

Doctoral Programme of Computing and Electrical Engineering

Structure and content of a doctoral thesis

The doctoral programme has gradually outlined several specifying principles and recommendations for doctoral theses. They were put together to this guide to help supervisors on instructing and students in writing a dissertation. There are separate guidelines for the examination and evaluation processes of a dissertation.

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1 Dissertation

A doctoral dissertation is a thesis that students seeking a doctoral degree prepare to demonstrate their ability to conduct independent scientific work and produce new knowledge in their field of research. The format, contents and general properties required of dissertations are governed by the Government Decree on University Degrees (794/2004) and further specified in University's degree regulations and other guidelines.

Together, the thesis author and supervisor must define the thesis topic and content so that the doctorate can be completed within the target timeframe of four years of full-time study, or a scaled timeframe for those studying part-time that corresponds to four years of full-time study, up to a maximum of eight years.

According to the degree regulations, the Faculty makes the decisions concerning the pre-examination, publishing permit, public examination and grading of dissertations. This document contains the Programme's principles and specifications concerning the contents and publishing of dissertations.

2 General dissertation quality requirements

The dissertation must meet the following general quality requirements:

- It must deal with a consistent set of questions and form a solid, logical entity with consistent contents.
- It must contain new scientific knowledge from its field of research and demonstrate the doctoral candidate's in-depth understanding of the dissertation topic, as well as his/her ability to independently and critically apply scientific research methods.
- The results and deployed research methods, such as experimental methods, measurement systems and materials, must be clearly described and fulfil the requirements of scientific research. Matters must be addressed in a logical, objective, critical and thorough manner. The research must be placed in the right framework through reference to other researchers' relevant results and methods. Reference to the most recent published results - with due reference to the primary sources - is particularly important.
- The dissertation must contain a sufficient amount of independent input by the doctoral candidate, and this must be clearly demonstrated. The dissertation must express the candidate's ability to conduct independent, critical scientific research.
- The dissertation must be written in flawless language.
- The deployed research methods must fulfil the criteria of scientific research. Research findings must be described and analysed in a manner that enables review and repetition.
- The dissertation must comply with the good scientific practice and ethical principles.

3 Language of dissertation

As a rule, dissertations are written in English. Exceptions can be made in cases where the use of Finnish language is clearly more appropriate due to the topic or analysis. It is recommended to involve both Finnish and foreign examiners in the dissertation examination process. The language must be finalized before submitting the manuscript for pre-examination. The doctoral programme may request a separate statement concerning the quality of language in the manuscript and require language revision if necessary. Language checking is a prerequisite and language revision sometimes recommendable for the permission to publish the dissertation (this is confirmed in the application for permission to publish). The Faculty has given more detailed instructions about the costs of language revision.

4 Forms of dissertation

A doctoral dissertation may take the form of a single monograph written by the doctoral candidate, or it may consist of a number of scientific publications or manuscripts accepted for publication and deemed sufficient by the Doctoral Programme plus a summary, or another type of work that meets scientific criteria. The publications may also include co-authored publications as long as the independent contribution of the doctoral candidate can be demonstrated. In the CEE Programme, the accepted dissertation forms are monograph and compilation dissertation, which are discussed in chapters 5 and 6.

5 Monograph dissertation

5.1 Objectives of a monograph

A monograph is an independent piece of scientific research and a consistent whole, partially based on the author's peer-reviewed scientific publications. It is the result of the author's own personal work and is written by the author. A monograph must include new, publishable scientific content produced by the author in the field represented. Scientific results presented as new must not come from sources in which the thesis author did not play an independent role.

The author must focus on the essentials in the thesis and present the matters covered in a succinct and structured manner. For example, unnecessary repetition of textbook information should be avoided. As a monograph is, as a research publication, coherent and independent, the related methods and results included in it must be viewed as a whole, as must earlier studies on the same topic, for the most part. The monograph author must take particular care to clearly present new results observed and obtained in the thesis, as well as the scientific novelty value to the field community.

