



Dr Pekka Belt, Dr Matti Mottonen & Dr Janne Harkonen

PRACTICAL TIPS FOR DOCTORAL STUDENTS

**University of Oulu
Teaching development unit**

Dr Pekka Belt, Dr Matti Mottonen & Dr Janne Harkonen

**Practical tips for
doctoral students**

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PREFACE

Too often PhD students struggle with writing of scientific articles and their doctoral thesis, because there are no straightforward instructions on how to do the work swiftly and efficiently. There is no need to learn all the related aspects from scratch, as one can learn from others and learn together with others.

The university environment has a tendency to over-complicate matters, either intentionally, or unintentionally. It is true that all matters have a number of dimensions and deeper, more detailed information is always available. It is also true that a PhD student must learn to think from different perspectives. However, from the perspective of a PhD student, it is vital to obtain an adequate understanding on how to successfully write scientific documents. For this purpose, one may benefit from a certain amount of advice, but overly detailed information and unnecessary snobbery with related terminology will result in inefficiency.

This document aims to provide tips to PhD students for writing a doctoral dissertation, and for writing scientific articles. The central focus is on how to conduct the work effectively and speed up the process. Our intention is to enable researchers to rationalise their graduate studies and the writing of their doctoral thesis, while maintaining high scientific standards.

The authors formed a three people research group some years ago and completed their doctoral studies in three years. These three years consisted of fragmental starts and finishes of projects, worries over the continuity of funding, required graduate studies, writing of 15 Journal articles and doctoral dissertations. In our opinion, the decisive factor for the success of our dissertation projects was working as a close group. Currently, the group works for a project, at the University of Oulu, aiming to improve the efficiency of doctoral studies, including tangible hands-on guidance.

Our group had strong experience from industry, where in order to succeed, one must be effective. In our experience, a newcomer who starts working in a University has to start too often from scratch and tends to make the same mistakes others have made before them. Too often, graduate studies and the writing of a doctoral dissertation are inefficient. We do not try to be all-inclusive, but aim to present the main factors we believe may be beneficial for others to consider. We also aim to bring to light ways of working that tend to slow down the work and progress of many doctoral students.

The authors' own experience from industrial engineering and management combining technology, economics and social sciences, provides a good base for understanding the research methods of various disciplines. This document is continuity for a document "Vinkkejä väitöskirjaprosessin nopeuttamiseen" originally published in Finnish. This English version is more advanced and includes acknowledging the received feedback from multiple scientific disciplines, as well as the feedback from the cases we have personally guided. A reader should note that there are numerous guides for writing doctoral theses in written and online forms, providing help for doctoral students. For example, the University of Oulu, Finland, has an online [Toolbox](#) created specifically for this purpose. This document simply aims to complement these guides from the point of view of effectiveness. The document contains the *authors' opinions* and is based on their own experience.

ACKNOWLEDGEMENTS

We would like to thank the management of the University of Oulu for the possibility to concentrate on developing the efficiency of post-graduate processes. This opportunity has been a great boost for understanding the underlying issues from the perspective of doctoral students.

The original document, published in Finnish, has been attempted to improve by obtaining more feedback from various disciplines. We would especially like to thank Dr Anthony Heape, the coordinator of the Biocenter graduate school of the University of Oulu, for many fruitful discussions and for his valuable comments. Tony's excellent experience in guiding doctoral students in life sciences has greatly broadened our basis. In addition, numerous people across the University of Oulu have provided comments for this document. These comments and feedback have significantly improved this document.

We would also like to thank Professor Pekka Kess, the head of the department of industrial engineering & management and Professor Harri Haapasalo, vice dean for research in the faculty of technology, for the possibility to complete our own doctoral dissertations and to simultaneously learn of improving the effectiveness of the required work.

Pekka Belt, Matti Mottonen, Janne Harkonen

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INTRODUCTION

This document aims to describe the authors' views on how a doctoral student can effectively write his/her dissertation and the related Journal articles. In addition, some tips are given on how to integrate the dissertation work and the related studies, and on how to apply for research grants.

Academic research and related scientific writing should be seen as a learning process. It is essential to have your first article published as soon as possible. Do not expect yourself to master everything in your field before starting the learning process towards publishing, but start sooner rather than later. Once you know how to publish, you become a beneficial contributor for your University and will provide your stake for improving the University's ranking internationally. The ambition levels should be raised while learning to write better articles and you can aim towards publishing in increasingly better Journals.

Figure 1 presents the essential topics we aim to highlight. These topics, highlighted throughout this document, are relevant for all the activities relating to doctoral studies.

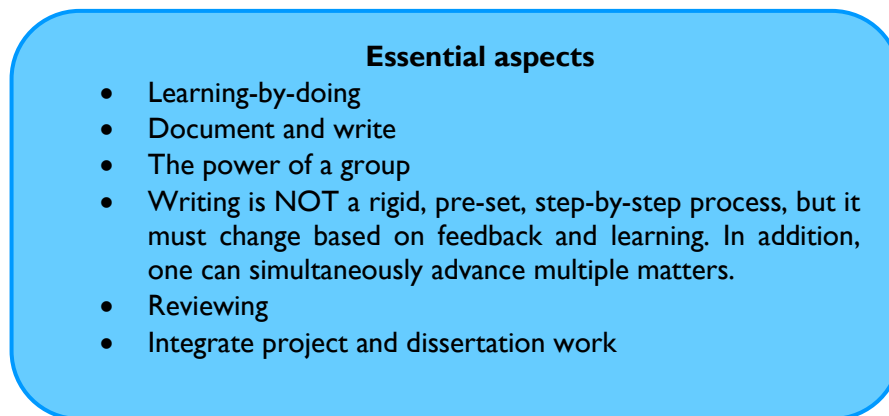


Figure 1. Essential aspects

It is vital to comprehend that *learning-by-doing* is an effective method to improve writing and learn the aspects that are required to write good articles. This is why it is advised to avoid over-planning, both in conducting research and in writing. Start concrete work as soon as possible and start writing. Aim to work in small increments, analyse what you have done, contemplate what went well and what can be improved. Based on this, change your processes and the way you work. Write the next increment, a paragraph, a chapter, or sketch some ideas, ask others for feedback, analyse and improve. This type of iterative process helps you learn more, faster, but most importantly you will identify your mistakes and improve your working method.

