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Jury Member Report – Doctor of Philosophy thesis.

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 Clement Fortin

Name of the Reviewer:

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	 **Date: 17-01-2024**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

The PhD of Mr. Sabah Farshad aims to study non-technical and human-centered challenges in collaborative engineering design and suggest improvement solutions. This is a timely, challenging, and multidisciplinary important research problem. Indeed, in today's rapidly advancing digitalized and globalized world, engineering design professionals are increasingly facing the need to adjust themselves to interdisciplinary working conditions and multicultural team interactions, which are essential for success, therefore understanding the behavior of team members and evaluating their motivation and engagement is key to successful design activities.

pThe thesis manuscript comprises 4 chapters plus a general introduction and a conclusion. The introduction presents the scope of the thesis, its relevance, and an overview of the research methodology. Chapter 2 reviews the state-of-the-art literature related to collaboration, eCollaboration, and their evaluation criteria. The last section of this chapter discusses the research gaps identified in the literature and relevant to collaborative engineering design in the context of digitization and Artificial Intelligence. This section is very important as it directs the future research of the candidate toward solving some of the challenges raised by the identified gaps. Chapter 3 discusses the objectives of this work in more detail, and presents the research questions and the methodology (holistic framework, and validation strategy). Chapters 4 and 5 constitute the heart of this work, they include the main contributions of the author. In Chapter 4, the candidate presents 5 different case studies that have been conducted to improve the understanding of collaborative engineering design and learning. These studies generated important insights about the growing complexity of engineering collaborations as teams become increasingly dispersed and reliant on digital platforms. In Chapter 5, the candidate discusses how each research question has been addressed through one specific case study. The main findings and limitations are highlighted, and improvement solutions are proposed. Namely, a ML-NLP proof of concept is discussed as a promising Artificial Intelligence empowered solution that can assess team members' motivations and engagement levels and automate feedback and actions required to support and motivate team members and restore team dynamics.

The thesis manuscript shows clearly that the candidate has mastered his research topic and has followed a rigorous approach to understand the research problem, formalize the research questions and propose solutions based on emerging technologies such as human behavior models, machine learning, and natural language processing.

The solutions and methods proposed by the candidate (e.g. designing and validating a method for measuring and monitoring Active Engagement, combining natural language processing and machine learning to create computer mediate feedback) and the results obtained constitute valuable contributions to the studied domain; Even if an industrial implementation of some of the proposed solutions might be quite complex e.g. due to privacy issues when analyzing the digital conversations and communications between the team members.

Mr. Sabah Farshad validated his work with a total of 5 publications of acceptable quality: 3 conference papers, one journal paper published, and one journal paper accepted for publication.

Provisional Recommendation
☒ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*
☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*
☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*