The monograph is the traditional doctoral thesis format in some sectors. The author of a substantial individual publication clearly demonstrates their ability to take on long-term, challenging projects. On the other hand, a monograph does not offer its author intermediate objectives, continual quality assurance or good scientific publicity. In fields prone to rapid change, the content of a monograph can become outdated or lose its value when others publish similar results. (*Airila M., Pekkanen M.: Tekniikan alan väitöskirjaopas. [Doctoral thesis guide for the technology sector] Teknillinen korkeakoulu, Hallinto-osaston julkaisuja 2002/3*).

The monograph format should be considered in particular in situations where the doctoral candidate's publications are heterogeneous or from a long time ago.

5.2 Contents of a monograph

A monograph is an independent scientific research and a uniform entity published in a single volume, yet partly based on articles published in scientific publication channels which use peer review methods. The doctoral candidate must be a key author in these publications. Any scientific input or results presented as new knowledge may not be based on sources in which the doctoral candidate has no independent contribution.

The doctoral programme has set some specifying recommendations for monograph dissertations (revised by the Faculty Council on 14.1.2015):

- By the term "publication" on this document is referred to a scientific paper, which has been published, or accepted or submitted to be published in a scientific publication channel which uses peer review methods.
- A monograph dissertation is a printed manuscript with a recommended maximum extent of 150 pages (excluding appendices).
- A monograph dissertation must contain a list of abbreviations used, descriptions of the research topic, goals and methods deployed, key findings and their evaluation, conclusions and a list of references.
- A monograph is a piece of writing produced by the author on his/her research and its outcome i.e. scientific publications. The main difference between a monograph and a compilation publication is the consistency of presentation. A monograph is a uniform, independent research publication, and therefore it must address the research methods and results as a whole and also include an overview of previous research in the same field.
- A monograph is the outcome of the author's individual efforts, and it must be written by the doctoral candidate him/herself. It must contain new, releasable scientific knowledge produced by the author from the featured field of research; unnecessary repetition of generally known information, such as textbook contents, should be avoided.
- In a monograph, references shall be made to the candidate's publications or submitted manuscripts as to any other publications relevant to the present subject. A monograph does not contain a separate list of the candidate's publications; all references to such publications are included in the list of references. The thesis must contain a Contributions section, in which the author introduces his/her research publications which the thesis is based on, and also specifies each authors' contribution to these publications.
- Depending on the rating level of the publication channels, the author's publications from the dissertation research must include at least 1-3 scientific papers published in a channel rated to represent at least level 1-3 on the Publication forum of the Federation of Finnish Learned Societies (JUFO).

The review and evaluation of a monograph dissertation calls for particular diligence from the examiners, because, by default, the monograph contains new knowledge that is most likely reviewed for the first time.

Faculty has given more detailed instructions about the costs of possible language revision of the dissertation.

5.3 Structure of a monograph

A monograph should present the background and objectives of the thesis research, along with the research problem and specific research questions, methods and materials used, and research results with the related discussions and conclusions.

The candidate should provide an account in the introduction section of their own publications on which the doctoral thesis research is based. The account should also specify the candidate's and the other authors' roles in the work contained in each publication. A monograph should not include a separate list of the author's own publications, and instead should only feature references to relevant publications by the author in the text, and publications listed in the References section along with other source material.

A monograph-format doctoral thesis must be bound and include a cover page, abstract, table of contents, and the doctoral research study itself. The details to be included on the front and back covers and the cover page of doctoral theses to be published as part of University's journal series must follow a standard format, and guidelines for this can be found from University Library's pages at <https://libguides.tuni.fi/dissertationpublishing>. On the reverse of the title page, the details of the supervisor of the doctoral studies and any confirmed additional supervisors for the thesis should be stated, along with the details of the pre-examiners and opponents.

