

CME 2000 – CME2001

GRADUATION THESIS – THESIS PREPARATION

GUIDELINE

CONSTRUCTION MANAGEMENT AND ENGINEERING



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CME 2000/2001 GRADUATION THESIS GUIDELINE

CONSTRUCTION MANAGEMENT AND ENGINEERING

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1. INTRODUCTION

This Graduation Thesis Guideline describes the procedure and gives hands-on tips for the final part of the MSc Construction Management and Engineering (CME) at Delft University of Technology (TU Delft): **the graduation thesis**.

At the Delft University of Technology, the CME courses are given at three faculties:

- The Faculty of Civil Engineering and Geosciences (CEG);
- The Faculty of Architecture (AR) and;
- The Faculty of Technology, Policy and Management (TPM).

Students have the possibility to finish their master by writing a thesis at one of these faculties.

For completing the final year, a number of procedures should be followed. In this Guideline these procedures are explained in more detail. Besides the graduation thesis project (CME2000 course), the path leading towards your Master's diploma is described in this Guideline. Part of that path is the Master Thesis Preparation (CME2001).

The official processes and procedures for the Master CME are described in a number of official publications:

- Teaching and Examination Regulations MSc CME (TER)
- Implementation Regulations MSc CME (IR)
- Rules and Guidelines Board of Examiners MSc CME (R&G)

In case of any contradictions or omissions, these official publications precede over this Guideline.

The latest version of these documents can be found on the TU Delft website – student portal

Apart from information about the procedures, this Guideline also gives you hands-on information for your thesis preparation and the completion of your master thesis.

If, after reading this Guideline, you still have questions about your graduation procedure, please contact:

- the graduation coordinators or
- CME secretary, Sandra Schuchmann-Hagman (s.c.m.schuchmann@tudelft.nl).

2 COMMUNICATION – WHO WE ARE

2.1 Construction Management And Engineering (CME)

General information about the organization of CME at Delft can be found at the website:

<https://www.tudelft.nl/en/education/programmes/masters/construction-management-and-engineering/msc-construction-management-and-engineering/>

The CME Director of Operations is ir. drs. J.G. Verlaan. He is located at the section Infrastructure Design and Management at CEG, room 3.48.

The Board of Examiners CME (Delft) consists of dr. M. Leijten from the Faculty Technology, Policy and Management., mr. dr. F.A.M. Hobma from the Faculty of Architecture and dr. M. de Bruijne from the Faculty Technology, Policy and Management.

Board of Examiners CME:

dr. M. (Martijn) Leijten

mr. dr. F.A.M. (Fred) Hobma

dr. M.L.C. de Bruijne

m.leijten@tudelft.nl

f.a.m.hobma@tudelft.nl

m.l.c.debruijne@tudelft.nl

These persons can also give you contact information of the relevant professors and other colleagues that can help with your thesis at any of the faculties.

Faculty of Civil Engineering and Geosciences

Students who would want to do their thesis at the faculty of Civil Engineering will most likely go to the section Infrastructure Design and Management. For more information, contact one of the graduation coordinators of CME: ir. drs. J. Verlaan or dr. R. Schoenmaker.

Faculty of Technology, Policy and Management

Information on graduating at the faculty of TPM can be found on their website. For more information, please contact one of the graduation coordinators within TPM. Please do not approach professors directly but contact them via graduation coordinator. Check this link first:

<https://teams.connect.tudelft.nl/sites/tbm/graduate/SitePages/Graduation%20Coordinators.aspx>

– see also 5.1.3. Composition of The Graduation Committee

Faculty of Architecture

The graduation thesis can also be done at the faculty of Architecture. This will most likely be done at the department of Management in the Built Environment (MBE). Check their website for more information on graduation. You can also contact mr. dr. Fred Hobma for more information.

2.2 CME Dispuut

CME Dispuut is the study association for students of the master Construction Management and Engineering. They are located at room 3.53 at Civil Engineering.

Contact the CME Dispuut for practical information about CME and graduating. CME Dispuut has information about previous master thesis projects, companies where students are or have graduated and where alumni found their new work environment. See www.cmedispuut.nl for more information.

3 THE CME GRADUATION PROGRAMME

The study load for the CME Master's degree course is 120 EC. The graduation thesis has a study load of 32 EC (CME2000) and 4 EC for Graduation Thesis Preparation (CME2001), which means that you should have finished a minimum of 84 EC of cornerstone, compulsory and elective courses.

The CME graduation programme consists of 4 parts and is described in the Teaching and Examination Regulations MSc CME (TER) and Implementation Regulations (IR), and is shown in form CME-1 (see appendix):

- A. Compulsory courses
- B. Elective courses
- C. Graduation thesis (CME2000-CME2001)
- D. Deficiency programme – depending on your BSc degree –

The TER and IR that are valid for you depend on the year of your enrolment in the master CME (your cohort). The TER and IR precede over any information given in this Guideline.

