

EXTERNAL EXAMINER'S REVIEW OF DOCTORAL THESIS

Topic: Integration of the Lean Six Sigma methodology within the Industry 4.0 framework

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This review was worked out on the basis of designation by Mr. doc. Ing. Michal Pilík, Ph.D., the dean of Faculty of Management and Economics of Tomas Bata University in Zlín on March 13th 2026.

The reviewed doctoral thesis was worked out at Tomas Bata University in Zlín, Faculty of Management and Economics under supervision of ass. prof. Petr Briš, Ph.D. It was published on February 2026. The thesis contains 135 pages of text, including figures, tables, references, author's CV, list of author's publications and one appendix. Such content and structure can be perceived as fully relevant to doctoral theses.

General comments:

Commonly saying, the concept mostly called as Industry 4.0 has been changing many approaches, methods and technologies for more than the last decade. This revolutionary transformation affected also traditional quality management. A term Quality 4.0 is really hot and very popular theme at present as it covers all changes in area of quality planning, control, assurance and improvement in Industry 4.0 environment. The Lean Six Sigma is recognized as one of the most effective methodology in area of continuous quality improvement. Any of quality improvement practices can use relevant new technologies. Therefore, from my point of view, the topic of submitted doctoral thesis is interesting and current indeed, especially from the Czech point of view. Author discusses some important issues of mutual linkage between Industry 4.0 and Lean Six Sigma and presents results of own research activities. She brings findings which are not revolutionary new, stunning or surprising on the one hand – but they fully confirm contradictory opinions, knowledge or experience in this field on the other hand.

The text of the thesis is structured by appropriate manner: from deep theoretical analysis up to presentation and discussion of the core results and findings. Chapters 2, 3 and 4 represent key parts of the thesis. Principal body of knowledge is deeply analysed by author in chapter 2. I highly appreciate wide choice of literature resources. Total list of references is absolutely remarkable! But author only quotes opinions of others and her critical remarks and own views unfortunately absent there.

Chapter 3 is dedicated to the presentation of approaches, methods and tools (including statistical) used for author's investigations and gathered data processing. As a whole, I look upon them as suitable, helpful and expedient means. The mixture of qualitative and quantitative research supported by relevant approaches to data collection and fair interpretation is logical. This evaluation concerns used sampling method, hypotheses testing and other aspects associated with all parts of author's research activities.

Chapter 4 brings the most important and interesting set of information which was created in the course of author's research work. It is obvious that the research questions, hypotheses and objectives were completed through clear quantitative and qualitative methods. Unfortunately, some essential information regarding research schedule, selection/sampling of the participating companies is missing. These facts should be explained during thesis defence – see also question Q3 below. The standard significance level for statistical tests was set at 0,05. I consider it as fully acceptable decision. The Spearman's correlation analysis proved to be correct way for searching potential association between variables. But in general, in spite of using right and effective methods, the research results cannot be considered as fully representative. Statistical analysis was made correctly on the one hand, but input data quality could be considered as easily open to doubt for some reasons.

Consideration is given to summarization and discussion key findings in remaining chapters. They are (similarly clause 4.5) formulated fairly and convincing facts are presented according to the research results. But one significant fact should not be omitted: results from qualitative and quantitative parts of the author's research bring divergent and contradictory findings. Attention should be drawn to this actuality!

In total, submitted thesis is worked out carefully and following remarks or questions could not cast doubt upon overall level of the work! Especially, four questions formulated bellow, should serve only as a basis for discussion during thesis defence!

Formal remarks:

1. The research gaps mentioned on page 15 were to describe more closely.
2. Many abbreviations occur in the text without relevant explanation in a special list on page 12.
3. General description of qualitative and quantitative research seems to be a bit superfluous as they are commonly known.
4. A lot of figures and tables are not referenced into the text. For example, Fig. 1, 2, 3, 5, 6, 7, 13, 20 or Table 3.
5. Chapters 5 and 6 describe similar conclusions and findings repetitively. Connection of these chapters should made them more compact.