The key for effective completion of articles and doctoral dissertations is *documenting and writing*. Brainstorming is, naturally, an essential part of the research process and its power to generate and clarify ideas should not be underestimated. However, merely talking about it does not make your articles, or dissertation progress. A written piece of work can be reviewed and works as a medium for discussions, transforming itself gradually into a finished document. It is often easier for your supervisor and others to give you good feedback, when the medium for discussion is a written document. Aim to start generating written documents as early as possible. For example, you can start by putting your initial

ideas into PowerPoint, followed by a Word document with a working topic. You can start structuring the text by using a bulleted list etc. It is only the written piece of work that will truly make your articles and doctoral dissertation progress.

Being systematic is also important. For example, if your research involves interviews, record the interviews and transcribe the tapes, instead of merely making notes and leaving room for misinterpretations. This way you will have the material in a precise written form, enabling better analyses. Reading the transcribed material also enables “reading between the lines”, and returning back to the material. If you only make notes, you will probably write down what seems interesting on the spot, but not necessarily everything essential. Being systematic applies also to other types of research; for example, if your research contains measurements, maintaining good records and writing down any deviations and observations are important for the optimal utilisation of this material.

In our experience, *a group has power*. If possible by any means, try to find/form a suitable research group within your unit/University. If considering joining an existing research group, study whether the leader is productive, for example by analysing his/her results during the past five years.

Effective review practices are a good way to advance your writing process. Write in **small increments** and ask others (colleagues, supervisor/s, etc.) for feedback when you feel that a logically coherent subsection of the document is ready. This way, the feedback is more precise than when asking for comments for a larger whole, you can maximise your learning, and give yourself time to correct “mistakes” early. It is essential that the person giving the feedback has enough time and motivation to thoroughly examine what you have written. In an ideal situation, you will create a win-win situation, where everyone involved will benefit in some way. Remember that everything does not need to be symmetrical, but it is beneficial when people have different roles. Help those that you expect to help you in order to create a true win-win situation. Organise review sessions at different stages of your writing process. Sketch articles chapter-by-chapter and organise review sessions for a chapter at a time. In review sessions, it is vital to document any feedback so as to facilitate analysis and changes. In our experience, this type of iterative process of discussing and documenting is the most effective way to progress rapidly. It is recommended to give your text to the reviewers well beforehand to read through & comment, after which you can go through all the comments together in front of a screen and revise the document together in real-time. Commenting only via email is less effective, as the full explanation on the reviewers’ comments is missing. Verbal comments without real-time changes also tend to be inefficient.

Outline the first version of your research plan as soon as possible. Remember that this will not be the final version; a research plan is a living document that evolves with the project results. It is beneficial to ask others to comment your research plan, most importantly your supervisor, but also others. Your supervisor can help in assessing whether the research is realistic; from the point of view of resources, equipment, schedule, etc. Once you have the first version of your research plan, it is worth starting to apply for research grants. Start doing this during the early stages of your research, because, as with articles, the quality and chance of success improves with experience. Furthermore, both, writing your research plan and applying for research grants will clarify your thoughts.

There are a number of databases and scientific Journals online that allow finding reference material. University libraries provide an access to many of these scientific resources. *Google Scholar* is also a way to find references swiftly and effectively, but to be truly beneficial requires a full access to the articles provided by e.g. your university library. When using any database, it is vital to remember to concentrate on the essential, and not

to chase terms that, in many cases, have multiple meanings and may mislead you. If in doubt, discuss with others about your selection of search criteria; this will allow you to save a considerable amount of time. Especially when conducting applied research, try to **understand** what different matters mean in the real world, e.g. from companies' viewpoint. Selecting correct search words is a good topic for a coffee break discussion. Using university library services is recommended as they provide a wide access to information sources and give advice on using these.

When considering the realisation of any practical elements of your doctoral research, note that *you do not necessarily have to do everything by yourself*. You can potentially utilise data that has been originally collected for another purpose, combine and analyse data from different sources, or even material collected by students for their assignments. However, you should not forget to acknowledge the work by others.

A person supervising your doctoral dissertation can either be a professor or a post-doctoral researcher. The know-how of the supervisor is crucial, but aim to utilise also other people aside your supervisor, including colleagues, company representatives, other doctoral students, post-docs, etc. It is beneficial to build horizontal networks, meaning that you utilise other doctoral students by forming small groups. Remember that you should not aim to please everyone; instead, it is essential that your own understanding is enhanced through discussions. After all, it is the researcher who carries the sole responsibility of the completion of his/her doctoral dissertation.

Anyone considering of starting doctoral studies should carefully consider whom they will ask to supervise their dissertation. If you are in a position to choose, you can interview the potential supervisors and check their results for e.g. past five years (supervised dissertations, scientific publications). On the other hand, a supervisor with a good track record, may be overly busy. Also, supervisor's interests towards your topic will affect the quality of guidance. This is why it may be wise to consider how well your topic fits the goals of your potential supervisor. A doctoral student working in industry may find it easier to be able to choose among University units and supervisors. If one is not able to choose, especially those already on University's payroll, can only hope that their supervisor is able to maintain adequate funding.

Identifying one's own motive for dissertation work is also something a doctoral student may find beneficial. This motive may have an influence on the selection of a supervisor, or research group. When you are focused on a certain topic try to find the best possible group and supervisor who are successful in the field of your interest. This is when you can obtain high level guidance, especially for the **substance**, and you can be in the front line of advancing the science in your field. If you wish to build a research career joining a high level research group would benefit you the most. Alternatively, if you only wish to obtain the merit brought by a doctoral degree, then an effective guidance for the **process** towards the degree may be especially desirable. In an ideal situation, both process and substance guidance are simultaneously present.

The following chapters will describe, in more detail, how to effectively complete doctoral studies, a monograph dissertation, a compilation dissertation, write a scientific article, and apply for research grants. The chapters have some intentional overlap, allowing them to be read independently.

A FUNCTIONAL RESEARCH GROUP

This chapter describes functioning of a research group, in order to a doctoral student to understand, what to expect and to appreciate what is expected from him/her. Also, at the end of the chapter, few tips are given on how to cope with unwanted situations.

A high level research group aims towards excellence in its own field. This type of group tries to recruit talented people interested in a long-term research career. A high level research group tries to secure funding and enable the researchers to concentrate on their research duties.