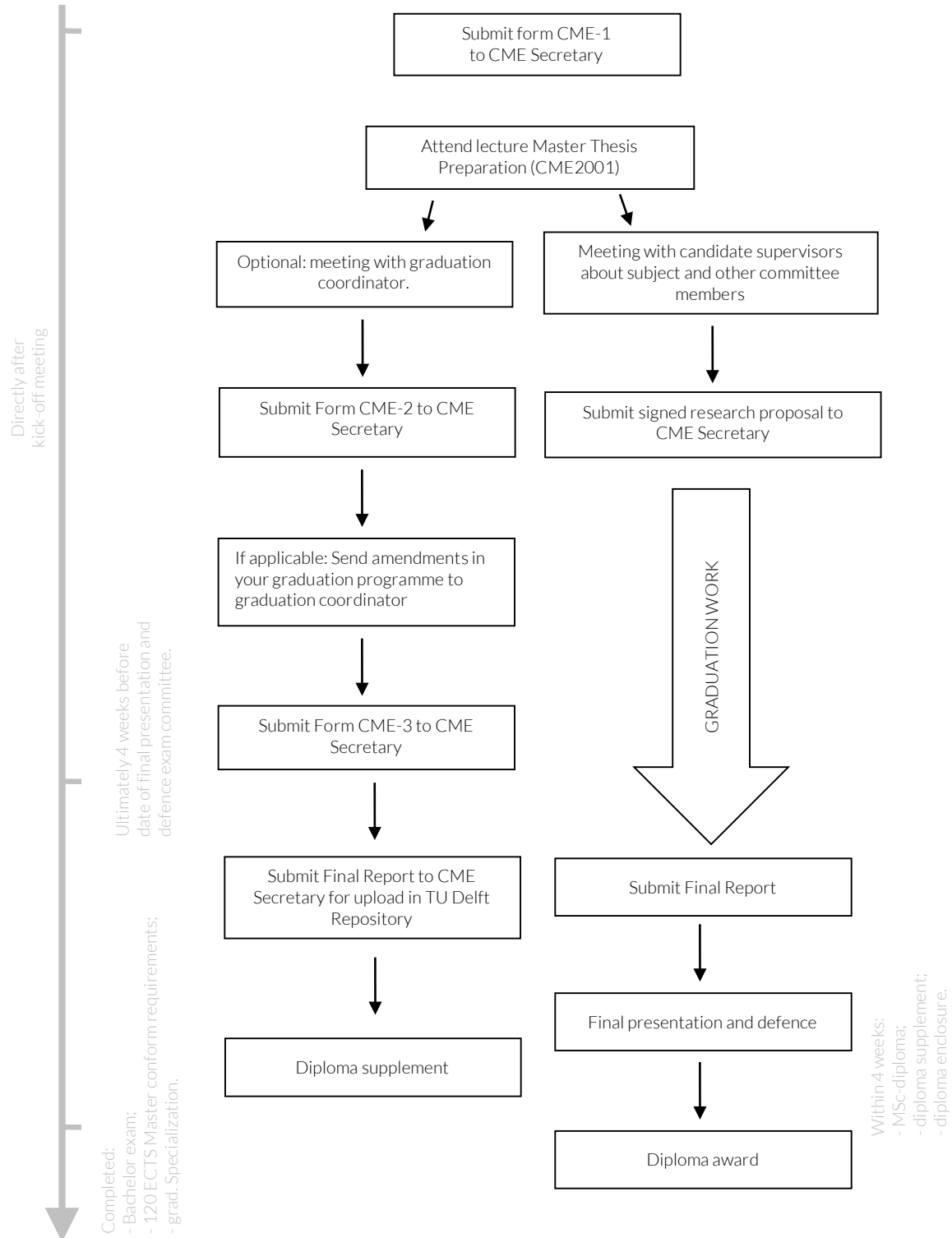
The CME programme has four specialisations and one free study programme. These specialisations offer four directions that reflect current trends and needs in the market.

- *Project Management* explores a new perspective on applying Operations Research (Decision-Making Engineering) in Design & Construction Management. This perspective is that technical and social optimisation should not be separate processes, but should be integrated into a single design and construction process.
- *Asset Management* is a structured, rational, goal-oriented approach to deliver value from assets and to achieve the organisation's goals. Asset Management seeks the best balance between performance, cost and risks by any combination of tools and techniques to achieve the organisation's aims, provided that the tools are appropriately applied and deliver value.
- *Infrastructure and environment* focuses on the balance between economics and sustainability, while taking all legal, safety-related and humanitarian aspects into consideration.
- *Legal & Finance* considers the financial and contractual issues related to the implementation of civil engineering projects. It introduces concepts and topics from economic engineering and finance, such as project financing and financial accounting

For more details of your programme check the Teaching and Examinations Regulations (TER) of the year you enrolled in the CME programme – your Cohort.