The structure specified below is not a table of contents for a thesis, but the content shown below must be available in the doctoral thesis, using a table of contents:

Abstract	At the start of a doctoral thesis must be a short, one-page abstract – or summary, in English, giving an account of the thesis and its key findings. The abstract should concisely present the background of the topic, along with the motivation, key new findings observed whilst completing the thesis and their significance, impact or purposes, as well as any conclusions drawn on the basis of these findings. The abstract must state which the thesis's scientific field.
Preface	The preface generally features a free-form thanks section written by the author, expressing gratitude to those who have contributed to the completion of the thesis.
Lists of abbreviations, symbols, definitions	Lists to be used as needed.
Table of contents	A list of the contents of your dissertation.

When dealing with the actual research topic, you can use a division such as:

Introduction and author's contribution	<p>The introduction sets out the key background information from the perspective of the thesis topic. This section should describe the research topic and its significance, the objective(s) of the research, and specific research questions that the thesis will explore, along with the structure of the thesis.</p> <p>The introduction can also set out how each article resolves the research problem and how the articles relate to each other.</p> <p>The introduction section should include an account of the author's own publications on which the doctoral thesis research is based. The account should also specify the candidate's and the other authors' roles in the work contained in each publication.</p> <p>The doctoral thesis author's other related publications should not be listed here.</p>
Background	An overview of the key literature in the research field, i.e. a description of the scientific background to the thesis and latest information in the field – what is

	already known and has already been researched on the topic, and how the thesis positions itself in this overall context.
Theoretical foundation	Description of the theoretical basis of the topic.
Research methods	Explanation of the materials and methods used.
Results and research contribution	Key research findings and the most significant information discovered in the thesis process and its relevance. After this, you can discuss what the research contributes in relation to the research problem and questions.
Conclusions and discussion	The conclusions and discussion of the results achieved through the thesis work. The research and results should be assessed from theoretical and practical perspectives (who can benefit from the research carried out and how). The conclusion section can proceed into a deeper analysis of the topic and future prospects, as well as any potential further research topics.
References	A bibliography of the sources used.

6 Compilation dissertation ('article dissertation')

6.1 Content and structure of a compilation-based doctoral thesis

A compilation-based doctoral thesis comprises scientific articles, or manuscripts approved for publication, dealing with the same overall problem, and a summary section drawn up on the basis of these. The publications may include co-authored publications as long as the independent contribution of the doctoral candidate can be demonstrated. The thesis must, in terms of content, form a consistent, concise and logical whole.

A compilation-based doctoral thesis must be bound and include a cover page, abstract, table of contents, summary section and articles. The articles are to be appended after the summary section. The details to be included on the front and back covers and the cover page of doctoral theses to be published as part of University's journal series must follow a standard format, and guidelines for this can be found from University Library's pages at <https://libguides.tuni.fi/dissertationpublishing>. On the reverse of the title page, the details of the supervisor of the doctoral studies and any confirmed additional supervisors for the thesis should be stated, along with the details of the pre-examiners and opponents.

Faculty has given more detailed instructions about the costs of possible language revision of the dissertation.

6.2 Objectives of the summary section

The thesis author must independently write the compilation-based doctoral thesis summary section, which, when combined with the articles, forms the overall thesis. The summary section should not just be an extended abstract-type piece about the articles; instead it should be an analytical introduction to the piece, written on the basis of the articles included in the thesis and the source literature. It should express the candidate's own scientific thinking and maturity, as well as their ability to tie in their own work with the broader field of research. In the summary section the author should bring together the articles contained within the thesis and highlight the significance of each article from the perspective of the research as a whole and the research findings, whilst critically assessing the research presented in the articles and the significance of the findings at the time of publication.

It is recommended that the summary section should not have an excessive amount of direct quotes from the articles. This section can also be used to present new results and discussions not included in the articles. The objective should, therefore, be for this section to be more than just a cursory summing up of the articles.