In order to develop further and obtain results, the group functions in a disciplined and planned manner. Ready pathways are considered beforehand for young researchers joining the group, and their working is guided. A newcomer writes his personal study plan that is an integral part of the long term plans of the group. The student becomes an important part of the group / project.

A high level research group includes doctoral students at different stages of their career. This enables co-supervision, mentoring, and lecturing.

The role of a supervisor

The supervisor is especially important for a doctoral student and, consequently, each doctoral student has a named supervisor. Research programmes are owned by the group leaders supervising doctoral students and, hence, it is them who choose the newcomers. It is the supervisor who informs the student on the aims and what he/she will be working on. The supervisor organises regular meetings with the doctoral student, at least biweekly.

It is essential for a doctoral student to learn to conduct research scientifically, to write and publish his/her results, network with other researchers and relevant interest bodies, and how to apply for funding. The supervisor has a vital role in supporting this learning process.

The role of the student in the group increases as time passes – in the beginning the role of the supervisor is greater, later the student takes on more responsibility. A supervisor should never be too busy and should always have time for his/her doctoral students. It is typically a target for a supervisor to have one doctoral student graduating annually. This leads to a supervisor simultaneously having approx. five doctoral students of different stages. If the supervisor allocates about twenty percent of his/her working time for tutoring, this would result in a doctoral student having a right to expect 1.5 hours a week, or some two months of one-to-one personal instruction during a four year period.

Research plan

The research plan is a plan for the realisation of research, and the doctoral dissertation and scientific articles are among its important milestones. The importance of a well written research plan is highlighted in high level research groups. A student writes his/her research plan on a given project together with the supervisor. The research plan should be clear, but should not be considered as definite until the research ends. The research plan should be detailed for the present and near future, but less detailed for longer term.

Tips for unwanted situations

Unfortunately, a researcher does not always find an ideal research group, or finds himself/herself in a non-ideal situation. If this is the case, you probably have two choices, either to leave for elsewhere, or find ways to at least reach the goal of obtaining a doctoral degree.

If you decide to continue and an optimally functioning research group cannot be found, aim to group with others by other means. It is beneficial to have a close group of colleagues to cooperate with while writing your dissertations. Feedback on your research and discussions with colleagues are invaluable for the progress of your articles and doctoral dissertation, especially when the feedback is documented and analysed systematically.

Especially in contract-oriented research groups, in order to obtain funding, a doctoral student is sometimes employed by a unit working on a dispersed set of projects, not optimally supporting his/her dissertation. In these cases, it may be that scientific publications are not fully encouraged. Regardless of this non-optimal situation, try to find *synergies between project work and the writing of your dissertation*. Too often, a doctoral student only carries out documentations required by the project, and only afterwards starts progressing his/her own dissertation. In order to obtain a pay check, a researcher often has to familiarise himself/herself with a new project at this point, and does not utilise the results of the previous project in academic publications. Instead, a doctoral student should work to integrate project work and dissertation work by combining project reporting and academic writing. Sometimes, academic articles are accepted as a part of project reporting. If this is not possible, utilise common elements, as much as possible, in both articles and project reports.

A doctoral student writing his/her dissertation as a monograph is sometimes left alone with the work and the standard of the manuscript is assessed too late. Another risk of a monograph is that the results can become obsolete if the writing process takes too long time. In cases with adequate supervision, these problems will not occur. In worst case, when left alone, the author conducts enormous amounts of wasted work if the standard of the manuscript is not good enough and re-writing is required. It can be difficult to successfully manage hundreds of pages of text at once, when revising a monograph. However, when successful, the workload may be smaller for a monograph than for a compilation dissertation. On the other hand, a doctoral student writing a compilation dissertation, comprising of a number of scientific articles, may find it easier to obtain "friends" to assess the quality of the text. Having one's name on an academic article is a merit for all authors. Consequently, it is in most cases relatively easy to find motivated co-authors. It is in many cases up to you, with whom you decide to work.

TIPS FOR COMPLETING DOCTORAL STUDIES

In order to earn a doctoral degree, a student is expected to complete a certain amount of studies, write a doctoral dissertation and defend the dissertation in public. There are many ways of completing doctoral studies. It may be sensible to avoid chasing credits and completing impulsively random courses that may not be linked to your research in any way. Instead utilise your doctoral studies to *broaden your understanding*. As an example, near half of the studies could relate to your research topic and the rest could broaden your knowledge base. In any case, try to avoid a situation where, after finishing all your doctoral studies, you do not have the theoretical base needed for your dissertation.

If you prioritise earning your doctoral degree, aim to organise most of your activities to serve the realisation of your doctoral dissertation by integrating the earning of the required credits and the application for research grants into this process. To maximise the effectiveness, avoid courses that do not support your research. Select courses so that they are somehow related to the subject matter of your dissertation. Too often a doctoral student makes the mistake of taking courses that are interesting, but do not support the dissertation work in any way, or take all the courses before even considering the doctoral dissertation. Earning the required credits is typically not a problem, therefore concentrate on your own learning, progressing your dissertation and collecting relevant material.

In order to learn to write and publish, you may wish to switch into writing mode as soon as possible, already when earning your credits. You can, for example, study books and recent scientific articles relevant to your research. Instead of verbal exams, favour completing studies by writing summaries of books and articles. Professors typically accept written summaries as doctoral studies. Furthermore, you can later utilise some of this material in the theoretical parts of your dissertation.

You may also be able to get credits/partial credits for articles that are not directly related to your dissertation. This is a good motive for taking part in co-authoring colleagues' articles and taking part in their writing process. For the articles that will be included in your dissertation you cannot obtain separate credits, but for other articles you may. However, there are some differences among different units within Universities, so you will need to check with your professor/faculty what they find acceptable.

TIPS FOR WRITING A MONOGRAPH DISSERTATION

This section presents the authors' views and tips for writing a monograph dissertation, and effectively realising the related research. Appendix 1 contains our view on the content of a monograph dissertation. This content is an example of the components of your dissertation.

It is vital to see your dissertation project as a pull-based process where you aim all the activities to serve the realisation of the final product, your monograph. Start realising your research, and especially writing your dissertation as early as possible. There is no need to over-plan, or aim towards perfectionism at early stages. This way you will *learn-by-doing*.