4 THE GRADUATION PROCESS

This flow chart shows the main steps to be taken during your graduation process:



Forms as mentioned in the scheme above can be found in the appendices of this document. An up-to-date version can be obtained at the CME Secretary. The following forms are applicable:

- *Application start graduation and programme approval* CME-1;
- *Kick-off and Committee Approval* CME-2
- *Exam Application Form - Green Light* CME-3.

As a graduation student you are responsible for timely submission of the forms that are due at the designated times. You have to take care of proper completion of the formalities and will use only the forms supplied in digital form.

4.1 CME-1: Application Start Graduation And Programme Approval

Fill out the form *Application start graduation and programme approval* (CME-1) and send it to the CME Secretary. Your graduation programme will be checked for completeness and correctness. If we find any irregularities in your programme you will be notified by us. Beware: this is an informal notice a formal check of your graduation programme will be done after handing in CME-3. The graduation coordinator will check if you have completed programme properly and he will make sure that it is cleared with the education administration. The Exam Committee will check your programme against the Teaching and Examination Regulations (TER). Special attention will be paid to the (prior) approval for your elective courses.

| You are only allowed to start your graduation project if you have completed all of your courses.

4.2 CME-2: Kick-off and Committee Approval

Fill out the form *Kick-off and Committee Approval* (CME-2) and send it to the CME Secretary together with a signed version of your kick-off document, your research proposal.

4.3 CME-3: Application MSc Exam

Use the form *Exam Application Form - Green Light* (CME-3) to apply for your final presentation and graduation. A final check will then be made if the exam programme mentioned on your graduation application (see paragraph 3.2) is fully completed as far as marks/grades are concerned and if it meets the fail-pass regulation.

You have to hand in the form *Exam Application Form - Green Light* (CME-3) least **20 working days** before the final presentation. Practically this means that the form CME-3 has to be handed in straight after the Green-Light meeting – complete with the signature of the chair of your graduation committee.

If it becomes clear, after you handed in your application, that you do not pass all preconditions on time for your final presentation, you will be notified by the graduation coordinator and/or the Education & Student Administration.

5 YOUR GRADUATION PROJECT

You can make an appointment with one of the CME graduation coordinators to discuss a graduation subject and for getting advice for finding a company and committee members. You can get some advice for drawing up a research proposal, including a planning scheme, and the formation of your graduation committee. You will have to take the initiative in carrying out these preparatory activities.

At least one **compulsory** lecture is part of your Master Thesis Preparation (as part of CME2001). The goal of this lecture is to give you practical information about the procedures and making a research proposal that will get you successfully through your master thesis kick-off meeting.

Just being present at the lecture is not sufficient. You will get the most out of this lecture when you come prepared with a draft research proposal/research question. Through peer review we will assess and improve your research question. See chapter 8.

5.1 Preparation and Start

5.1.1 Choice of Subject

To start with the obvious: your graduation subject should be within the professional field covered by the MSc CME. The professional field of CME is very broad, so it may still be difficult for you to find focus.

An overview of possible graduation subjects can be obtained from the graduation coordinators. It is also possible to formulate your own subject, or to slightly amend a brief already drawn up. If you are looking for some inspiration to do so, please contact the graduation coordinator or check this webpage that lists all the CME graduates with links to their thesis reports:

<http://www.tudelft.nl/studeren/masteropl/masteropleidingen/construction-management-and-engineering/msc-programme/thesis/graduates/>

And you can always check the graduation project announcements in the corridor between room 3.48 to 3.30 of the section Infrastructure Design and Management.

See chapter 8 for more tips on finding a suitable subject.

5.1.2 Research Proposal

Content

The research proposal is an outline of your graduation research project. Preliminary study is absolutely necessary for writing your research proposal. Please refer to the compulsory course CME2001 – Master Thesis Preparation. The lecture in this course is given by research practitioners and gives you a very practical orientation on how to write a good research proposal. This proposal has to contain a short description of the problem to be examined, a problem formulation, a precise research question, an appropriate research method and a consistent desired/expected result – See chapter 8. Also, a planning overview has to be included, in which the various activities that lead up to the final report, are summarized. This will reflect the scope and depth of your graduation study. Your research proposal has to have a literature overview and a list of the graduation committee members.

