Chapter 12
Compiling Your Work into a Dissertation

Abstract In this chapter, we discuss writing the dissertation. The first topic deals with planning the writing of a dissertation. We discuss how to estimate the amount of time that you need for your writing, and how you can spread out the writing so that you can move forward slowly but surely, without needing to pull all-nighters or other forms of writing sprints. A second topic deals with structuring a dissertation: you have all your material ready, or you are at a point where you have a good grasp of your work and what remains to be done – how do you now bring everything together into a coherent dissertation? A third topic deals with self-care during the writing of a dissertation. Writing a document of 100,000 words takes time, and often PhD students burn out before finishing their writing. To avoid this pitfall, we stress the importance of a good planning that allows sufficient time for writing, and the importance of routines and other activities that keep your mind balanced. A fourth topic deals with the practicalities of writing the introduction and conclusions chapters of your dissertation. We also touch upon the topic of future work, and how to identify additional elements for future research. The fifth topic deals with the defense committee. We talk about how to compile a balanced committee, for those who have a voice in the selection of their committee members. Then, we look at how to implement the comments of the committee members. The final part of this chapter talks about the thesis defense. To prepare for a defense we outline some standard questions.

Keywords Dissertation · Thesis · Writing · Academic writing · Introduction · Conclusions · Thesis defense · Viva

12.1 Introduction and Learning Goals

This chapter describes all steps required for submission, completion, and defense of your doctoral dissertation, or PhD thesis. If your requirement for graduation is the development of a “big book”-style thesis, then you will find all relevant information in this chapter. If your requirement for graduation is a number of journal articles, revise the information in Chap. 11. To compile your journal articles into a dissertation, you will still need to write the introduction and conclusions chapters. You can find recommendations for these elements in this chapter.

E. O. L. Lantsoght, *The A-Z of the PhD Trajectory*, Springer Texts in Education,
https://doi.org/10.1007/978-3-319-77425-1_12

As always, planning is essential in finishing your dissertation before your funding or scholarship runs out. We discuss when is a good moment to start writing your dissertation. If writing propositions is part of the graduation requirement, check out the section about writing propositions, and finding ideas for propositions. Then we continue with looking at the actual writing of a dissertation. A typical PhD thesis is about 100,000 words long. The main technical challenge for many students that need to write such a large amount text, is to keep the "red thread" through the entire text. This red thread should be your answer to your research question and subquestions. Moreover, when you need to produce a large document, you may feel overwhelmed, or you may lack motivation, For those of you in this situation, we will discuss how you can stay motivated and stay on track with your planning while you write your entire dissertation. Writing a dissertation is a marathon, not a sprint. In a next topic, we go into the technical details of bringing everything together in the first and last chapters of your thesis: the introduction, and the conclusions. For these chapters, it is important to crystalize the most important elements of the dissertation, without becoming repetitive.

Depending on the procedures in your country and institution, you publish your thesis before your defense, or need to submit revisions after your defense. This chapter is written assuming you will finish your dissertation first, and then defend your thesis. The recommendations, however, are still generally valid in case the procedures are different at your institution. Since the publication of the dissertation prior to the defense will involve quite some interaction with the committee members before the defense, you will find all tips related to implementing the comments of committee members in a subchapter.

The last topic is the actual defense[1] of the dissertation. We will discuss how to move from finished thesis to the day of the defense, how to prepare for the defense, and how to sail smoothly through the big day.

12.2 Planning Towards Your Dissertation

12.2.1 How to Plan Your Dissertation

By now, you may wonder if I'm even able to start a chapter without talking about planning in the first place. If you made your general plan for your PhD trajectory as outlined in Chap. 3, then you should already be planning towards the finalization of your dissertation, and your defense. So why should you plan your dissertation then? Let's say that your multiple-year-plan from Chap. 3 has all the major milestones. You won't know in the very beginning when you are exactly ready to start

[1] Also called: viva.

Table 12.1 Overview of writing of dissertation

Time period	Activity
19/02/2012–03/03/2012	Writing chapter 1 & 2
04/03/2012–02/04/2012	Writing chapter 4
03/04/2012–21/04/2012	Writing chapter 3
22/04/2012–09/05/2012	Writing chapter 2
23/05/2012–21/06/2012	Writing chapter 7
04/07/2012–31/07/2012	Research for chapter 6
01/08/2012–16/08/2012	Write chapter 6
05/09/2012–20/10/2012	Research for chapter 5
21/10/2012–30/10/2012	Write chapter 5
01/11/2012–11/11/2012	Calculations with theory of chapter 5 for chapter 6 + add this information to chapter 6
05/11/2012	Update chapter 2 with model used in chapter 5
05/11/2012	Update chapter 7 with discussion about skewed bridges
06/11/2012–11/11/2012	Write chapter 8
12/11/2012–13/11/2012	Compile dissertation
14/11/2012	First draft to supervisor

writing – you may have it as a goal to start writing somewhere half-way your PhD trajectory, but you will not have defined your chapters and contents yet.

When we talk about planning your dissertation, we deal with identifying in which months you will write which chapter. You will need to already have a main idea of the chapters that you will write, even if you haven't finished all the research yet or have all results available for each chapter. You need to be able to estimate the time it will take you to come to the first draft of each chapter, including the remaining time to finish your research. In doing so, you will also need to move some topics to the side that may look interesting, but that don't have a direct place in your dissertation. When you make a planning for writing your dissertation, also add an estimated word count for each chapter.[2] Generally, your introduction and conclusions chapters will be shorter, and all chapters in between can be of comparable length. You can see how and when I wrote the chapters of my dissertation in Table 12.1. As you can see, I didn't write all chapters in order, and I still had to do all the research for Chap. 5, which then also influenced what I introduced in the literature review chapter (Chap. 2) and what I compared to my test results in Chap. 6.

So, once you have identified in which month you will write which chapter, you need to translate this into estimating the amount of time you will need for writing each chapter, and the amount of time you need to reserve in your calendar on a daily

[2] Provided that you find working with goal word counts motivating.

basis to move your writing forward. Plan ahead, and leave yourself plenty of time, so that you can work steadily towards graduation without needing to pull all-nighters and other forms of writing sprints. Keep in mind that you still need to fit in other activities, such as teaching and writing conference papers.

As with all writing, you need to know that writing the first draft is not what takes most time. When I finished writing the first draft of my dissertation, I was convinced that I had done the majority of the work on my thesis. The data [1], however, proved that I was wrong. During my PhD, I meticulously tracked my time in ManicTime on my office computer, and I calculated that it had taken me about 205 hours to write my first draft version, between March 2012 and November 2012 (nine months, see Table 12.1, not counting the long summer holidays I took that year, because that's the summer I will always remember as the summer I got married, not the summer I spent holed up inside, writing my dissertation). Little did I know that I would need much more time to finish the final version of my dissertation. Including the comments of my promotor and copromotor took me 123 hours, between November 2012 and January 2013. Then, my draft thesis was sent to the committee. Implementing the comments of my committee is what took me most time: 255 hours in total between February 2013 and April 2013. In adding the comments of the committee, my thesis grew from 200 pages to 300 pages. The last preparations included layout and getting the document ready for printing and publishing, which took 30 hours in May 2013. In total, writing the entire dissertation took me over 600 hours. For most chapters, I had research reports ready by the time I got to writing the chapter. I progressed rather slowly in the first months, as I combined finishing reports with writing up the respective chapters. For one chapter, I still had to do all the research. As a result, the actual time spent writing over those first nine months was only 205 hours, but I needed the time of those nine months to finish the required research. I did most of my writing in the evenings and on weekends, as my work days were still filled with finishing up research and teaching duties.