In some cases, writing a monograph dissertation may be more straightforward than writing of a compilation. If you are left alone with your dissertation project, a monograph may be a sensible option. On the other hand, a compilation dissertation will provide an additional academic merit through publications, potentially better enabling academic career as a future option. An additional benefit of a compilation is the potential of involving other people as co-authors, as the publications are academic merit also for them. Many University departments favour compilation dissertations as the articles will improve their results, and enable following your progress. The risks of a monograph dissertation include, your research becoming obsolete if the process takes for too long, and a need to fully rewrite the entire dissertation, when you think it is ready, due to it not optimally documenting the core content. It would also be utterly unfortunate for you, should the pre-examiners rejected your work completely at such a late stage.

The following will describe a recommendation for the writing process of a monograph dissertation and provides tips for different phases.

1. Research topic – initial outlining

The work towards writing a doctoral dissertation starts by outlining the research topic, including a potential research problem or a set of ideas. A perfect understanding is not required at this point, but your work will clarify while progressing. Ask others to comment your topic/ideas. Do not get stuck with the initial ideas. The topic may change and be re-focused during the dissertation project. You do not need to know everything beforehand. Writing some elements of your dissertation will probably provide new ideas and help progressing.

Listing potential key words, aspects, or problems you are searching solutions for may help in outlining your research topic. A PhD student may think that his/her dissertation will provide a solution even to a broad challenge. In some rare cases it may be so, however, most often it is sensible to narrow your research topic adequately.

2. Initial literature review

Conduct an initial literature review on the subject matter of your dissertation. However, it is not practical to collect a large pile of books onto the corner of your table and read them thoroughly. Instead, screen some relevant material, e.g. 5-10 books and 10-30 scientific articles. This is to get a level of understanding of recent research close to your topic. Ask your supervisor and colleagues for advice when selecting the books and articles.

You can write summary/summaries by combining the core content of the books/articles discussing similar matters into a single report, e.g. 3-5 pages. These reports can later be utilised as a frame for the theoretical part of your dissertation. You may also be able to obtain credits for these summaries.

Beware of losing yourself in the literature for a too long time, or overemphasising the initial literature review. The purpose at this point is not to come up with perfect literature review, but familiarise with the subject matter. Use no longer than 1-2 months for this phase.

3. Research plan for dissertation

After initial literature review, start writing the first version of the research plan for your dissertation (see Figure 3). Even, if you have completed a research plan for your research group already when joining them, it may be sensible to either have a separate plan for reaching your dissertation, or adjust your original plan to cover these aspects. Among other purposes, your research plan will act as a mean of communication with colleagues and your supervisor. Research plan enables applying for research grants/other funding and guides your research. There is no need to aim for perfectionism as this is merely an **initial** version of your research plan. Your dissertation research plan will evolve during the process. We encourage *flexible planning*, meaning that it is important to have a **vision** towards which you aim with your dissertation; however, it is not meaningful to tie up your hands, instead allow the plan to live while your understanding is enhanced.

Do maintain the following parallel versions of your research plan:

- 4 pages (the main version)
- 1 page summary
- (more extensive version for your own purposes, where you describe the scientific gap your dissertation aims to address and how you realise the practical aspects of your research)

These versions enable more effective application of research grants. You can adjust and target different foundations and funding bodies, instead of always writing a completely new one. Do update your research plan regularly, at least in the pace of application deadlines for research grants, 2-3 times a year.

More extensive and precise version of your research plan can be done later during your dissertation process, if needed for your own purposes. In the more extensive version, you can better describe the scientific problem that is tackled by your dissertation, and how you realise the empirical research.

Research plan content for grant applications

- Summary.
- Introduction, describing the subject matter of the dissertation and who benefits of this research.
- Description of the state of the research and its future progress.
- Description of the research realisation and possible results.
 - Research questions, Research methods, etc.
- Description of funding and resources (persons, equipment, partners.).
- Schedule for your research
- Existing publications, relevant to your research (academic CV).

Figure 3. Research plan content for grant applications

4. Research method

Next, it may be sensible to study scientific research methods. This way you ensure that you realise your research in a manner that is scientifically sound. In addition, you may be able to obtain some credits.

Concentrate on methods that you believe are useful for your research (discuss with your supervisor and colleagues). Research methods include terminology that may seem difficult to grasp. Unnecessary snobbery with this terminology is not essential; instead try to adequately understand the essence for the purpose of your dissertation work.

Some clearly written books may help in adopting the necessary aspects. In our opinion best books are ones originally designed to be used as University textbooks and that are targeted for large markets, such as the USA. However, beware of unnecessarily complicated books as the issue itself is already complex enough. The best books are field specific. For example, in the field of industrial engineering and management, Bryman & Bell - Business research methods and Saunders, Lewis & Thornhill - Research methods for business students may prove beneficial.

5. Planning experimental research

Using your research plan, design the practical steps to conduct your experiments. You may also be able to utilise the results of earlier research projects, or even utilise work by other people, i.e. lab assistants or students, to conduct some of this work. Do not forget that you will have to acknowledge the contribution of others in your manuscripts.

Update your research plan after planning experimental research.

6. Realising experimental research

Realise your research plan. Be systematic and remember adequate documenting. If your research includes interviews, record and transcribe everything. In research that includes measurements, it is vital to adequately record all measurements, deviations, and observations. This way you will have your material in a written form, enabling effective analyses. The motivation for systematic documenting is that you may think differently afterwards and wish to analyse from an angle you did not think of during the experiments.

7. Analysing and documenting results

Analyse the data you have obtained. If your research is qualitative, avoid over-complicated presentation of your results. The results should be presented so that outsiders find it easy to grasp. For example, if you have an intention of dividing your findings into categories, four may be better than twelve. Clear results are also easier to publish!

Start writing the practical elements of your dissertation and ask others to comment.

8. Finalising theory

Write the theoretical elements of your dissertation. This means that now it is the time to conduct a systematic literature review.

Utilise the theoretical summaries you may have done before, and condense them where necessary. Complement the theory with new aspects, viewpoints and references. Describe the theoretical frame of your subject matter. Synthesise the essence of theory that is relevant to your research and present this at the end of your theory chapter.

Google Scholar is one way to find references effectively. However, as mentioned in the beginning of this guide, concentrate on essential and avoid unnecessarily chasing terms. Try to understand the true message of the articles you cite.

9. Writing of introduction chapter

Now write the Introduction chapter. Utilise *a funnel principle*, meaning narrowing the focus, paragraph-by-paragraph, starting from a more general and ending with the research questions, which you effectively answer in the thesis. This will help in making your text more logical for an outsider and easier to follow.