You will most probably start looking for committee members before your research proposal is really mature. Write a *pitch* of 2 to 3 pages in which you explain your research and pitch that summary to your potential committee members. Your *pitch* should give a short description of your research proposal. Be sure to highlight: - the WHAT - the WHY - the HOW - your intended RESULT.

Check your research proposal

Feel free to check out with the CME graduation coordinators if your research proposal is up to standard and suitable for distribution to the members of the graduation committee. However, an approval by the graduation coordinator is no guarantee that the graduation committee will agree to your plan. But

consulting the coordinators may help. Plan the kick-off meeting in time and properly prepare yourself for it. Remember: “first impressions last!”

5.1.3 Composition of the Graduation Committee

The graduation committee exists of at least three academic staff members from the TU Delft, two of which shall represent different faculties (CEG, TPM, Architecture). The chair of the committee is a full professor. Exceptions to the rules can be made, but have to be approved by the Board of Examiners of CME. Normally your daily mentor at the company, where you do your graduation thesis project, is the fourth member of the committee.

Example:

- TU Delft full professor as chair;
- An academic staff member of CEG, TPM or Architecture as first supervisor*;
- An academic staff member of CEG, TPM or Architecture as second supervisor*;
- A daily mentor for a company, consultancy or government office

* = From two different faculties at TU Delft

Select the members of your committee carefully: make sure that you have access to people who can guide you on a ‘daily’ basis, who respond quickly to your calls and who have specialist knowledge that fits your research question. Not only make sure that you have specialist knowledge in your committee, but also try to find a committee member that can act as a coach during the process of writing your graduation thesis.

| Use your *pitch* to get potential members enthusiastic for your graduation project.

| Before approaching candidates for your graduation committee prepare a 2 A4 outline about your intended research. For the main components of that outline see chapter 8.

Finding graduation committee members at Civil Engineering or Architecture.

Inform yourself about suitable candidates via the CME graduation coordinators or CME Disput.

Finding graduation committee members at Technology Policy and Management.

If you are looking for graduation committee members at TPM please do not approach the candidates individually. Please contact the graduations coordinator of the most appropriate section, see:

<https://teams.connect.tudelft.nl/sites/tbm/graduate/SitePages/Graduation%20Coordinators.aspx>

One of them will then look for the most appropriate TPM candidate in your committee.

Graduation project and employer

Most of the times, graduation work is carried out in collaboration with a temporary employer, who will also provide you with a working place. Most departments of TU Delft cannot offer a working place for graduation students. Graduation work is in principle an independent and public affair. The empirical part of the work is carried out in conjunction with the temporary employer. The graduation work must not, however, become an assignment for advisory (consultancy) work for the employer. The conclusions of the graduation work are of general relevance and significance.

Allowances from Employer

Graduate students do not receive an allowance from CME for graduating, resp. the costs (re)production of the graduation report, etc. All costs are considered to be an integral part of the overall cost of studying. However, it may be possible for you to make your own arrangements for an allowance paid by your temporary employer.

5.1.4 Planning

An important part of your research proposal is the planning. Most of you are too optimistic about their planning. Use the following information to draw up a realistic planning.

The weight of the final year graduation project is 32 EC. One EC corresponds with a study load of 28 hours. Working (effectively!) 28 hours a week on your thesis, therefore amounts to approximately 32 weeks of work of 28 (net working) hours each. Starting point is an approved research proposal. Making a good research proposal takes at least 4 weeks, making it a total of 6 to 8 months for your whole graduation work.

Be aware that, of the total time you spent on the different parts of your graduation project, on average about 30% of your time you will go into making a research plan, planning and doing a proper literature research. Another 30% will go into fact finding and collecting your information. Analysing your data and drawing conclusions and making recommendation will take about 20% of your time. Only 20% of your time will be spent on the actual writing of your thesis.

Making a research proposal, or preparing yourself for the kick-off meeting also includes finding your committee members. Do not underestimate the time it takes to find and get your committee members.

Beware that it is (even) harder to make appointments in July and August.

5.2 Graduation Thesis Committee Meetings

There will be a number of committee meetings, during which you will present the state of your research and your findings. Include these meetings in the planning scheme of your research proposal. Table 1 shows an indicative scheme with the four obligatory meetings with the full committee. Plan more frequent meetings with your supervisors especially during the beginning, as a large number of questions need to be answered during that period and the expectations that the committee has of you and vice versa, need to be discussed.