Before you start planning, and think that you can simply fit 600 hours in ten weeks of 60 hours, read carefully what I wrote above. The number of months it takes and the number of hours you can spend on writing depends on how far you are in your research. You need to look at your time logs of the previous months to have a good estimate of the amount of time it takes you to write a certain number of words, how much time it will take you to do the remaining research work, and how much time it will take you to finish the remaining research reports. Keep in mind as well that you can't just storm forward to the completion of your dissertation. Sooner rather than later your supervisor will need to read your work, and provide input. If you try to finish everything in a short amount of time, you can't expect from your promotor that he/she will be able to read it all and provide feedback in a matter of a few days.

When you plan writing your dissertation, keep in mind that dissertation-writing can bring out doubts and fears about your writing voice and expertise. As such, the process can be a "messy, unanticipated experience of conducting research and writ-

ing a dissertation" [2]. Kamler and Thomson argue that the development of your dissertation is text work/identity work, i.e. that your identity as a scholar is "formed together, in, and through the process of dissertation writing". "The practices of doctoral writing simultaneously produce not only a dissertation but also a doctoral scholar," they caution. Allow yourself time and space for this growth process.

12.2.2 How to Kick-Start Your Writing

If the idea of starting to write a chapter feels terrifying, you can start to generate documents with loose ideas for each chapter. Typically, a dissertation will contain (some of) the following chapters:

- Introduction
- Literature review
- Methods
- Analysis of results
- Development of theory
- Verification of theory with results
- Computational modeling
- Comparison between computational analysis and experimental results
- Recommendations for practice
- Case studies
- Summary and conclusions.

Depending on the type of research you are doing, you can identify which of these elements will go into your dissertation, and number your prospective chapters. Then, start a file for each chapter. Every time you come across some interesting information, you can copy the reference, a relevant figure, and/or an interesting quote into the document of the relevant chapter, see for example Fig. 12.1, in which I added information about a certain topic from a report to a section and commented how I needed to implement this information into the chapter. As you start to shape your research, you will be able to spend an afternoon developing an outline[3] for the respective chapter as well. Just add this outline to the document of the relevant chapter, reshuffle the snippets of information that you have in there, refer perhaps to parts of your research report, or even copy-paste parts of your research report in there for future modification, see Fig. 12.1, and then let it be again. Once you feel ready to start writing a chapter, you can take this document, and you will already have some information to start working with. You don't need to start writing your first chapter first. You don't need to start writing each chapter from the beginning to the end – you can start from the part of the outline where you have the most

[3]You can simply list the topics you want to discuss and organize later if outlines don't work for you.

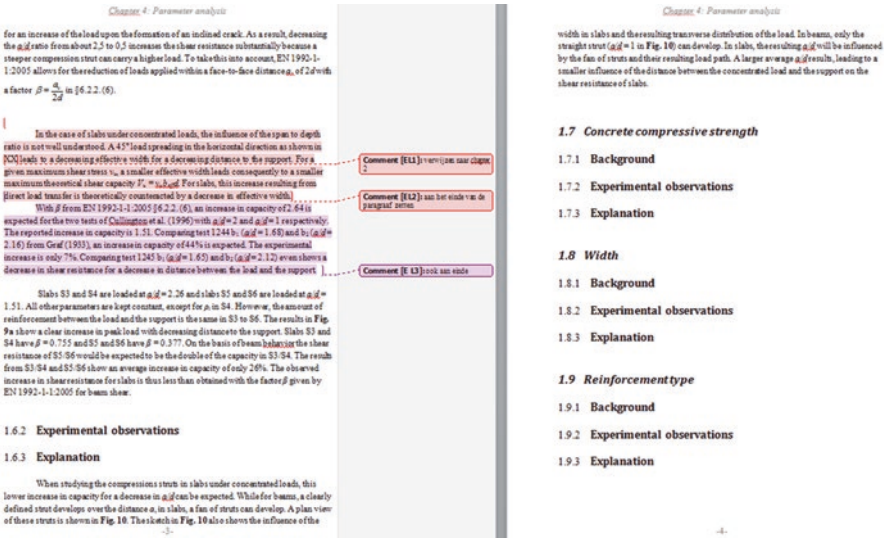


Fig. 12.1 Getting started with writing a chapter by copying and pasting available information from reports and adding comments

information ready to get your writing momentum going. With this simple method, you won't have to stare at a blank screen to start writing a chapter – you can just plunge in and start working on the information you have available. As you start working on these documents, make sure to turn them into the right format for your final dissertation – you don't want to spend countless hours moving tables and figures around because the page size for your final dissertation is smaller than the regular A4 or Letter size that you are using for most documents.

12.2.3 When to Start Writing

Often, students ask me when is the right time to start writing. Should you start writing your dissertation at the beginning of your PhD trajectory, and revise and edit your documents as you move your research along? Should you wait until the very end, when you have everything ready and all you need to do is sit down and write? The truth lies somewhere in between.

As discussed in Chap. 2, you should start writing in the very beginning. But, here's the caveat: you won't start writing your dissertation at the very beginning of your PhD trajectory. To start writing your actual dissertation chapters, you will need to be sufficiently far in the PhD trajectory (half-way is a good starting point) to know the red thread that needs to be woven through your work. That red thread will be your main answer to your research question. If you start writing and rewriting material from the very beginning, you risk to develop a very fragmented disserta-

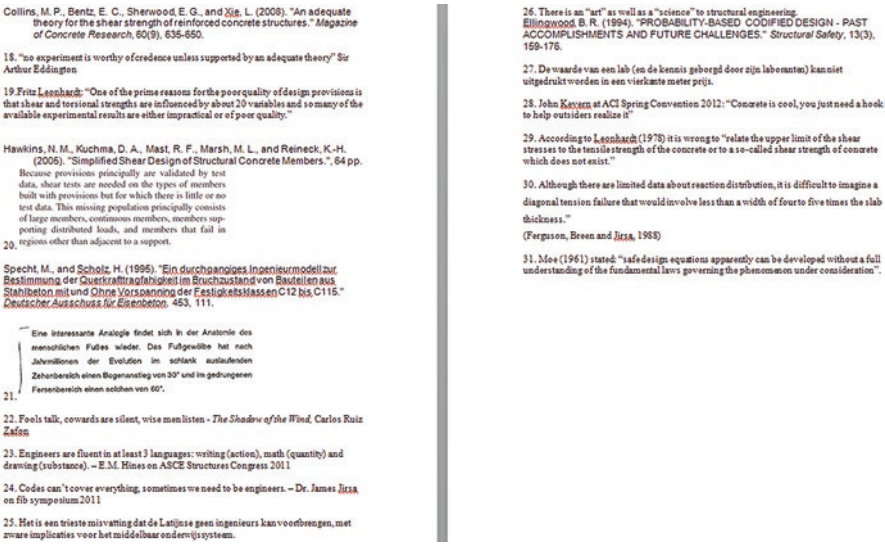
tion. Instead, I recommend you start writing short documents and material for discussion with your supervisors early on. After these initial exercises, you can move to research reports, such as the report with your literature review, or giving the description or analysis of your experiments. You won't reproduce large amounts of text from these research reports into your dissertation. Instead, you will summarize the important information (often in overview tables or figures) and refer to your reports for further reference. What you summarize, and the way you present the information in your dissertation, will again be related to how you are answering your research question and subquestions.

