express my gratitude and to include the reviewers and jury members who played a vital role in evaluating and shaping the outcome of this work.
- Glossary moved from the end to the beginning.
- Some inconsistencies in Tables and Figures numbering resolved.
- The header of List of Figures and List of Tables have been updated.
- Some other minor formatting and layout changes have been made.