Type of meeting	Week	Subjects to be dealt with
1. Kick-off meeting	1	Results of the orientation phase
2. Committee meeting - Mid term	..	Professional content and progress
3. Green light meeting – Go / no-go	..	Permission to complete the study
4. Thesis presentation / defence	32	Assessment of professional content, working method and presentation

Table 1 Sample planning scheme – week 1 is the week of your Kick-off meeting

You are the project manager of your own graduation project: *Master you master*. This entails:

- Planning the activities and meetings;
- Monitoring & control of progress;
- Communication with the graduation committee and third parties;
- Informing the graduation coordinator of relevant developments and progress, including dates of meetings.

A good book on how to manage your graduation work is: *Graduation - Challenge Accepted*, by de Haan and de Regt (2014).

This book gives your very practical insights in your graduation project. Take for instance the motto: *you're the leader, and the professor is the boss*. So make sure that you set the agenda for the meetings, take the lead and accept that the final decisions lie with the committee.

As far as content of the graduation project is concerned, there will of course be differences per subject that is chosen. For that reason, this guideline concentrates on the general aspects of the meetings with the full committee. You prepare all meetings, make appointments, provide the agenda and intended duration of meeting, including action- and decision lists. Send the agenda to the committee members timely before each meeting date, together with a summary (maximum of 2 A4) of the activities carried out to date, and a report showing your progress. This report can be in the form of an addition to the previous report, but a completely revised intermediate report is usually preferable. Make and distribute the minutes of meeting of the committee meeting within one week after the meeting has taken place. If you have not received any comment from the committee members one week after dispatching the minutes, you can consider the minutes to be approved.

Make sure that the work you produce is free of plagiarism. TU Delft pays a lot of attention to detecting plagiarism (e.g. using SafeAssign). Do not run the risk of being accused of plagiarism!

More information on how to avoid plagiarism is given during the lectures of CME2001 – Master Thesis Preparation and can also be found on the TU Delft website.

5.2.1 The Kick-off Meeting

No all committee members participate in the process of writing your research proposal. This meeting is meant to align the expectations of all members and get approval to start your research. During the kick-off meeting you will check the preliminary dates for the next meetings and preferably turn the upcoming one into a permanent one. All parties, i.e. the student, TU Delft staff and the people representing the company where the student is (temporarily) employed, express their commitment to the agreed subject of research and timetable.

Address potential confidentiality in your kick-off meeting. Your main report (with possible exclusion of the appendices) has to become publicly available through the TU Delft repository. The committee members need to have access to all data during your graduation project.

The final report has to be written in the English language. This rule may be waived if the committee unanimously agrees as such. The Board of Examiners CME should also give permission to this exception. After the kick-off you can hand-in form CME-2.

Involve your supervisors in making your proposal, this will increase the chance of a successful kick-off meeting.

5.2.2 The Mid-term Meeting

In between the kick-off and mid-term meeting you will probably have several meetings with your supervisors. Communicate and share the intermediate results of these meetings with the whole committee. In this way opinions and comments are exchanged and you can see to it that they are in balance with each other. The results of the meetings with your supervisors should be laid down in action and decision lists.

Manage your graduation thesis as a project

- Use progress reports to steer the committee meeting or supervisor meetings – a sample progress report can be found in the appendices
- Think about the risks you run in advance, how you can mitigate and manage them: include a risk register in your research proposal

The mid-term meeting is generally the meeting where the last major changes regarding your research will be discussed. This is usually the moment when you (think you) have finished the analysis phase of your research and start working towards the results. The function of the mid-term meeting is to make sure that you are (still) working in the right direction and that you are consistently working towards your green light meeting.

Discuss daily questions regarding the subject content with your supervisor at the TU Delft or the company you are working for. The form and content of such daily consultation with supervisors is determined by mutual consent.

5.2.3 The Green Light Meeting - Go/No-Go Meeting

After the mid-term meeting you start working towards the end of your graduation project. Once you are confident that you can finish the project within a few weeks you can plan the Green Light meeting. Your thesis report should be roughly 95% complete. It should contain everything from a summary to conclusion and ideas for further research. During the Green Light meeting the committee assesses and establishes whether the report of the graduation work is ready to be finalised. You have to send in a complete pdf version of the Green Light version of your report. Make sure that this version is a **public version**. It is possible to put confidential information in appendices that will not become publicly available. The committee, however, has to have full access to all data that you have used.

The graduation committee will do a plagiarism check on the Green Light version of your thesis. The result of this check will be noted on form CME-3

Once you have received your Green Light you can submit the *Exam Application Form* (CME-3). Make sure that the chair of your graduation committee signs the form. This form must be submitted 20 working days before to the date of presentation of your master thesis. This period of time is not only needed for a final

check of your CME programme, but also to prepare your certificate. You can use this period to finalise your report and prepare your presentation.