Don't postpone writing to the very end of your PhD trajectory. You may have heard wild stories from other students that claim that you can easily write a dissertation in six weeks or three months. Perhaps it is possible. Perhaps that first draft will need many rounds of revisions because it was written so hastily. But by all means, if you need to sit down and write from the morning to the evening, you won't be having a good time. I haven't met anyone who claims he/she wrote his/her thesis in six weeks and didn't feel miserable or ended up living on junk food and coffee. Do yourself a favor, and plan. You'll perhaps end up spending the same amount of time on your writing, but stretched out over a larger period of time, than when you need to speed up the process at the end. But, you'll be writing when your planning tells you it is time for your daily timeslot of writing, and at the end of the day you can go home and relax. So, which option sounds more pleasant to you?

12.2.4 Writing Propositions

In some countries like the Netherlands, your requirement for graduation is the development of the dissertation and propositions that you need to be able to defend. Traditionally, the propositions were the only graduation requirement in the Netherlands. Nowadays, the propositions are still an integral part of the defense. In the Netherlands, these propositions should include some defendable statements that result from your thesis, some defendable statements related to your field in general, and some statements related to other fields that are not related to your research, such as politics. One proposition is also supposed to be "funny".

You can imagine that if you need to come up with these propositions, you don't sit down one afternoon and write a list of propositions. You will need sufficient time during your PhD trajectory to think and develop possible propositions. Don't wait until the very end to write your list of propositions. I was lucky to hear this golden nugget of advice from a senior PhD student, and it made developing the propositions a walk in the park. If against all better advice, you do end up with a draft dissertation but still no propositions, then get out of your office. You'll get more inspiration for your general propositions by going to a coffee place or pub with friends, and discuss life, the universe, and everything. Just remember to write down your ideas before you forget them.


Collins, M. P., Bentz, E. C., Sherwood, E. G., and Xie, L. (2008). "An adequate theory for the shear strength of reinforced concrete structures." *Magazine of Concrete Research*, 60(9), 635-650.

18. "no experiment is worthy of credence unless supported by an adequate theory" Sir Arthur Eddington

19. Fritz Leonhardt: "One of the prime reasons for the poor quality of design provisions is that shear and torsional strengths are influenced by about 20 variables and so many of the available experimental results are either impractical or of poor quality."

Hawkins, N. M., Kuchma, D. A., Mast, R. F., Marsh, M. L., and Reineck, K.-H. (2005). "Simplified Shear Design of Structural Concrete Members.", 64 pp.

20. Because provisions principally are validated by test data, shear tests are needed on the types of members built with provisions but for which there is little or no test data. This missing population principally consists of large members, continuous members, members supporting distributed loads, and members that fail in regions other than adjacent to a support.

Specht, M., and Scholz, H. (1995). "Ein durchgangiges Ingenieurmodell zur Bestimmung der Querkrafttragfahigkeit im Bruchzustand von Bauteilen aus Stahlbeton mit und Ohne Vorspannung der Festigkeitsklassen C12 bis C115." *Deutscher Ausschuss für Eisenbeton*, 453, 111.

21. Eine interessante Analogie findet sich in der Anatomie des menschlichen Fußes wieder. Das Fußgewölbe hat nach Jahrmillionen der Evolution im schlank auslaufenden Zehenbereich einen Bogenanstieg von 30° und im gedrungeren Fersenbereich einen solchen von 60°.

22. Fools talk, cowards are silent, wise men listen - *The Shadow of the Wind*, Carlos Ruiz Zafon

23. Engineers are fluent in at least 3 languages: writing (action), math (quantity) and drawing (substance). – E.M. Hines on ASCE Structures Congress 2011

24. Codes can't cover everything, sometimes we need to be engineers. – Dr. James Jirsa on fib symposium 2011

25. Het is een trieste misvatting dat de Latijnse geen ingenieurs kan voortbrengen, met zware implicaties voor het middelbaar onderwijssysteem.

26. There is an "art" as well as a "science" to structural engineering. Ellingwood, B. R. (1994). "PROBABILITY-BASED CODIFIED DESIGN - PAST ACCOMPLISHMENTS AND FUTURE CHALLENGES." *Structural Safety*, 13(3), 159-176.

27. De waarde van een lab (en de kennis geborgd door zijn laboranten) kan niet uitgedrukt worden in een vierkante meter prijs.

28. John Kevern at ACI Spring Convention 2012: "Concrete is cool, you just need a hook to help outsiders realize it"

29. According to Leonhardt (1978) it is wrong to "relate the upper limit of the shear stresses to the tensile strength of the concrete or to a so-called shear strength of concrete which does not exist."

30. Although there are limited data about reaction distribution, it is difficult to imagine a diagonal tension failure that would involve less than a width of four to five times the slab thickness."
(Ferguson, Breen and Jirsa, 1988)

31. Mee (1961) stated: "safe design equations apparently can be developed without a full understanding of the fundamental laws governing the phenomenon under consideration".

Fig. 12.2 Collecting ideas for the propositions

Just as with the kick-start method for writing dissertation chapters, you can keep a file on your computer, and jot down an idea or quote that could be a proposition whenever you stumble across it. You can see the file that I developed in Fig. 12.2. Once you need to compile your final list of propositions, you will have a fair amount of information to pull from. You will need to revise your wording, and make sure every word is crystal clear (unless you are using a quote). You will need to be honest with yourself, and see if you can defend each and every proposition, even the proposition that is supposed to be funny. Do you have enough data and background for each proposition?

12.3 Structuring a Dissertation

12.3.1 How to Outline Your Dissertation

Once you know the general topics that need to go into your dissertation, you need to decide how you will tie all these elements together. Remember that the main idea, the red thread through your work should be your answer to your research question. If you have all material ready, or are at a point where you have a good grasp of your work and what remains to be done, you need to tie everything together into a coherent dissertation. You need to bring structure into your mass of ideas [3].

Once you feel ready to start writing your dissertation, the first thing you will need is an overview of how you will structure your dissertation. Traditionally, the first thing your supervisor will ask you, is a table of contents for your dissertation.

However, you may need another approach to get started. You may need to think very well about the cohesion of your dissertation, and how you will answer your research question and subquestions, and how you will keep your main idea strong and solid throughout your entire dissertation. If you start by developing a table of contents, without keeping the bigger picture in mind, you risk ending up with a very fragmented document, which will need many rounds of revisions before it all comes together.

Think of your general overview as the map you can refer to. Think of your thesis as Mordor. One does not simply walk into Mordor. One does not simply walk into thesis writing. You need a plan and some magic powers (or better: a good grip of how you will answer your research question in your dissertation). You need to gather your weapons and have your map to guide you before you start plodding through thesis writing land.

The best way to have a map of what you will write, is to mind-map. Develop a scheme or diagram of the contents of your dissertation, so that you get to understand how the different chapters are interrelated. You can make a rather elaborate mind-map, or stick to a general overview that looks like a flowchart. If you are not sure about what you want to discuss in your dissertation, start from your research question. The answer to your research question should be the red thread through your dissertation. The answer to the subquestions can each be discussed in a chapter, for example. Or, if you are more of a visual person, draw a mind-map of your research question, how you branched out to subquestions, and the results you have so far and/or are expecting in terms of answering each subquestion. In the next step, you need to draw, sketch, or describe how these elements tie together. Refer to Chap. 5 for a discussion on how to combine the subquestions of your research question into your main chapters.

Besides functioning as a map, you can also use this scheme in your introduction chapter to explain the contents of your dissertation to your readers. A typical introduction contains a short summary of what the reader can expect in every single chapter of your dissertation. If you add the diagram of how the contents of these chapters are interrelated, or which data you have used where, it will be clearer for your how to read your dissertation.