If the articles are heterogeneous or from a long time ago, you should consider compiling a monograph-format doctoral thesis on the basis of the articles.

6.3 Structure of the summary section

This section should present the background and objectives of the thesis research, along with the research problem and specific research questions, methods and materials used, and research results with the related discussions and conclusions. Methods, findings and discussions should be presented to the extent necessary to facilitate understanding without having to delve into the original articles.

In this section you can use some of the same figures and tables as in the articles, but these must be accompanied by appropriate references to the original sources and permission from the journals in which the articles were published.

The structure specified below is not a table of contents for a thesis, but the content shown below must be available in the summary section of a compilation-based thesis, using a table of contents:

Abstract	At the start of a doctoral thesis must be a short, one-page abstract – or summary, in English, giving an account of the thesis and its key findings. The abstract should concisely present the background of the topic, along with the motivation, key new findings observed whilst completing the thesis and their significance, impact or purposes, as well as any conclusions drawn on the basis of these findings. The abstract must state which the thesis's scientific field.
Preface	The preface generally features a free-form thanks section written by the author, expressing gratitude to those who have contributed to the completion of the thesis.
Lists of abbreviations, symbols, definitions	Lists to be used as needed.
List of original publications	A list of the articles forming the thesis. The list must include details of the publication status of each of the articles (published/accepted/sent for publication) and the publication rights of the thesis. The name of the journal or other publication, written in full and without abbreviations or acronyms. This list should not include related publications authored by the candidate but not included in the thesis; instead related publications by the author may be included in the References section, and referenced in the text where appropriate.
Author's contribution	An account of the author's and others' contributions to each piece contained within the thesis should be given in a separate introductory section chapter or when listing the articles making up the thesis. A particularly detailed account should be written for publications where the candidate is not the first author or where they are co-first authors with another author, also known as an 'equal contribution' situation. Co-authorship should be mentioned in both the article and the list of articles included in the thesis.
Table of contents	A list of the contents of your dissertation.

When dealing with the actual research topic, you can use a division such as:

Introduction	The introduction sets out the key background information from the perspective of the thesis topic. This section should describe the research topic and its significance, the objective(s) of the research, and specific research questions that the thesis will explore, along with the structure of the thesis. The introduction can also set out how each article resolves the research problem and how the articles relate to each other.
Background	An overview of the key literature in the research field, i.e. a description of the scientific background to the thesis and latest information in the field – what is already known and has already been researched on the topic, and how the thesis

	positions itself in this overall context.
Theoretical foundation	Description of the theoretical basis of the topic.
Research methods	Explanation of the materials and methods used.
Results and research contribution	Key research findings and the most significant information discovered in the thesis process and its relevance. The natural solution for the results section is to present the results article by article. After this, you can discuss what the articles contribute as a whole in relation to the research problem and questions.
Conclusions and discussion	The conclusions and discussion of the results achieved through the thesis work. The research and results should be assessed from theoretical and practical perspectives (who can benefit from the research carried out and how). The conclusion section can proceed through the results of the articles into a deeper analysis of the topic and future prospects, as well as any potential further research topics.
References	A bibliography of the sources used.

6.4 Articles making up a compilation-based doctoral thesis

The Doctoral Programme has set some specifying recommendations for compilation dissertations (revised by the Faculty Council on 14.1.2015):