5.2.4 Preparation of Oral Presentation and Defence

After the Green Light has been given, you can start with the preparation of your final oral presentation and defence. The graduation student invites the committee members and makes a reservation for the lecture room. It is recommended to include in the final report an introduction and summary in two languages: English and Dutch.

Usually one week before the final presentation you have to supply a hardcopy version of your final report to each member of the graduation committee and the CME secretary. Check with your committee for their demands.

During the last two weeks before your presentation carry out the following actions:

- Fix an announcement (1 x A4), in English, of your planned oral presentation in the elevators;
- Send the following to the to the secretary of CME:
 - a **pdf version** of your final report. Make sure you mention any parts that are subject to an embargo-rule of confidential. In case of market-sensitive information the company where you have done your thesis project may stipulate that the sensitive parts be published with a certain delay after you have completed the report. Such a delay may be up to a maximum of one year. At the request of the company, final year graduation articles may be published anonymously. For more information about how to deal with confidentiality please contact one of the graduation coordinators;
 - Important data files that you have produced during your graduation work (video's, models, drawings, etc.).
- Upload your graduation work in the TU Delft Repository. If you fail to do so your diploma supplement will NOT be send to you – see below, paragraph 5.3.6.

If you and your TU Delft committee members consider it appropriate, the possibility exists to convert the graduation research and its findings into a scientific paper (most often of approx. 10 pages). This is not compulsory, but very useful for both yourself as well as the section where you graduate. So it is recommended to make use of this option. Discuss this option early on with your supervisors.

5.2.5 The Final Presentation and Defence

This presentation is in public and, after the assessment has been made, rounds off your graduation work. The opening of the session is usually done by the chairman of your graduation committee, followed by the presentation prepared by you. Both the public and the committee members are invited to ask you some questions. The order (public, committee members) depends on the preferences of the chair. The presentation has to be in English. Often the chair of the committee allows that your defence, the question and answer part, to be in Dutch. After your defence the committee withdraws to reach a final conclusion and agreement on the grade. This may take some time, but usually does not take much longer than fifteen minutes. When the committee returns the chairman gives an introduction to the assessment and announces the final grade. At CME the diploma is handed over to the newly graduated engineer directly after the presentation and defence. Don't forget to sign on both sides of the diploma.

The thesis graduation committee will do the assessment of your final thesis. The final grade will be given right after the graduation presentation. The assessment is based on the 4TU Master thesis assessment form, as shown in the appendices. The assessment form is also available on Blackboard (under CME2000 or CME2001).

5.2.6 Uploading Graduation Work in The TU Delft Repository

CME students are obliged to upload their graduation work to *Pure*, the digital library of scientific public publications of the Delft University of Technology. If you do not comply with that, you will not receive your diploma supplement.

The instructions for uploading your thesis in *Pure*, using your NetID, are available at:

<https://repository.tudelft.nl/content/education-upload-tips>.

Once the Secretary of CME receives your diploma supplement, we will check if your work has been uploaded to the Repository. If you do not meet this requirement the diploma supplement **will not be sent** to you. Of course you will be notified if such is the case.

| For questions about uploading please contact Team Delft Repository (repository-lib@tudelft.nl).

6 GRADUATION COLLOQUIUM CME

Knowledge exchange is vital for students and especially during your graduation thesis this can be necessary input for you. For this reason, graduation colloquia will be facilitated by graduation coordinators from CME. There are no exact details concerning form and organization for the colloquia. The following is an outline:

Graduation students prepare at least one presentation during their graduation thesis period. The graduation coordinators facilitate the organisation of a colloquium by and for graduate students. After the kick-off meeting the student is included in the colloquium-planning scheme. Graduation student colloquia are given in small groups and are jointly prepared by the same group of graduate students. In case one of the students is prevented from giving her/his presentation, the students are to switch dates with another student participating in a different colloquium. The student informs the graduation coordinators about the results of the switch, so he can adjust the colloquium-planning scheme.

All graduate students and their supervisors are invited to attend the colloquia so as to learn from each other and to give feedback to the students presenting their research.

The graduate students who will do a presentation organise the colloquium, open the lecture hall (collect and return the keys from/to the Service Point), take along a laptop computer, make sure all equipment is functioning, open the colloquium, lead the discussion and close the colloquium and the lecture hall (don't forget to return the keys!).

7 GRADUATING IN A FOREIGN COUNTRY

The procedure for graduating outside The Netherlands is basically the same as for graduating here. In this chapter some specific differences and characteristics are mentioned.

The following activities must be carried out at the TU Delft:

1. Selection of graduation subject, intake meeting;
2. The preliminary completion of the research proposal;
3. The kick-off meeting.
During this meeting procedures are agreed upon to for a digital meeting method;
4. Preferably: The Go / No Go meeting;
5. The graduation colloquium.