Exercise

1. On a sheet of paper, write a bullet list with the major research tasks you have done so far (eg. literature review, case study X, recommendations for funding institution, experiments, theoretical work, …) . Then, write your research question in the middle of a large sheet of paper (a new sheet), and branch out with your subquestions. Identify how you need to answer each subquestion. Then, look at your page with the research tasks you have done so far. Where do they fit in? Add these to your sketch with the solutions to the subquestions. Some research tasks may fit in multiple categories – if that's the case, identify the relation between these subquestions. Now, look at your overview. How can you tie this information into a structured dissertation? Make an overview drawing that is as simple as possible, to function as your map for writing the dissertation. Which research tasks do you still need to do to answer your research question and subquestions? Identify the remaining tasks, and plan for them. Use the overview you developed to draft a table of contents for your dissertation,[4] and send this to your promotor for discussion.

12.4 Staying Motivated When Writing Your Dissertation

12.4.1 A Little Goes a Long Way

A key element to staying motivated when you need to write an entire dissertation is that you need to start early on. Slow and steady wins the race. Don't try to cram too much writing into a short amount of time – you will crash and burn before reaching the finishing line. Again, planning is a key tool here – to know when to start writing, and to put in the daily work of writing. Work in time slots of one to two hours daily, and try to achieve a certain word count during those hours if you need to produce text, draw a certain figure, edit a certain number of pages… Make sure you know exactly what you will be doing with your short time slot for the day, and do something that moves your dissertation forward – slowly but surely. You don't need to spend endless hours behind your computer screen every single day. Of course, you will have plenty of other tasks to fill your workday – but don't feel tempted to stay late every day to get your writing done faster. Take enough time for rest and relaxation, so that you will feel refreshed, energized, and inspired the next day when you tackle your next, well-defined writing task.

[4] If your promotor likes seeing a table of contents as a starting point.

Schedule frequent meetings with your supervisor to discuss your progress, and to discuss the chapters you have written so far. Don't wait until you have a complete first draft to show it to your supervisor, but start to get his/her input early on. If you have doubts about requirements with regard to contents, depth, level of detail, or writing style, make sure that you discuss these elements early on, so that you can make course corrections as you write your first draft. For an excellent book, filled with weekly exercises to become an academic writer, see [4].

12.4.2 How to Stay Motivated and Balanced

When you have written two chapters, but still need to write six more chapters, you may have the impression that you have been writing forever, but that at the same time you are nowhere. Just remember that every day, every time you show up to write and move your dissertation forward, you are placing one foot in front of the other. And some day, somehow, your dissertation will be finished.

If you feel disheartened by the realization that you've already done so much, yet achieved so little, you may start to lose your motivation. You may feel stressed and worried, or simply dread the idea of waking up in the morning and going to university, where another day of writing, doing research, and teaching waits for you. One way to tackle this dark mood, is by having routines in your schedule. If you commit yourself to writing simply one or two hours each day, and to do one specific task (as discussed above) during that time, you may feel as if you have more grip on the situation. Your task is clear, and you know that at the end of your writing time slot for the day, you will have done something small but significant towards completion of your dissertation.

Another important element while writing your dissertation is to take good care of yourself. Routines in your working schedule and other activities that are not related to work are important to get you out of your stuffy office and into the world [5]. At the very beginning, in Chap. 2, we talked about the importance of including self-care and fun activities into our schedule. This advice is more important than ever when you are writing your dissertation. If you feel that your life currently is all work and no play, turn it around by signing up for a dance class, joining a book club, or simply calling your friends for drinks.

Whereas most of us begin with outlining our work (for example, in the form of a table of contents or by developing a diagram), and most of us finish our dissertation with compiling the list of notations, checking the format of references, compiling the final table of contents, and writing our acknowledgements for those who supported us during all this time, what happens in between these moments can be a bit messier. Somehow, at some point, we all run into gaps in our work, and need to spend a few more weeks to figure things out. Dissertation writing is almost never a process of smooth sailing,[5] so here are some ideas for what you can do to pick up your motivation again:

[5] It's a journey of finding your identity as a scholar.

- **Reread an important paper**: Remember what got you inspired and motivated to do your research in the first place. Look for that inspiration again by revising a paper that was crucial for your research. If you are stuck in trying to fill a gap in your work, reread a paper that was essential to your work. If you need some fresh ideas, read a recent publication in your field. Remember that reading sparks creativity [6].
- **Edit a previous chapter**: If you want to leave the heavy number-crunching behind for a few days because you got stuck in trying to fill a gap in your work, then procrastinate by doing something useful. Pick a task that doesn't require much of your deep work capacities, but that still needs to be done before completion of your dissertation. You can edit a chapter that you wrote earlier, format a table, put some symbols in the list of notations, or make a drawing. Do something that you can easily tick off your checklist, and perhaps the action will make you forget about your foul mood.
- **Work on your propositions**: If a list of propositions is part of your graduation requirements, as it is in the Netherlands, then you may divert your thoughts when you get stuck by working on your propositions. If you've started to compile a list of possible citations and ideas, you can start to filter out some good ideas for your list of propositions. If you don't have any idea yet, you may want to browse your literature for good citations for your propositions.
- **Take some time off**: Sometimes, all you need is a weekend of time away from your research to feel refreshed and inspired again on Monday morning. Commit to having an evening or weekend to doing things you love. Don't spend it scrolling through your Twitter feed on your phone. Instead, think about what would feel really good for you now. Is it a dinner with friends, a cup of wine, a hot bath, three hours of escape with a book, a long bike ride…? Ask yourself consciously what would feel good for you right now, and honor that feeling.
- **Talk to your supervisor**: Are you having a difficult time, then let your supervisor know. If you are stuck and can't find a way out, outline possible solutions, list down what you've done so far to try and tackle the problem to no avail, and discuss this with your supervisor. He/she may just have the right idea to get you started again. If there are other difficulties in your life that keep you feeling down, let your colleagues and your supervisor know.
- **Accept friction**: Friction and creative blocks are inherent parts of the research process. There will always be this point when you feel really stuck and you need to sweat all the little details before suddenly you start to move forward again. Be prepared to face some creative and mental blocks while writing your dissertation. Everybody goes through these difficulties at some point during their PhD trajectory, and for many these difficulties arise during the writing stage. Accept friction as part of the process – it is not a sign that something is wrong with you as a scientist. In fact, you are growing as a scholar and finding your identity.
- **Set boundaries:** Don't work all your waking hours. Sure, there will be times during your PhD when you need to do a little sprint, or need to temporarily put in some extra effort. The number of scholars who've worked a nine-to-five schedule from the days of their PhD until getting tenure and beyond is very lim-

ited. You should set office hours (or work hours, if you don't always work in an actual office) for yourself for most days, and at the same time allow yourself to roll with the punches when needed. Everybody is different in what works best for them. For me, starting around 8 am together with my colleagues and leaving no later than 6 pm (when I am hungry and want to have dinner) worked well during my PhD days. If needed, I'd put in a bit more work after dinner, and I often worked on Sunday. Just identify for yourself what is a comfortable working schedule. Know what are non-negotiable self-care elements for yourself, and commit to never giving these up. Identify your comfortable working schedule, even if you are a part time PhD candidate, and plan your tasks and time slots accordingly.