The core content of Introduction:

- Justify why the topic of your dissertation is important (Background & research environment).
- Describe the research problem and its background (Objectives & Scope).
- Consider whether the original research questions are still correct by comparing them with your results, theory, and adjust the questions if needed. Using research questions aid the reader to follow the structure of your dissertation and to understand the logic of your research.
- Write a description of the scientific approach of your research (methodology) and how your research has been realised.

10. Making and documenting conclusions

Write the Discussion section of your dissertation by paying attention to the following:

- Answer your research questions
- Reflect your research and its results
 - against existing literature
 - against practice. Who benefits of your research and how?
- Assess the scientific reliability and validity of your research.
- Describe the limitations of your research.
- Describe any recommended topics for further study.

11. Finalising your dissertation

Check whether the research questions, reasoning and the results match. Refine the research questions if necessary. Pay special attention to the way your research questions and the answers have been worded as the answer must match the questions exactly.

Write the Abstract by briefly describing:

- the topic of your dissertation
- justification / why is it needed
- utilised research methods
- key findings
- theoretical and practical implications

Finalise the different elements of your dissertation. Pay special attention to the style and format requirements of the publisher.

12. Give the dissertation to your supervisor for final comments

Carefully consider your supervisor's comments and make changes in the manuscript, if necessary. If he/she does not understand what you have written, you should find another way to write it.

If you are not a native English speaker, send the dissertation for a professional language checker before forwarding it to your opponents. Finally, it may be beneficial to have someone to proof-read your text. If you cannot find anybody do it yourself.

13. Forward your dissertation to your opponents

If you receive critical feedback, do not get depressed! Be analytical, this is the time for a final effort. It may be beneficial to discuss the comments with others, as you may overreact when your own work is being criticised. The required changes are probably smaller than you first think. Contemplate the fundamental reasons behind the feedback, and tackle them. Be systematic and make the required changes to the dissertation.

Prepare a point-to-point response to the reviewers, where

- you clearly present any changes made. This will allow the pre-examiners to avoid reading the entire dissertation again
- you present counter-arguments for issues that you believe are not necessary to change

TIPS FOR WRITING A COMPILATION DISSERTATION

This chapter presents viewpoints and practical tips for effective realisation of a compilation dissertation and related research. A compilation dissertation constitutes of a number of scientific articles and a combining storyline (the doctoral dissertation). Requirements relating to individual articles, their numbers, and publication mediums may vary among different scientific disciplines. The main benefit of a compilation dissertation is the additional academic merit gained through published articles. If you are a member of a functional high level group, the others are happy to help you with writing articles. However, if you are left alone, by including other researchers as co-authors, you can motivate them to provide valuable feedback early and hence potentially avoid unnecessary work. Also, the person supervising the dissertation may have a greater motivation to provide contribution and invest time towards an article, if he/she is included as a co-author. In addition, one of the main benefits of a compilation dissertation is the research being divided into smaller fragments with a potential to obtain better feedback. On the other hand, the workload towards a compilation dissertation may be slightly bigger than the one required for a monograph dissertation.

It is vital to start the process of writing the articles as early as possible. There is no need to overemphasise planning or aim to have a perfect outline for the future articles before starting to write. Learning by doing enables one to learn quicker. The following presents a recommendation for the process of writing a compilation dissertation and provides practical tips relating to different phases.

1. Research topic – initial outlining

The work towards writing a doctoral dissertation starts by outlining the research topic. Write down a potential topic or a set of ideas. Outline the articles that constitute your dissertation, include any initial ideas and research problems. Ask others for comments.

Do not get stuck with the initial ideas. The topic may change and be re-focused during the dissertation project. You do not need to know everything beforehand. Writing your first article will probably provide new ideas and help in writing the second one, etc.

2. Initial literature review

Conduct an initial literature review on the subject matter of your dissertation. This can also be limited to cover the literature relevant to your first article. However, it is not practical to collect a large pile of books onto the corner of your table and read them thoroughly. Instead, screen some relevant material, e.g. 5-10 books and 10-30 scientific articles. This is to get a level of understanding of recent research close to your topic. Ask your supervisor and colleagues for advice when selecting the books and articles.

You can write summary/summaries by combining the core content of the books/articles discussing similar matters into a single report, e.g. 3-5 pages. These reports can later be utilised as a frame for the theoretical part of your dissertation. You may also be able to obtain credits for these summaries.

Beware of losing yourself in the literature for a too long time, or overemphasising the initial literature review. The purpose at this point is not to come up with a perfect

literature review, but familiarise with the subject matter. Use no longer than 1-2 months for this phase.

3. Research plan for dissertation

After initial literature review, start writing the first version of the research plan for your dissertation (see Figure 4). Even if you have completed a research plan for your research group already when joining them, it may be sensible to either have a separate plan for reaching your dissertation, or adjust your original plan to cover these aspects. Among other purposes, your research plan will act as a mean of communication with colleagues and your supervisor. Research plan enables applying for research grants/other funding and guides your research. There is no need to aim for perfectionism as this is merely an **initial** version of your research plan. Your dissertation research plan will evolve during the process. We encourage *flexible planning*, meaning that it is important to have a **vision** towards which you aim with your dissertation; however, it is not meaningful to tie up your hands, instead allow the plan to live while your understanding is enhanced. The research plan should be detailed for the present and near future and less detailed later.

Do maintain two parallel versions of your research plan:

- 4 pages (the main version)
- 1 page summary

These two versions enable more effective application of research grants. You can adjust and target these versions for different foundations and funding bodies, instead of always writing a completely new one.

More extensive and precise version of your research plan can be done later during your dissertation process, if needed for your own purposes. In the more extensive version, you can better describe the scientific problem that is tackled by your dissertation, and how you realise the empirical research.

Do update your research plan regularly, at least in the pace of application deadlines for research grants, 2-3 times a year.

Research plan content for grant applications

- Summary.
- Introduction, describing the subject matter of the dissertation and who benefits of this research.
- Description of the state of the research and its future progress.
- Description of the research realisation and possible results.
 - Research questions for each article (The order your articles will be presented later in the compilation dissertation will not necessary be chronological, instead they can be presented in an order that is the most beneficial for the dissertation.)
 - Research methods, etc.
- Description of funding.
- Schedule for your research
- Existing publications, relevant to your research (academic CV).