In consultation with your committee members the meetings 2, 3 and maybe 4 can be held digitally.

Guidance by the mentor

The external committee member from the (foreign) company takes over the role of daily mentor. During the intermediate periods between the committee meetings she or he is the daily contact for the graduate student.

Communication

Periodically (interval to be agreed upon) you will inform the other committee members of your progress.

8 RESEARCH PROPOSAL AND CME2001

8.1 What is the Master Thesis Preparation CME2001?

The course Master Thesis Preparation is a self-study course in which you prepare your research proposal for your kick-off. The course consists of one lecture.

Study goal

The study goal of the Master Thesis Preparation is to be able to effectively formulate a thesis subject and a plan to carry out the necessary preparatory studies. After this lecture you will be able to prepare a research proposal that fulfils the standards for the master thesis kick-off meeting.

Course contents

This lecture in this course will give you an overview of the steps you have to take to write a good research proposal. The topics in the lecture are very hands-on. Many good books about preparing and execution a research have been written. We focus on practical steps, simple emphasis and applied examples. The lecture is based on the book 'Een onderzoek voorbereiden' by Oost and Markenhof – available in Dutch only. Another good book to guide you through your research preparation is 'Designing a Research Project' by Verschuren and Doorewaard.

A prerequisite for this lecture and starting your graduation is that you have finished all compulsory courses, elective courses, internships or multidisciplinary project. Requests for dispensation from this prerequisite can be send by mail to the CME director of Operation, Jules Verlaan.

Practical information for the lecture

How can I prepare for this lecture?

A central part in the lecture is a discussion about (preliminary) research questions from the students. You can prepare for this lecture by thinking about your research topic and drawing up a (preliminary) research question that we can discuss in the second part of the lecture.

Is there anything else I should know?

Yes. The course CIE4030 Methodology for Scientific Research goes deeper into the actual execution of your research and the individual assignment is about writing a research proposal.

The lecture of CME2001 is very hands-on, pragmatic and takes you through the process of the graduation project and preparing your research proposal. Key criteria for a good research proposal are given.

When are the CME2001 lectures?

At the beginning of every quartile an introductory lecture for your master thesis preparation is given. See 'General info lecture' on Blackboard for announcements of date, time and location.

8.2 What is the Use of a Research Proposal?

The general goal of a research proposal is communication. A good research proposal will give guidance and focus for yourself during your entire research. It also functions a means to communicate your research plans with your graduation committee: your professor and the supervisors. It tells them WHAT you are going to, WHY, HOW and what your intended RESULT is. The research proposal provides your company supervisor with a clear explanation of the problem you are going to tackle and why you choose their company as the basis for your graduation subject.

The text of a good research proposal can be (re)used in your thesis as well, as it provides a clear explanation of the WH, WHAT and HOW of your research.

In the following paragraphs we start with some tips on how to find a good subject for your thesis, if you have to start from scratch. Next we will discuss what the four main criteria are for a good research proposal. Finally we list the basis elements of a research proposal.

8.3 Finding A Good Subject for Your Thesis

To start with the obvious: your graduation subject should be within the professional field covered by the MSc CME. The professional field of CME is very broad, so it may still be difficult for you to find focus. If we would have a FAQ the most frequently asked questions would be:

Yes, a CME subject, but what do I do if I don't have any idea yet?
I want to do something with Asset Management, but what exactly?
I want to do something with Project Management, but where do I start?

There is no specific moment in time where your thesis preparation exactly starts. You will probably start thinking about a topic, a subject, and a company (which company?) during the third semester of your CME study. For some the choices are clear, for others it is fuzzier and they do not know where to start. For those that are not so sure what they want to do, the questionnaire below might help.

1. What is your favourite course?
2. What is your most favourite subject?
3. What are you most interested in?
4. What would you like to learn from your research?
5. What is your preferred point of view: Contractor? Consultant? Principal? Science?
6. If you already have a subject: what is your subject?
7. If you already have some idea about a research question, what is it?
8. Is there already a large body of knowledge on your subject?
9. What do you think is the gap in the knowledge?
Are there different opinions available?
10. What are the things you do not want to get involved in?
11. Why is this research or research question interesting for you?
12. Why is this research interesting for others? For whom and why?
13. How is your question linked to your study or master's programme?
Is it linked to certain themes or theories?
14. What are the aspects within your research or subject that you do not want to focus on?
15. What is the most important outcome of your research that you are looking for?
16. What other information do you expect to deliver?
17. Do you have any idea about the sub-questions of your research?
18. How are you going to execute your research?