12.5 Writing the Introduction and Conclusions Chapters

12.5.1 How and When to Write Your Introduction

There is a lot of discussion on when you should write your introduction chapter. Should you start writing your introduction chapter at the beginning, because it is your first chapter? Should you wait until the very end, because the introduction chapter needs to contain a brief introduction to what you will cover in all other chapters? As with all difficult questions: it depends…

If you start writing your dissertation, I recommend that you start by developing your overview diagram, and an extended table of contents or mindmap outlining how your subquestions will be answered in the separate subsections of each chapter. Then, if you feel ready for it, I recommend that you write a first draft of your introduction chapter. Your introduction chapter will discuss what the reader can expect in your dissertation. As such, writing the introduction chapter is an excellent exercise in framing your mind to what you need to discuss in your dissertation. Similarly, having your introduction chapter ready, with an overview of what you will cover in your dissertation, is a good starting point to discuss with your supervisor. Does he/she agree with your writing style? Did you define and limit the topic in an appropriate way? Your introduction will typically give a short background to the problem you studied, define the scope of your research, outline the aim of your research and/or state your research question, discuss the outline of your thesis, and perhaps give an idea of the impact of your work on society (or how your little piece of research fits into something that has a broader impact on society). By sitting down, and writing out all of this information, you will have a better grasp of what needs to be the red thread through your writing.

However, your introduction chapter may change significantly as you start to develop your dissertation. After you will have written your entire dissertation, you may need to seriously revise your introduction. It may be that you still needed to complete important chunks of research, and that the red thread you originally had in mind was altered significantly during the writing process. Once you have written all

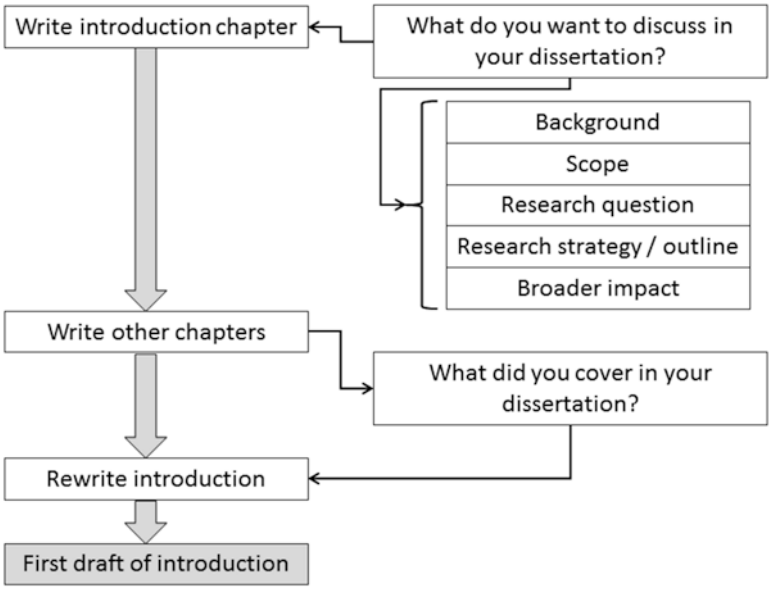


Fig. 12.3 Writing your introduction chapter at the beginning and revising it at the end of writing your dissertation

your draft chapters (including the chapter of conclusions), revise your introduction in depth. Ask yourself for every element that you mention in the introduction if your dissertation covers this element. Revise your research question and scope to make sure these sections are still reflected in the final version of your dissertation. You can find a flowchart of this recommended procedure in Fig. 12.3.

12.5.2 How to Write Conclusions

We mentioned in Chap. 11 that for writing the "Summary and Conclusions" section for a paper you can take notes while proofreading your paper and then draft this section based on your notes. Remember that you learned that you should not introduce new information in this section. The same holds true in general for writing the final chapter of your dissertation [7]. In terms of planning, you want to write your conclusions chapter after you've written all dissertation chapters, and before you thoroughly revise your introductions chapter.

Before discussing how you should write the final chapter of your dissertation, let's have a look at the goals for this chapter. Your final chapter contains specific messages that you want your readers to remember. Consider covering the following elements in this chapter:

- **Overview of main original contributions:** Give an overview of your original research contributions. This list helps your committee identify what you have contributed, and if it is worth graduation. It will also help your readers to see where within the research field your contributions are situated, which helps readers to identify if they should read your dissertation.
- **Executive summary:** Your conclusions chapter should include an executive summary of your entire dissertation. This summary may help a reader decide if he/she should read your entire dissertation. Use this summary to give a helicopter view of your work, so that a reader pressed for time can quickly identify what you worked on. You can provide the summary as a series of summaries of each chapter, but I recommend that you release the structure of the chapters and organize your summary in a thematic manner. Identify a number of main topics and summarize your work around these ideas.
- **Reach out to the industry:** Think about the practical implications of your work, and include a section in which you discuss how your results can impact the industry in your field and/or society. If you worked on a more practice-oriented research topic, you may have developed recommendations for practice, and be able to develop a paragraph that is detailed and ready to implement. If that's not the case, you still can write a general paragraph that points towards a few ideas for further development by the industry.
- **Future work:** Every Conclusions chapter contains an overview of future work. There will always be smaller open questions that remain, and the "future work" section is the right place to discuss these open questions. Having open questions does not mean that your work is not finished. If you've provided a supported answer to your research question, your work is finished sufficiently for graduation. But as you do research, you will always find other topics that seem interesting to study, or you may have identified the next necessary steps in experimental work to continue where you left. Smaller side questions are a good topic for assigning to a master's student.

Now that we have identified all the elements that we want to include in the Conclusions chapter, we can have a look at how to do this. As always, the key here is a lot of reflection on your work (which comes best when you have sufficient time to think everything through without needing to rush). Ask yourself the following: If a reader only has time to read your Conclusions chapter, what do you want him/her to remember from your work? What is the big take-home message (i.e. the answer to your research question) for your audience? Keep these questions in mind while you write your final chapter. If you want to decide if a topic needs to be discussed in your Conclusions chapter, revise these questions. If the topic is of minor importance, leave it out. If it's something you want every reader to remember, include it.

A method that you can use for writing the final chapter of your dissertation, see Fig. 12.4, is based on reading each chapter, and developing summaries of each chapter first. This method is similar to my recommended approach for writing the "Summary and Conclusions" section of a paper:

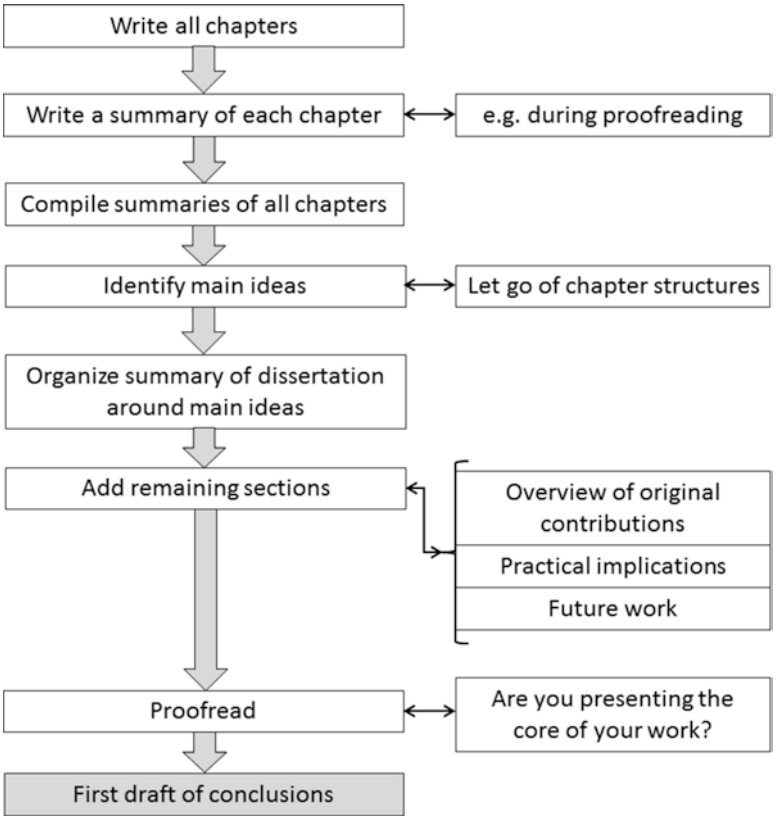


Fig. 12.4 Writing your conclusions chapter around the main ideas of your work

1. Develop a summary of each chapter. You can takes notes of each chapter while you proofread it, and then type out these notes into a summary of the chapter.
2. Compile the summaries of all chapters. The result will not be a cohesive piece of writing – yet.
3. Identify the main ideas from this compilation of summaries. Rearrange and rewrite all material of the compilation of summaries so that it is centered around the main ideas of your work.
4. Add the sections about your original contributions, practical implications of your work, and future research.
5. Reread the entire draft chapter after a few days. Ask yourself if the material that you are presenting is the very core of your work or not. If a main idea is missing, add a paragraph about this topic. Identify superfluous material and leave out all that is unnecessary.

In terms of planning, you should be able to develop a draft version of the final chapter of your dissertation in a week (it took me about two or three days). Remind yourself to stay on course, to stay close to the main idea of your work (i.e. the

answer to your research question), and avoid writing excess text. Write your conclusions chapter with the pressed-for-time reader in mind!

12.5.3 How to Identify Future Work

We've briefly looked at future work in the previous section. If you can't think of any topics to add to this part, take a step back. Have a look again at the material that you used to outline your dissertation, and how you subdivided your research question in subquestions. Which of these subquestions led you away from your research question into lands full of unknowns? Identify these remaining unknowns as possible topics for future work. You can subdivide your recommendations for future work in the following elements:

1. **Future experimental work:** At some point you may have needed to make space in the laboratory, or you may have gathered sufficient data to answer your research question adequately. However, there will always be parameters that you may have wanted to vary as well, or other measurement techniques that at some point sounded interesting to try out. These topics certainly fit the "future work" section. If your work was mostly analytical, you may want to add experimental validation of your work as future work.
2. **Future numerical work:** If you've mostly focused on experimental work, there may be interesting work remaining in modeling your experiments numerically, extending your experiments numerically, or using other simulation techniques. Similarly, if your research mostly involved numerical work, you may identify other modeling techniques, other material models, or other parameters that still would be interesting to analyze.
3. **Future theoretical work:** Every doctoral dissertation contains a certain advance at a theoretical level. You may have had ideas for other theories to explore, which you can mention here. You can have found the basic assumptions of your theoretical work and the boundary conditions to exclude some cases. An extension of your theoretical work to include these cases then makes an excellent topic for the "future work" section.
4. **Improvements for practice:** If your research is practice-oriented, you may have developed recommendations for the industry, but you may have also identified for which cases you cannot extrapolate the results of your work. Such extensions fit in the "future work" section. If your work was more theoretical, you may have written a paragraph with some ideas for implementation in practice. In the "future work" section you can outline how you would go about developing these implementations, and which additional research may be required to come to conclusive recommendations.

12.6 Implementing Comments of Committee Members

12.6.1 How to Compile a Balanced Committee

Depending on the guidelines of your university and the common practice in your country, you will either compile your committee at the beginning of your PhD trajectory, or towards the end. If your committee gets selected at the beginning of your PhD trajectory, it is unlikely that you will be able to provide a lot of input to your supervisor on your committee. At that point in your journey, you will still need to do the research and literature review to identify the important players in your field. Your supervisor will have an idea of the direction he/she wants you to explore for your research, and select the appropriate committee members. You will then work with your committee at several points during your PhD trajectory.

If your institution defines the task of your committee members as examiners towards the end of your PhD trajectory, you may assist your supervisor in compiling a balanced committee. Sometimes, fulfilling all the requirements for a committee can be quite cumbersome, and you may need to do some puzzling across categories to make it all fit. If you have a say in the selection of your committee, you can recommend people from different categories. For example, if your work has practical applications, having somebody from the industry or the government in your committee can be very beneficial. This person can advise you on how to formulate your recommendations for practice, how you can implement these, and perhaps help you find employment outside of academia after your defense. Other typical picks for a committee are: the researcher whose work you continued, or the professor whose PhD student is working on a similar topic as yours. If your work is interdisciplinary, make sure you have the different disciplines represented in your committee. If you have worked with a professor of a different research group or faculty during your PhD to address specific issues, he/she can also be a good pick for your committee. Once you have identified possible committee members, your supervisor will take the task upon him/her to ask if they are willing to join your committee. You typically have to puzzle a bit to fulfill all the requirements of your institution (for an example of the requirements of TU Delft, see Fig. 12.5).

One last hurdle in compiling your committee can be the defense date. In some universities, fixing a defense date is simply a matter of booking a meeting room and finding a time that suits everybody. In other places, like in the Netherlands, the university has one designated room for all defenses, and the availability of this room will dictate your defense day and time. It happened to me that I actually had to replace one committee member because he was not available on my defense day – and it turned out that changing the defense date would be harder than changing a committee member, because of the lack of room availability (and availability of the beadle, the person in charge of all protocoled elements of the defense).

Article 12 Composition of Doctoral Committee

12.1. A doctoral committee consists of at least six and at most eight members and is composed as follows:
- a. the Rector Magnificus or a member of the Doctoral Examination Working Committee as chairperson;
- b. the promotor;
- c. at least four independent members, as described in 12.2;
- d. possibly also an additional promotor, copromotor or another member.

12.2. All members have the task of assessing the dissertation and the propositions and acting as examiners during the doctoral defence ceremony. An independent member is not involved in the preparation of the dissertation. He must be capable of reaching an independent judgement of the quality of the dissertation and the doctoral candidate without having any personal interest in this judgement and that of the other members of the doctoral committee.

12.3. The members must be experts in the area of science of the dissertation or part of it. This requirement does not apply to the chairperson.

12.4. Close family members with an affinity up to and including the fourth degree or other persons who have such a relationship to the doctoral candidate that they cannot reasonably be expected to make a judgement will not be eligible to act as members of the doctoral committee.

12.5. At least three independent members will have ius promovendi at a Dutch or foreign university, of whom at least one must be employed at TU Delft as professor and at least one at an institute for higher education other than TU Delft.

12.6. The other members will be holders of a doctorate. The Board for Doctorates may depart from this in response to a substantiated request from the promotor.

12.7. If the doctoral committee includes only one independent member who is employed at TU Delft as professor, a TU Delft professor must be added to the committee as a reserve member. The reserve member must be available on-call until ten minutes before the time of the doctoral defence ceremony and will only be part of the committee if the aforementioned independent member is unable to take part in the doctoral defence ceremony. The task of the reserve member is to assess the dissertation and propositions as stipulated in paragraph 2.