Figure 4. Research plan content for grant applications

4. Research method

Next, it may be sensible to study scientific research methods. Also, prior to writing your first article, it may be worth taking a course on scientific research methods. Alternatively, you may take this type of course later and start immediately collecting the experimental material for your first article, once you have an adequate understanding of relevant methods.

Concentrate on methods that you believe are useful for your research (discuss with your supervisor and colleagues). Update your knowledge on research methods later during the dissertation process. At this point, you only need enough understanding to complete your first article.

5. Planning experimental research

Plan the experimental aspects of your research for the entire dissertation, even if more precise planning is needed only for the first article. Think, whether there are possibilities of collecting the needed data for all the articles at once, or whether more iterative data collection suits your purposes better. In some cases it may be more efficient to collect all the data at once and then analyse it from different angles for different articles.

Do realise that you may not have to collect all the data alone, or conduct the analyses alone. You may also be able to utilise the results of earlier research projects, or even utilise work by other people, i.e. lab assistants or students, to conduct some of this work. Please remember to acknowledge the work done by others.

Update your research plan after planning experimental research.

6. Write your first article

Start writing your first article as soon as possible. Do start ideating and outlining potential articles, even if you do not feel ready. For example, once you have outlined your theoretical background, or you have collected data for analyses, see instructions in chapter Tips for writing articles.

It may be sensible to write the first article of a topic that feels the easiest. Especially important consideration for the first article is the availability of research data, or the ease of collecting it. Writing articles is a learning process, worth starting as soon as possible. No article is perfect, essential is to learn to publish your work. After the first article, it is much easier to perceive Journal format and understand what constitutes an article. This will help in planning and writing the following articles.

It is important that a PhD student working on a compilation dissertation will examine potential target Journals. One of the vital aspects when choosing a target Journal is the *turnaround time*, the time until feedback and decisions. A PhD student cannot afford to wait for an extended period of time before obtaining a decision on rejection or acceptance. Slow turnaround does not only delay your dissertation, but also decisively slows down your learning process.

7. Update your research plan

Update your research plan. Critically analyse, whether the original plan is still valid in the sense of your research and effective progress. Your view over the content of future articles may change significantly.

8. Write your second article

9. Update your research plan

10. Write your nth article

11. Outline the content for the compiling part your dissertation

It is time to start writing the actual dissertation, once all the articles intended for your doctoral dissertation are ready (submitted, not necessarily accepted). Start a document for the compiling part and roughly outline the content for the dissertation using the attached table of contents (Attachment 2). Utilise the main results from your articles for the Results chapter, and potentially some theory to the theoretical sections of the compiling part. This type of “copy-paste” aids in perceiving what you have already done, and also to understand the work remaining.

The listing below gives a rough outline on the core elements of your dissertation (there is no need to perfectly write these, just to consider initially):

- The introduction of a compilation dissertation must present the subject matter of the dissertation, potential gaps in previous research, and possible research questions that are tackled in your dissertation. Additionally, introduction chapter must present how each article provides a partial solution to the studied problem and how the articles are interlinked.
- Theoretical part will discuss the theoretical playground relevant to your research. You may be able to obtain a good part of this from your articles, and any material excluded from the articles due to e.g. page limitations.
- In the results chapter, it may be a natural way of presenting the results article-by-article. After this, it may be sensible to consider the contribution the articles provide as a whole.
- The Discussion chapter includes implications, both scientific and practical, assessment of reliability & validity, and recommendations for future research.

12. Perceiving the positioning of the articles and the research problem

Write first version of ‘Objectives & Scope’ in the Introduction chapter by answering the following questions:

- What is the storyline of your dissertation?
- What is the whole the articles constitute?
- What are the true research questions?

- It may be sensible to have only one research question for each article (main contribution), even if the article itself would initially have had more than one. This will clarify the compiling part of your dissertation. Note that the research questions in the compiling part can be different than in the articles.
- What is the order of presenting the articles in the compiling part (it is not necessarily the same as the chronological order of publication) and how are the articles interdependent?
- What is the research problem?

Do note that the previous research plan you had was only a plan, and it is only now when the actual content of your dissertation starts to freeze.

13. Write the Results chapter

After this, complete and finalise the Results chapter by utilising the previous outlining and the content of your articles. The results must match your research problem and research questions.

14. Write the Theory chapter

Complete and finalise the theoretical part of your dissertation by utilising the articles and any background material you already have. Should there be any needs, complement these with new viewpoints, paragraphs and references. Make sure you have noted the gurus in your field. Describe the theoretical frame of your dissertation and summarise the core content relevant to your dissertation at the end of the chapter, if necessary.

15. Write the Introduction chapter

After this, it may be worth completing the Introduction chapter. Utilise a funnel principle, meaning narrowing the focus, paragraph by paragraph, starting from a more general and ending with the research questions. This will help in making your text more logical and easier to follow. Utilise the content of your articles, and especially their introduction chapters. Justify why the topic of your dissertation is important and describe the research problem.

Consider whether the original research questions are still correct by comparing them with your results, theory, and adjust the questions if needed. Using research questions help readers follow the structure of your dissertation and to understand the logic of your research.

Write a description of the scientific approach of your research (methodology) and how your research has been realised.

16. Write the Discussion chapter

Write the Discussion chapter by reflecting your research and its results against:

- The existing literature (theoretical implications)
- Practice. Who benefits of your research and how? (practical implications)

Utilise the discussion chapters of your articles. Do also consider the whole, constituted by these articles.

Evaluate the scientific reliability and validity of your research. Describe the limitations of your research and describe any potential future research topics you recommend for the scientific community.

17. Finalisation

Check whether the research questions, reasoning and the results match. Refine the research questions if necessary.

Write the Abstract briefly by describing:

- the topic of your dissertation
- justification / why is it needed
- utilised research methods
- key findings
- theoretical and practical implications

Finalise different elements of your dissertation. Do pay special attention on the style and format requirements of the publisher.

18. Give the dissertation to your supervisor for final comments

Carefully consider your supervisor's comments and make changes in the manuscript, if necessary. If he/she does not understand what you have written, you should find another way to write it.

If you are not a native English speaker, send the dissertation for a professional language checker before forwarding it to your opponents. Finally, it may be beneficial to have someone to proof-read your text. If you cannot find anybody do it yourself.