- By the term "publication" on this document is referred to a scientific paper, which has been published, or accepted or submitted to be published in a scientific publication channel which uses peer review methods.
- The dissertation must always form a consistent, uniform and logical entity. The summary section must contain a list of publications, a list of abbreviations used, descriptions of the research topic, goals and methods deployed, key findings and results, conclusions, a list of references and the individual publications specified in the list of publications. The summary may also feature new results and ideas not included in the publications. The conclusion section can proceed through the results outlined in the articles to a more in-depth analysis of the topic. Ideally, the summary should be more than a sum of the featured articles.
- The recommended length of the summary section is about 50 pages. Summaries exceeding 100 pages must be separately justified.
- The number of publications to be included in a compilation dissertation depends on the contents and the author's contribution in co-authored works. Typically, a dissertation comprises 4 to 6 publications. The recommended maximum number of included publications is 10.
- The publications may also include co-authored publications as long as the independent contribution of the doctoral candidate can be demonstrated. The summary section of the thesis must contain a Contributions part, in which the author indicates his/her contribution in the co-authored publications included in the dissertation. The report must be carefully written especially from the papers in which the doctoral candidate is not the primary or key author or has an "equal contribution" authorship.
- As a rule, all articles included in the dissertation must be published or be accepted to be published when the Faculty Council decides to submit the dissertation for pre-examination. No more than one of the articles may be at the 'submitted' state in this phase, and the submitted-state article must be for a refereed scientific publication channel rated at level 1 or higher in the [Publication forum of the Federation of Finnish Learned Societies \(JUFO\)](#). The article summary should indicate the publication to which the article has been submitted. The article may be at the 'submitted' state even after the pre-examination during the whole dissertation process, i.e. when the permission to publish and the acceptance of the dissertation are under advisement.

- Depending on the rating level of the publication channels, the author's publications from the dissertation research must include at least 1-3 scientific papers published in a channel rated to represent at least level 1-3 on the [Publication forum of the Federation of Finnish Learned Societies \(JUFO\)](#). The dissertation may also contain peer-reviewed conference publications. However, conference presentation summaries comprising only a couple of pages cannot be included in a compilation dissertation.
- The author of the compilation dissertation must be the primary or key contributor in at least three articles published or accepted for publishing in refereed series of scientific publications.
- The doctoral programme assesses the level of articles when necessary.
- Based on case-specific evaluation and approval, it may be possible for a compilation dissertation to include articles that are also included in another dissertation. Application for such evaluation requires a plan written by the doctoral candidate, approved by his/her instructor and confirmed by the supervisor. If a publication is included in several dissertations, this must be indicated in the dissertations. The same publication can be featured in no more than two separate dissertations written for the same field of research by members of the same research team. In this case, each author must have a unique profile and their contribution in the work must be specified. In addition to the publication with joint authorship, each dissertation must also contain a sufficient number of independent publications.
- Patents cannot be used as publications in dissertations because their writing style does not meet the criteria of scientific writing. Nevertheless, material related to patents can be included in the summary section.
- The dissertation author must obtain the permission to publish the articles in the dissertation from the respective publishers in advance. The permission to publish must cover the printed and electronic version of the dissertation. The dissertation author is in charge of obtaining the permissions to publish the articles. The permission must be separately indicated in conjunction with each article or on the article summary page, for example, in the following wording: *"The permissions of the copyright holders of the original publications to reprint them in this thesis are hereby acknowledged."* or *"This thesis is based on the following original publications which are referred to in the text as I-V. The publications are reproduced with kind permissions from the publishers"*.

7 Other instructions

Guidelines on the external appearance and technical writing of the thesis, as well as available templates:

- University Library: Dissertation template and layout instructions <https://libguides.tuni.fi/dissertationpublishing/template>
- University Library: Article permissions: <https://libguides.tuni.fi/dissertationpublishing/permission>
- TUT's thesis writing guidelines (where applicable, e.g. instructions on using sources): <https://portal.tut.fi/group/pop/study-info/masters-thesis/msc-thesis-guidelines>
- Belt, Pekka; Möttönen, Matti; Härkönen Janne: Vinkkejä väitöskirjaprosessin nopeuttamiseen [Tips to speed up the doctoral thesis process], Oulun yliopiston Tuotantotalouden osaston työpapereita 1/2010. <http://jultika.oulu.fi/files/isbn9789514261374.pdf>