Fig. 12.5 Excerpt of Doctoral Regulations of TU Delft with regard to the compilation of the committee [8]

12.6.2 How to Implement Comments of Your Committee

Depending on where you are studying for your PhD, your committee members can have different tasks. Similarly, the timing of your defense depends on your institution: some institutions require an approved and printed thesis prior to the defense, whereas other institutions require revisions to the dissertation after the defense. At some point during your PhD trajectory, however, you will receive comments from your committee members that you need to implement into your dissertation.[6]

Implementing the comments of your committee members can be similar to implementing the comments of reviewers for a journal article. The main difference though is that you know the identity of your committee members. You may be able to meet with them in person, and verbally address some of their comments. You may explain better what you meant, and agree together which parts you should rewrite. In such a meeting, you can also learn which part of your dissertation they find important (a possible hint for their questions on your defense). In such meetings you can talk about possible concerns of your committee members, and show sound technical reasons why there is no need for doubt. Make sure you can strengthen each argument with your work or with evidence from the literature. If your committee member points out a flaw, go back and do the necessary work.

For the comments of reviewers, you need to prepare a detailed reply to each and every comment. For the comments of your committee, it may not be necessary to have a written report of each small editorial comment that you worked through. Instead, you should focus on the main concerns of your committee with regard to your novel contributions, and prepare a written point-by-point explanation about how you addressed these concerns, together with more background to the literature or your own work to explain these concepts further. Be prepared to defend your point of view, with all the required evidence from the literature and your own work, during your defense.

12.7 Defending Your Thesis

12.7.1 From Finished Thesis to Defense

When all is said and done in your thesis, it is time to plan towards your defense. Again, the timing of dissertation and defense depends on the institutional policies. If you need to make changes to your dissertation after the defense, the defense itself will feel more like a part of the dissertation process. If your defense is the very last step between you and your diploma, there may be more time between finishing the

[6] This section is written from the perspective that implementing the comments of the committee comes before the defense. You can implement this advice as well if you need to submit a revised version after your defense.

dissertation and defending, and it may feel as that last looming heavy task on the horizon before you are finally done.

By now, you should know how to plan for everything – you've made it to the end of your journey, and I'm assuming your planning skills have helped you through. The final months of the PhD trajectory involve their own difficulties [9]. Whereas planning experiments and writing may be something you have grown accustomed to over the last years, the last months of the PhD trajectory are a whole different beast. Unless you are doing your PhD in your home country and will roll straight into a faculty position at your institution, you will be finishing your PhD, and at the same time searching for a job, moving out of your current place, boxing up all your stuff, and perhaps arranging international moving.

For me, too, it was an overwhelming time. In between getting my thesis to the printer on time, filling out HR forms for my next job, attending seven conferences to show the world the results of my research, finding babysits for my cat, ending all insurance and utilities contracts I had in the Netherlands, and buying plane tickets, there was not much time for breathing. And there was the constant fear of "what if I forget paperwork X or Y and get into administrative difficulties?"

Be prepared for the last months of your PhD trajectory to be intense, and incredibly messy. Know what is ahead of you, and face it full on. Keep your head clear, plan realistically, keep lists with to-dos to remember everything, and allow sufficient time for sleep and recovery so that you can remain sane throughout this whirlwind.

Once the wind calms down, and everything is settled and you have defended, don't be surprised to find yourself looking up and wondering "what now?" Many recent PhD graduates have mentioned that they feel some sort of a black hole after graduation. I described it as a minor post-partum depression from my dissertation-baby. You may feel a period of unidentifiable gloom, you may feel lost, even though you're still incredibly busy with moving. Just acknowledge the fact that you've just finished a long period in your life where you worked towards one goal, and that suddenly that goal has been achieved, and the solid ground of certainty is removed from beneath your feet. If these feelings visit you, don't despair, and don't be ashamed of them. Be kind to yourself, and give yourself time to get back to your feet.

12.7.2 How to Prepare for Your Thesis Defense

If we zoom into those last messy months of the PhD trajectory, regardless of your institutional requirements, there will always be your moment to shine, at your defense. So let's now have a closer look at how you can prepare yourself best for your defense [10]. Some colleagues may tell you that you don't need to do anything in preparation. Their argument is that you have been doing all the research over the past few years, and nobody knows your work as well as you do. However, going into your defense without any preparation at all may not be the right strategy. If you wrote your literature review chapter 2 years ago, you may need a refresher on some of the

elements you discussed, and you may need to reread some key publications. Your defense will as well depend on your committee, so keep them in mind when preparing for your defense. The last reason why it is recommended to spend some time preparing for your defense, is that it helps you prepare mentally for the day itself. Chewing through possible questions in advance will give you some peace of mind.

When preparing for your defense, it is crucial to find the sweet spot between over-preparing and going without preparation. I certainly over-prepared: I spent a lot of time preparing for my defense, and not all activities were equally necessary for me. They were important for me at that time though, mostly to gain confidence towards the defense. I did the "check, check, doulecheck, triplecheck, quadruplecheck, quintuplecheck"-kinda thing, mostly to reassure myself that I could actually defend my work without fainting or suddenly being unable to speak English. If you need extra time, mostly to calm your nerves, then add in that time. If you want to prepare in a smart way for your defense, you should focus on the following:

- **Conferences:** Presenting your work at academic conferences is a crucial part of your PhD trajectory. If you've presented your work a few times for an international audience and answered questions, you are better prepared than when you'd never had the chance to travel and present your work. Every presentation adds a bit more confidence to your meter. Every time you present your work, you will have practiced and sharpened your presentation and presentation skills a bit more. Use your PhD time and available funding (or other sources, such as scholarships) to present at as many conferences, workshops, and industry events as possible. All this practice throughout your PhD trajectory will make you more prepared for D-Day (Defense Day).
- **Know your committee:** The questions you can expect during your defense will depend on your committee. As you prepare for your defense, don't make the mistake of navel-gazing at your own dissertation. Instead, take a step back and evaluate your work through the eyes of your committee member. Check out their most recent publications to be fully up-to-date with the work of your committee members: you don't want to be completely oblivious when a committee member hints at the fact that he/she worked on something interesting for your research very recently. Don't assume that you have read everything you need to know while you did your research; check out the latest and in press publications. If you've had a chance to meet with your committee members during your PhD, or while preparing for your defense, revise your meeting notes, and identify their main points of interest and of criticism to your work. Some committee members will tell you their exam questions in advance, whereas other members will leave you guessing. Try to come up with at least five possible questions per committee member, and prepare additional material to answer these questions where needed.
- **Revise crucial papers:** Brush up on your knowledge of the literature. Besides checking for the most recent work of your committee members, make sure that you do a brief search on recent publications in your field to have your knowledge of the literature up-to-date. Don't stop following the literature the day you finish your literature review chapter. Work on your general knowledge of the literature,

and also identify the papers that were most important for your work. Read these papers again to refresh your memory, and to address possible questions about the foundations of your work. Consider taking copies of the five to ten most important references you based your work on to your defense.

