

## 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:** Associate Professor Dzmitry Tsetserukou

<p>I confirm the absence of any conflict of interest</p>  <p>(Alternatively, Reviewer can formulate a possible conflict)</p>	<p><b>Date: 07-10-2021</b></p>
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*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

Thesis focuses on the development and study of a decision support system for Agile development of complex hardware systems. The proposed technology will potentially allow establishing a comprehensive approach to Agile method application for physical product development in industrial settings.

The presented PhD Thesis is a 158-page document, consisting 6 chapters. The thesis is well structured and written. Thesis demonstrates a solid understanding of the state-of-the-art in the research areas of Agile methodology, operational frameworks, engineering design processes, design theory, network-based project management techniques, product development, concurrent engineering, compressed and flexible models, and hybrid approaches, referring 145 relevant sources representing the most recent achievements in the area.

Chapter 1 introduces the topic, research questions, and describes the thesis structure. State of the art of Agile theory, stage-gate approach, and currently available project management techniques are discussed in Chapter 2. Chapter 3 presents the proposed decision support system. Chapters 4 and 5 describe the case

studies and evaluate the performance of the developed framework. Chapter 6 summarizes the scientific contribution, and conclude the research.

I suggest the following improvements of the PhD Thesis. The names of the chapters are short that does not allow the reader to get the idea of their content. Therefore, I recommend to include a meaningful titles, e.g. Agile can be replaced with Agile Methodology and Approaches.

It is important to include the Glossary to define a plenty of abbreviation used in the thesis. For example, such of them as PDP Product Development Process, MVP Minimum Viable Product, DRM Design Research Methodology, design-analyze-redesign (DAR), design-manufacture-test-redesign (DMTR), new product development (NPD), Mission Requirements Document (MRD), System Requirements Document (SRD), Assembly, Integration, and Testing (AIT), TRL (Technology Readiness Levels), Model-Based System Engineering (MBSE), Verification and Validation (V&V), Preliminary Design Review (PDR), Human-Computer Interface (HCI). Additionally, after defining abbreviation there is no need to use long statements as on Page 16 "the planned Minimum valuable Product", it should be planned MVP, it is same on the page 19. Oppositely, on the page 40 you have TRL abbreviation without defining it.

The grammar quality of scientific English is good, however, there are typos and some grammar mistakes through the text, e.g. page 16 2.2.1 Roles artifacts and events must be Roles, artifacts and events, page 17 "He or She" must be "He or she", page 17 2.) must be 2), in Section 2.2.4 must be Section 2.2.4., page 17 "The purpose of this meeting inspect progress and synchronize the work to reach the Sprint Goal", must be The purpose of this meeting is to inspect progress and to synchronize the work to reach the Sprint Goal, page 19 Since the Minimum Viable Product represent, must be Since MVP represents, page 21 Minimum Viable Product (MVP), must be MVP, complex hardware systems development must be complex hardware system development, page 22 Vertical axis of Time should be given the definition (hours, day, months, or etc.), vertical steps marked in blue must be vertical steps are marked in blue, page 25 State-gate must be State-Gate, page 26 state-gate must be State-Gate, page 30, product development process (PDP) must be PDP as you have already defined the abbreviation, page 33 of "Scrum master" must be of "Scrum master", "Tasks scoring aimed to evaluate the complexity of each task and allow" must be Task scoring aims to evaluate the complexity of each task and to allow, page 35 1,000 traces must be 1 000 traces, page 39 "rapid prototyping mechanical components", must be "rapid prototyping of the mechanical components", page 41 "dependencies structure" must be "dependency structure", page 41 the Figure 18 should be moved to page 42 after the reference to it, page 42, 2.5.10 The must be 2.5.10 The, 2.5.12 Catalog, must be 2.5.12 Catalog, page 48, different variables combinations must be different variable combinations, page 57 you need to correct subscript style to  $AV^T$ , page 57  $T_{MLi}$  must be in Italic style, page 69 Artistic representation must be changed to CAD model, page and 9089 "General case study data collection format" must be "Data collection format of general case study", page 125, Legends for the bar plot must be indicated. There are plenty of missed definite articles in the text. The thorough thesis proofread are heavily needed.

I suggest to reformulate the research question 1 to: "How to understand when and how to use Agile methods within the development of physical systems on the specific project context and system features?". The Research Question 2 is not comprehensive, specifically "How to support" can be formulated "Which infrastructure should be developed to make Agile methods more effective for physical systems development". Chapter 3 starts with introducing proposed CURSIVE depiction support system. However, the explanation of the problem that it solves comparing with other decision support system should be presented. Additionally, the motivation behind its structure should be explained. In the section 3.1 Structuring, it is stated "the approach proposed in this first stage answers the first research question" is not technically correct because it is not clear from approach when and how to use Agile.

The time-based index is not defined on page 56. All equations that are taken from the literature must have the reference to the source just before the Equation. Subchapter 3.2 ends up with picture. There are must be conclusion on results of the evaluation of the proposed decision support system. Conclusion on the page 73 should be reformulated as "This situation poses the trade-off between technical risks and the impact on cost" is obvious and does not proved a valuable data for the specialist.

Human-Computer Interface is a topic mostly related to the technologies to interact with computers, therefore, I suggest changing this term to Graphical User Interface (GUI). Title of the Chapter 4 is too general. I recommend changing it to Case study of CURSIVE framework for New Space Mission Payload. Name of Chapter 5 should be replaced with "Case study for a consumer product development". In the Chapter 6 Conclusion there must be given numerical values proving that the proposed framework is effective in some cases of product development

The quality of the research is approved by the publications in such prestigious Journals and Conferences as:

Progress in Aerospace Sciences, Elsevier (Q1)

Acta Astronautica, Elsevier (Q1)

Remote Sensing, MDPI (Q1)

IEEE Systems Journal (Q1)

IEEE International Geoscience and Remote Sensing Symposium (H-index(SJR)=67)

IEEE Aerospace Conference (H-index(SJR)=61)

Overall, he published as many as 16 scientific papers referred in Scopus. Nicola has successfully fulfilled the PhD requirements of Skoltech Doctoral Program in Engineering Systems by number and quality of publications. The impact factor of the presented research is supported by high H-index (in Scopus) of 3 and number of citation of 45.

#### **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*