19. Forward your dissertation to your opponents

If you receive critical feedback, do not get depressed! Be analytical, this is the time for a final effort. It may be beneficial to discuss the comments with others, as you may overreact when your own work is being criticised. The required changes are probably smaller than you first think. Contemplate what the fundamental reasons behind the feedback are and tackle them. Be systematic and make the required changes to the dissertation.

Prepare a point-to-point response to the reviewers, where

- you clearly present any changes made. This will allow the pre-examiners to avoid reading the entire dissertation again
- you present counter-arguments for issues that you believe are not necessary to change

TIPS FOR WRITING ARTICLES

A researcher easily has an illusion that his/her research will sell itself more or less automatically. When trying to come up with publications the key point is to express your main message as clearly as possible. A written piece of work must have a solid storyline.

It is important to start writing articles/putting your work in writing as soon as possible. From the effectiveness perspective, it is a major MISTAKE to wait for a moment when you feel that you know and understand “everything” needed for writing articles. It is more sensible to start learning to write piece-by-piece, better enabling perceiving what to do and when, aiding to avoid unnecessary work. Understanding over the studied issue is enhanced while working on it. In addition, do ask others for feedback often, preferably in small increments, allowing better and more detailed comments.

Articles are often written in small groups, allowing naturally obtaining the views of multiple people. In the case of a doctoral dissertation, especially monograph, it may be difficult to motivate other people to provide adequate feedback. Writing articles together with co-authors is a good way to obtain feedback for your research. Also, it is possible to have others to comment your work for example by offering counter favours. Dynamic group work cannot afford freeloaders, but everyone involved must have something to give. Different types of capabilities and backgrounds can be a strength. Working for the same project is not enough to get your name on someone’s article, but all the authors are required to provide a positive contribution to the realisation of an article. Also, note that some Journals limit the number of authors to e.g. four. As a rule of thumb, it is beneficial to include your supervisor as a co-author. This way you respect the help you receive and maintain the relationship.

The following discusses a recommended order of writing an article and gives tips on how to write different chapters.

Recommended order of writing

- Initial outlining of introduction (research questions)
- Initial outlining of theory
- Writing experimental elements
 - results
 - analyses
- Research process
- Finalising theory
- Introduction
- Conclusions
- Abstract
- Finalising

The presented order of writing highlights the importance of your results for defining the focus of your article. The focus of your article is sensible to define based on the evidence you have. This way you freeze the focus of your article relatively early and avoid unnecessary re-work when writing theory and other elements.

It is sensible to start writing an article by outlining the subject matter and content by a few bullets or key words. This phase acts later as an aid in writing an introduction.

After initial ideas and outlining, try to find a suitable target Journal. One of the vital aspects for a doctoral student is Journal's *turnaround time*, the time until feedback and decisions, to enable swift learning. Some Journals indicate their response time either on their web page, or on the published articles. Should this information not be available, you can consider sending a polite email to the editor-in-chief.

Aim to analyse about five recent articles in the target Journal, paying special attention to topics, structure, utilised research methods etc. If the Journal does not feel suitable, choose another one and conduct similar analysis. Browse through the editorial board and previous authors, and pay special attention on nationalities. For a European author, it may be beneficial if some of the authors and editorial board members are European. As an example, a pure US board may in some cases prefer American authors.

After selecting a potential target Journal, outline the initial theory for your article. After this, you will need to concentrate on the core of your article and write the results and analysis of your research. Once you have these elements, it may be worth reviewing your target Journal selection, if there are any reason to change, make a note on potentially different format and other requirements, such as the recommended article length. Now you have the core substance ready and you can concentrate on elements critical for articles acceptance, namely, introduction, discussion, and abstract.

In practice, an article constitutes of the following elements:

- Title
- Abstract
- Introduction
- Theory/Literature review
- Research method/ process
- Results (is sometimes divided into results & analysis)
- Conclusions

Note that the article structure may be slightly different for some disciplines. For example, the literature review may be integrated into the Introduction chapter.

The following will provide tips for each individual element.

1. Title

When considering a title for your article, do familiarise yourself with the types of titles in the target Journal, analyse whether they are more general or very specific. Editor-in-chief will want article titles to sell and gain clicks. This is why in some cases a more general title may be better than overly specific. Avoid abbreviations in the title and unnecessary “and” words. Fundamentally, a too long title is not good as the reader will have difficulties in perceiving the content. Suitable length may be for example less than eight words.

2. Abstract

Abstract is one of the most central elements of your article, luring other people to read it and may also influence the acceptance of your article. An abstract must describe the purpose of your article. Also, it must describe how you have realised your research and

provide few key findings and any practical implications. You can build your abstract by answering the following questions by preparing one or two sentences for each one:

- What is the bigger, more general whole your article relates to?
- What is the purpose of your article?
- What methodology have you used?
- What are the key results?
- What are the practical implications of your research (how can the results be utilised by e.g. practitioners or companies)?

Your target Journal may have some specific requirements relating to formulating the abstract, such as the word count. Make sure that the abstract is well written, including easy-to-follow transitions between sentences.

3. Introduction

Introduction justifies the significance of the subject matter and connects your work to previous research. It is sensible to write the introduction to form a logical *funnel*, where more general aspects are told first and sentence-by-sentence, paragraph-by-paragraph proceeding into more detailed. The purpose of the article is told last in the introduction by describing the research problem. Do NOT include any results in the Introduction. As the abstract already includes the key results in a condensed form, Introduction can be started in a more general manner. In our experience, a logical funnel is a practical way to build up a functioning introduction.

Start the introduction with sentences that are adequately general, and simple enough to understand even for those who are not experts in exactly the same topic as you. This way different type of readers will better understand the subject matter your article concerns. Aim to motivate the reader and provide understanding on why your research topic is important. Utilise published Journal articles to point out the importance, preferably recent ones as the editors will want the scientific discussion to occur on their own medium.

One way of describing the article content is to use research questions, which are presented at the end of Introduction. Research questions help the reader to perceive the content of your article and the author to structure his/her thoughts and writing. When using research questions, the author must remember that the questions can be changed or adjusted during the writing process. It is also imperative that the research questions and later results match.

4. Theory/Literature review

One can start writing a literature review by finding for example five good articles, of which some are from the target Journal, and maybe few good books discussing your topical area. Write a few pages long summary based on these articles and books. This will help in obtaining a relevant understanding on your research topic and acts later as a frame for the theoretical part of your article. You may also be able to obtain credits for these summaries.