- **Prepare for broader questions:** Your committee members will ask questions from their perspective, and will perhaps ask questions that are at the periphery of your work, and much closer to their work. Another common type of questions is related to the assumptions and basic foundations of your work, and of the literature you based your work upon. Make sure you have a solid foundation to answer such questions. Besides questions that sit right outside the main focus of your work (and the answer to your research question), there are also questions that focus on the broader scope of your work, other fields of application for your methods, and future work. You can find a list of common general questions at the end of this section. Make sure you practice preparing answers to these questions, and bring additional material to your defense where needed.
- **Familiarize yourself with the defense room and available tools:** Sort out the logistics for the day of your defense in advance. You don't want to be running around campus, looking for a cable or laptop last-minute, or trying to fetch coffee for your committee members. Talk with a recently graduated post-doc to verify if you have thought of everything. Make sure you understand all procedures, and when in doubt, ask the office responsible for the defense. Know where you will defend, and which tools are available in the room. Will you be using a microphone? If you will be using a microphone, will you be using a hand-held microphone (and have only one hand left for writing/sketching/gesturing), or will you be using a headset microphone (and need to clip it onto your clothing somehow)? Will you be able to project visual materials and use audio in the room? Are there other tools available, such as a blackboard, flipover board, or overhead projector? In Delft, the defense room has a digital overhead projector, which you can use to show pages of your dissertation, sketches, and other material. Depending on the available tools, make sure to bring the right material to your defense.
- **Be yourself:** Don't get too stressed about the defense. If you get stressed, you'll have a harder time keeping your thoughts ordered and replying the questions in a way that is satisfactory for the committee. Many students start their defense nervous (I remember I did – or better: I was so nervous I can't remember the questions from the first committee member!). Once the first spike of nerves calm down and you remember to enjoy yourself, your defense will go much smoother. Make sure you've slept enough in the week(s) prior to the defense to have a clear head, and take good care of yourself by exercising and eating properly. Treat yourself as an athlete preparing for a big effort: make sure you are in your best shape to give it your all on the day of the defense.
- **Don't forget your party:** You may be tempted to prepare for your defense just in terms of replying the comments of your reviewers. But don't forget that your defense is a main event in your life that merits a proper celebration. Honor your friends and family (and committee members and colleagues) who have gathered

to watch you defend, to support you, and to celebrate this major achievement with you. Keep in mind the importance and value of this day for all attendees. Unless for weddings and perhaps special birthdays, there are not that many occasions where you can have that many of your loved ones together, to celebrate you and your professional success. Your family may be even traveling internationally to attend this special event, so make sure it becomes a special day for everyone attending. Arrange a reception and a nice dinner, for example, or any other form of celebration as you see it fit.

Here is a list of general questions you can use to prepare for your defense [11–13]:

- Why is your research question relevant to the industry / your field?
- How did you define and limit your research question?
- What was the most interesting aspect of your research? Which discovery surprised you most?
- Which author/researcher has been most influential in your field, and why?
- Is somebody else carrying out similar research to yours? What are the main similarities and differences?
- You have based your model/methods on paper X. Can you explain why you selected paper X as a starting point?
- How would you apply your method to Another Field?
- You have not used A More Commonly Accepted Theory. Can you explain why you decided to based your work on A Different Theory?
- Did you make any changes to your experimental setup (or other methods you used) during your experiments?
- How did you decide on the variables to be tested in your experiments?
- What is the statistical relevance of the number of experiments you carried out?
- How did you measure the important variables in your experiments?
- Are there variables that you have not tested that you recommend for future work?
- Did you have any negative outcomes?
- Which other methods could you have used for your study? Why did you opt for the method you used?
- Can you explain in more detail how you analyzed your data?
- Can you extrapolate your conclusions to other related problems?
- Can you summarize your main contribution in a few sentences?
- Can you discuss your novel contributions?
- Can you defend Proposition Number X?
- Do any of your results or conclusions confirm or contradict findings from the literature?
- What is the broader impact of your findings on the industry or society?
- If you are to continue this research, what would you do?
- Which other research topics in your field have you identified as relevant for future study?

12.7.3 Surviving Defense-Day

If you feel nervous about your defense day, write down your itinerary for the day. Leave plenty of time for every step. Keep in mind that you need time for eating at some point during the day, and that when your family arrives, you may want to have a chat with them instead of running away while muttering "I need to go get a few more things." Take a snack with you to nibble on if you tend to get a bit dizzy when you haven't eaten in a while. Have a bottle of water with you. Don't forget all your preparation materials (including a printed version of your dissertation) and some empty sheets of paper for sketching when you reply the questions of the committee members (or a marker if you can use a whiteboard or flipover).

When you have everything you need for the defense, try to relax a bit. Know that you have prepared yourself properly for your defense, and that you are the expert in your work. If the nerves makes your breath short and jagged, place a hand on your abdomen and try to slow down your breath and breathe by using your diaphragm. If you need to isolate yourself a bit in the minutes prior to the start of your defense, go to a quiet place (as long as somebody knows that you didn't just run off). If you prefer social interaction, chat with your friends and family and let their stories distract you from the upcoming defense.

During the defense itself, the key is not to rush into answering questions. First of all, you need to let your committee member state his/her entire question (that is just basic politeness). If the question is long or has subquestions, take notes. Then, if the question is long, formulate the question in your own words, and ask the committee member to confirm that you understood the question correctly. Make up a strategy on how you will answer the question in an organized fashion, and tell your committee member: "I will first address your point X, and then show you experimental result Y to support my statements, and literature source Z to give further background." Then, explain every part clearly and with full detail. Don't stretch time unnecessarily, but also don't rush through your questions. Try to stay calm and composed, and keep your breathing under control. If you need to think for a moment to see how you will answer a question in a structured way, there's no shame in saying: "Let me think about this for a moment, so I can see how I can answer this in a clear and structured way." If you need to sketch something, tell them that you will first draw something, and then explain them. Just avoid the rabbit-staring-in-headlights look when you try to scramble your thoughts together.

12.8 Summary

In this chapter, we've covered all the steps related to planning, writing, and defending your dissertation. The first important topic was planning the writing of your dissertation. Writing a document of roughly 100,000 words is no small feat, so having a plan of how you will tackle this major task is not a luxury. We discussed which

steps you can take in the years of your PhD trajectory to gather material that will help your writing advance more rapidly, and when during your PhD trajectory is a good time to start writing. For those of you who need to write a dissertation and propositions, we briefly discussed how you can prepare yourself to develop your propositions.

Once you have decided to start writing, you need to structure the contents of your dissertation around answering your research question. A dissertation is not a tale of what you did in all the years prior to your defense, and there may be plenty of calculations you made that won't end up in your final dissertation. Make sure you limit yourself to answering your research question and subquestions. We revisited the scheme that shows how your different chapters are related to guide you towards developing your contents further.

Once you are halfway through your dissertation, you may feel like you've been typing and typing your chapters for months on end, and you still have so much work to do. If thesis writing starts to feel like a drag, you can use a bit of motivation to help you through. We discussed how setting realistic goals for writing each day in terms of a word count can help you move your thesis forward slowly but surely. We also discussed how you can avoid to burn out while writing your dissertation, and stay motivated and balanced.

A special topic is the writing of the first and last chapter of your dissertation. The first chapter, your introduction, is the chapter that introduces all information that will be discussed in your dissertation. We discussed that it can be beneficial to draft this chapter before writing all other chapters to help you focus on answering your research question, and then rewrite this chapter after you've written the rest of your dissertation. The final chapter, your conclusions, should contain a summary of the main ideas and novel contributions introduced during your thesis. Moreover, your conclusions chapter will require a discussion of the effect of your research for practice, the industry of your field, and/or society. You'll also have to identify elements of future work.

Implementing the comments of committee members is similar to replying reviewers' comments in a sense that most often the comments will mean that you need to better explain certain parts of your thesis. The difference between replying reviewers' comments and comments of committee members is that you will know your committee members, and you will be able to visit them, discuss in person, and learn more directly what they consider the most interesting as well as the weakest elements of your dissertation. Identifying this information will help you prepare for your defense.

Finally, we discussed the topic of defending your thesis. We discussed the steps that lie between finishing your dissertation and the actual defense – which differ of course depending on the institutional regulations. To prepare for the defense, we discussed some strategies to avoid over-preparing as well as to avoid going with the wrong type of preparation. Remember that your defense questions will be posed by your committee members, so getting to know them and their research is a crucial part of preparing for your defense. Finally, we discussed some practical tips to keep your head cool on the day of the defense and answer all questions in a calm and structured manner.

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