Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Nicola Garzaniti

PhD Program: Engineering Systems

Title of Thesis: A decision support system for agile development of complex hardware systems

Supervisor: Associate Professor Alessandro Golkar

Co-supervisor: Professor Clement Fortin

Name of the Reviewer: Professor Eduard Alarcon

I confirm the absence of any conflict of interest	**Date: 17-September-2021**

Reviewer's Report

This PhD dissertation is framed in the context of design methods aiming complex systems, in which it thereby presents key contributions within the strategic and timely topic of whether Agile design methodologies, currently used pervasively in Software Complex System, can be applied to their Hardware counterparts. This thesis represents what we consider a landmark contribution by addressing the two-fold question on when and how these methods can be applied, and articulating a structured methodology to do so, that crystallizes in a comprehensive design tool encompassing structured architecting and design, simulation and planning. This is indeed a very relevant field of research because its impact is all-pervasive. Although the topic has been explored and researched in the past years, it is still very challenging and many aspects remain unsolved, and hence the impact of this PhD thesis. The manuscript itself is remarkably well structured and impeccably written.

To our judgment, the **main core transversal contributions** of this work encompass (a) the proposal of a new comprehensive methodology to apply Agile Design methods to Complex Hardware systems (b) the conception, design and integration of a comprehensive design-oriented software framework aiming complex system design from an Agile perspective (c) The proposal of a new metric which indicates the plausibility and likelihood of applying Agile design (d) Demonstrating the feasibility and fully-fledge end-to-end operation of the method and tool in two seemingly distant use cases, namely that of a hardware subsystem in a small satellite as well as a consumer product. Beyond these contributions, it is outstanding that, in a field that is still emerging, his work is methodologically very solid, thereby establishing the foundations for a structured design approach that is foreseen to have strong impact in the research community.

As for the **suitability of the contribution to the state of the art**, this PhD thesis many-fold contributions indeed address the major challenge in this emergent field of Agile Hardware design, with a compelling and balanced approach

between scepticism and enthusiasm based upon quantitative analysis, statistical evidence, and tools for adoption by the community.

This work provides scientific evidence of **significant** and **original** contributions to knowledge at the overlap of four disciplines, well inspired on previous seminal contributions. The candidate has provided a thorough and comprehensive critical diagnose of the state of the art (best evidenced in, *verbri gratia,* the visual representation of the interactions among research contributions as shown in the in figure in pp 28, and related companion metrics-based quantitative benchmark comparisons), providing a categorized structured discussion of knowledge hitherto proposed by the scientific community and in turn providing the context for his conception, design and corroboration of original ideas, which represent a clear progress in such state of the art. The candidate thereby evidences that his relevant contributions address **timely** and **relevant** problems of key interest to solve long-standing application-related problems, and clearly highlights their interplay with current approaches, a sign of independent and critical scientific thought including the required significant engineering insight.

To conclude our judgement on the quality of this PhD thesis, we hereby state that this thesis confirms Mr. Nicola Garzaniti leading research in this area, with worldwide scientific contributions.

The contributions of this rigorous and high-impact thesis is best evidenced from independent peers in the notable publication record, which has in particular been recognized through a recent Progress in Aerospace Sciences and an IEEE Systems paper, a flagship journal in the system design field, and related publications in flagship conferences, some of the most prestigious fora in the field.

I therefore highly recommend the acceptance of this thesis and judge it to be of superior quality and ready for publication

Barcelona, September 17th, 2021

Prof. Dr. Eduard Alarcón
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Provisional Recommendation
x *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*