Write the theory to support the storyline or your article. Note that it is not customary to describe the development of your own understanding in an article (cp. e.g. Master's thesis), but describe what others have studied relevant to your topic. When looking for references, do not chase terms, but aim to understand what the true meaning of these articles are. It is important that you refer to some gurus in your field to show that you

know the scientific research in your field. Additionally, it is important to refer to new Journal articles to ensure the timeliness of your article. Minimise references that are not in English as reviewers cannot verify them.

It is wise to finalise the theory only after writing the results of your article. This way you can once more search for related studies and can thus better focus the literature review to match your results.

5. Research method/ process

An article must describe your research, the set up, and research methods precisely. This way the reviewers can assess the scientific basis of your research and the justification of your results. In principle, research method/ process should be described so that another researcher can repeat the study.

It is important to clearly describe how the research is done. If needed, you can visualise the preceding of the research. Also, you can include more justification as appendices, if necessary (for example, in qualitative research, the interview questions).

6. Results

Once completing experimental research and analysing the results, it is time to write and summarise the results, and especially the analysis. The experimental part of a Journal article must concentrate on the actual *analysis* of the material, not on documenting the data. Note that this differs from writing for other purposes, e.g. research report.

Consider what the core results of your research are and bring them forward clearly. Also, do highlight the core results by using visual elements (anything that differs from basic text, e.g. lists, illustrations, and tables). This way, anyone who quickly ruffles through the article will focus on the key results and will automatically get a level of conception of your results.

7. Conclusions

Conclusions chapter, alongside Abstract and Introduction, is one of the core elements of a Journal article. Conclusions chapter can be written by using the following structure (one paragraph each):

- Introduction
- Results (one paragraph for each research question)
- Significance of the research/ practical implications e.g. for companies
- Limitations
- Recommended topics for further study

By using this type of structure, you make it easier for readers to follow your thinking and enable understanding the core content without reading the entire article. It is important to include the practical implications of your research in the conclusions chapter, i.e. what are the implications for practitioners, companies etc.

8. Reacting to reviewers' comments

Typically, articles are not accepted for publication exactly as they are initially submitted, but reviewers require some changes. Obtaining critical comments is a good thing, meaning that you have a chance for publication - it is a **time to work and analyse!** The feedback may initially seem harsh, however, do not get depressed. Be analytical and start the work. It may be sensible to ask colleagues to join analysing the critique. You may be closer to acceptance than you first think. If you have chosen the right Journal, you have good chances for publication, once you take the effort and react to the given feedback.

It is important to carefully analyse what the feedback really means. Any requirements that initially feel extensive may in practice require relatively small changes to the article. Often you only need to adjust the way the "story" is told.

Do react swiftly to the given feedback and acknowledge all the critique. Should you wish not to change something, regardless of critique, do justify this decision in the covering notes. Do write a cover letter, where you give a point-to-point response to all the reviewers' comments indicating all the changes to the article, and justify if you did not change something. The purpose of the point-to-point response is to avoid the reviewers being forced to read the entire article again when checking your changes.

TIPS FOR APPLYING RESEARCH GRANTS

As a doctoral student you can apply for research grants to finance your research. There are a variety of different grants available, for full and partial time work, ones for a specific purpose, such as travel or equipment purchase. Do note that there are also *supportive grants* that are given regardless of your income from any other sources, as a reward for good work or a research plan. You can also decide yourself how to use a supportive grant, while reporting the progress of your dissertation work is often the only requirement.

This document does not try to describe the process of applying grants, but gives few tips for effective application. Preparing grant applications for different foundations also helps you in outlining your own research plan. By asking your colleagues to comment your application you will improve the chances for success and clarify your research plan. Do remember to return the favour!

Research grants are mainly applied from numerous different *foundations supporting research* in a variety of fields. For example, the University of Turku, Finland maintains a list of different foundations, each of which has its own unique criteria and application process. As a general advice, more applications you send to different foundations, higher the chances are for obtaining a grant. Nevertheless, foundations often wish to support young researchers that are capable of coming up with results, and whose research may have a positive influence to the surrounding society. Even if you are a more mature person, do apply when possible as there are foundations that are interested in supporting researchers of all ages. It is always worth applying, even at the start of your doctoral studies, as applying will improve your research plan and you can never be sure when you will be successful.

The central aspect of your application process is your own *research plan*. You may need to slightly modify your research plan for different foundations, including the length and focus of your plan. It may be wise to target the description of your research to fit the criteria of a potential foundation.

As a rule of thumb, maintain **two parallel research plans** to enable effective modifications for different foundations:

- 4 pages (main version)
- 1 page summary (often the most vital part of your application)

Research plan structure

- Summary
- Introduction – describe the subject matter of your research, and who benefits of your work (target foundation specifically)
- Description of the current state and future progress of your research
- Description of the realisation of your research and potential results
- Research questions, methods, etc.
- Description of financing your research (other grants, or other finance)
- Schedule for your research
- Your existing publications, if any (as evidence that you do get the work done).

When writing your research plan, pay special attention to clarity and readability. Aim to describe the benefits and results as clearly as possible. Do not write overly scientific

descriptions, but aim to write for “wider public”. The foundation representatives are not necessarily specialists in your specific field, and he/she receives hundreds of applications. The recipient also wishes to understand in a limited timeframe to whom he/she believes the money should be given. One needs to easily see the core aspects of our research plan.

Bring forward the progress of your work clearly, together with any obtained results, both in your research plan and in grant application. It is important to show your progress to the date and assure that you can progress swiftly with your research and will complete your dissertation. You can give this indication, for example, through listing your publications.

Update your research plan frequently, at least in the pace of common application deadlines, 2-3 times a year. In the field of engineering, the main application deadlines are roughly during winter (January-February), spring, (May), and autumn (September-October).

One important aspect for receiving research grants is letters of recommendation. Do ask your supervisor to write a recommendation letter (supervisors usually are happy to do this). These recommendations have a significant role when deciding who gets the grants.

APPENDIX I. STRUCTURE OF A MONOGRAPH DISSERTATION

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Abstract
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List of abbreviations and definitions

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APPENDIX 2. STRUCTURE OF A COMPILATION DISSERTATION

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Title

Abstract

Acknowledgements

List of abbreviations and definitions

List of original publications

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University of Oulu
Teaching development unit
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90014 UNIVERSITY OF OULU
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