Technical remarks and objections:

1. The main research question formulated in clause 1.2 (page 15) identifies two quite different aspects, which should be distinguished: Industry 4.0 technology and company culture. In my opinion, such aspects should not be assembled to the common variable.
2. General declarations as Lean Six Sigma or Industry 4.0 lead to performance increasing, processes effectiveness, improvement, etc. occur repeatedly in chapter 2, but these declarations seem to be rather anecdotal, if any exact data related to relevant indicators are missing!
3. Author presents the demographic breakdown in clause 4.1.3. The gender perspective cannot influence the research results reliability, I am sure.
4. A Gantt diagram or other similar tool should be used for presenting the time span of core research activities at the beginning part of chapter 4.

5. A scientific and practical contributions as well as opportunities for the next research activities should be described more exactly in chapter 7.
6. The sample size within qualitative and quantitative research must be perceived as important limitation. Nevertheless, this reality is ignored in chapter 8.

Questions:

Q1) What type of wastes presented on page 21 is the most important with respect to the Industry 4.0 concept?

Q2) Why the term “efficiency” is preferred to the term “effectiveness” in chapters focused on results and findings presentation or discussion. How these terms are perceived or defined by author?

Q3) When the core research (including the pilot study) was in motion, how 1267 companies were selected and why the response rate was too low (only 5% - see page 41)? In case of electronic questionnaire, was gathered data evaluated from the point of its reliability and validity?

Q4) The crucial findings discovered (see page 84 and similarity on page 87) that none of stipulated company’s characteristics is important factor for Lean Six Sigma success. This instigates the next question: Are there any other characteristics (barring the human factor) influencing Lean Six Sigma success from the point of view budget, time or efficiency? And further: could be such question perceived as chance for the next research?

When evaluating Anastasia Efimova’s doctoral thesis as a whole, I am able to declare a high level of positive perception in some ways:

- she has proved her ability to analyse wide set of special information. List of references is really remarkable: it contains 111 items, mostly respected journals.
- research hypotheses were clustered well and they comply to main objective of the work,
- overall research methodology seemed to be correct, including selection of quantitative or qualitative methods,
- approach to the statistical data processing is applied by appropriate manner (with suitable software support) and aimed to the hypotheses confirmation or refusing,
- findings and conclusions are described clearly,
- author fully demonstrated her ability to provide scientific approaches and methods.

Final summary and recommendations:

1. The topic of submitted doctoral thesis is really important and current, especially from Czech standpoint.
2. The objectives of the thesis were fulfilled and scientific level of the work is adequate for such kind of works.
3. Author used sound approaches, methodology and concrete methods. An achievement of exacting scientific objectives unquestionably asked for high level of labour intensity.

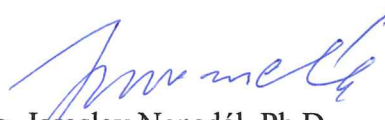
4. Substantial analysis of literature opinions can serve as nice resources for following students and researchers work.
5. Anyway, only future industry development will prove all practical impacts of the work. Chapter 8 indicates some directions of the next scientific activities, within role of human factor in area of mutual linkage between Industry 4.0 and Lean Six Sigma projects.
6. The dissertation thesis was worked out very carefully. Formal arrangement of the thesis is acceptable. Typing errors occur only exceptionally.
7. The author's publication activity (presented on p. 132) is adequate.

My statements presented above allow me to say that submitted thesis is good one! That is why, I fully suggest Ms. Anastasia Efimova is allowed to defend her doctoral thesis "Integration of the Lean Six Sigma methodology within the Industry 4.0 framework". In case of successful defence, I also recommend to award her to scientific degree

Philosophiae doctor (Ph.D.)

in a degree program P0488D050004 Průmyslové inženýrství.

Ostrava, 7th April 2026


prof. Ing. Jaroslav Nenadál, Ph.D.
external examiner