Figure 1 Curiosity Self-Assessment (based on Oost & Markenhof, 2002)

Try to describe in your own words the answers of the *Curiosity Self-Assessment*. Your viewpoint when answering these questions is your (intended) research. If you do not know an answer yet, just leave it blank. Another way to figure out where your curiosity lies is to make a mind map. You can use the questions shown in figure 1 to start building your mind map. Start by putting a rough idea in the middle. Add some branches. Then some sub branches. Use the table of contents of the books you have used during a course as inspiration for the branches. If you are interested in Asset Management, use the subject groups from IAM Asset Management Anatomy, and the 39 subjects as inspiration for the sub branches (Institute of Asset management, 2015).

For information about making mind maps, see The Mind map book by Buzan et al (2010).

Also think about the point of view you want to take. Are you more interested in the point of view the government or of the contractor? The consulting agency? The architect? The university?

Thinking about these questions is very important because your research question will be your problem for the next six to eight months. Make sure the research satisfies *your* curiosity, not just somebody else's.

An overview of possible graduation subjects can be obtained from the graduation coordinators. It is also possible to formulate your own subject, or to slightly amend a brief already drawn up. If you are looking for some inspiration to do so, please contact the graduation coordinator or check this webpage that lists all the CME graduates with links to their thesis reports:

<http://www.tudelft.nl/studeren/masteropl/masteropleidingen/construction-management-and-engineering/msc-programme/thesis/graduates/>

And you can always check the graduation project announcements in the corridor between room 3.48 to 3.30 of the section Infrastructure Design and Management.

8.4 Criteria of a Good Research Proposal

There are many books available about preparing your research – see also chapter 9. In general, you can identify four qualities of a good research proposal and these qualities have to be consistent with each other (Oost & Markenhof, 2002). During the lecture of CME2001 these qualities will be discussed in more detail.

8.4.1 WHAT: Show the link with your area of knowledge

The first criterion of a good research proposal is that the problem definition should be embedded in the context of your discipline, your faculty's or section's expertise. What is needed is a systematic approach for refining the broader context of your discipline, your expertise to the problem definition. The reader should be guided by giving the choices that are made and the assumptions that are used to arrive at the problem definition.

Conditions for a sound link with your body or area of knowledge, require your problem definition to be:

- Clear and precise
- Complete and in the right order
- Consistent and sufficient

8.4.2 WHY: Relevance

The second criterion of a good proposal is that it should show the relevance of your research – scientific, societal and practical. Your account for having a relevant problem definition should be showing that:

- There is no satisfying answer yet
- The answer contributes to theory, practice or society.

You cannot show the relevance of your research without doing proper literature research.

8.4.3 RESULT: The precision of your proposal

The third criterion is the precision of your proposal: what is your answer going to be? This seems like a strange question and many of you might say: *How do I know? I haven't started my research yet!* But think about it. There are many possibilities for a result of your research. However, CME is part of engineering education and is solution oriented. Your result will in some way be an advancement in understanding or an improvement in processes and be something like:

- An advice or a set of recommendations
- A model
- A framework
- A strategy
- An implementation plan

Your research can also be scientifically relevant and the results might include:

- An adapted theoretical framework
- A new or adapted method
- A new framework for evaluation

Pressing yourself to think about your domain will help you say something about possible generalisation of your answers. There two types of domains:

- The researched domain:
This is the part of the real world where you look for data, information to construct your answer
- The intended domain:
This is the part of the real for which your answer is meant to be valid

Be specific here, and define both domains by units, geography, speciality, numbers, space and/or time.

Many CME students use case studies in their graduation project. Make sure that early on, preferably at kick-off, you have a clear understanding of the requirements for applicable cases, that you have access to the cases and the relevant information, either through documents or knowledgeable people.

You will need to define the concepts that you use in your thesis. Make sure that you operationalise these concepts. The use of variables will help to become more specific in what you are looking for.

Remember that there are two types of variables:

- Independent variables: what you are looking for in order to find the answer to your question;
- Dependent variable: the specific item/concept your answer will be saying something about.

Literature research, applying theories will help in identifying the things to look for.

8.4.4 HOW: The functionality

The fourth criterion is called functionality. Your research method has to be functional, which means that there has to be a fit between your research question and your method.

This means that you have to explain your:

- Research function
Are describing, defining, explaining, evaluating, comparing or designing something?
- Research approach
Are you going to modelling, case study, survey or interviews? And why?
Explain why you choose a certain method.

Also of importance here are the criteria for academic rigor of your research. Show that your research will be reproducible, objective, has (statistical) validity and a sound degree of generalisation.

There are many research approaches and many books have been written about each of these approaches. Familiarise yourself with the approach you choose. See the bibliography at the end of this Guideline for suggested titles.

Also think about your sub-questions. These questions will be a mix of how, why and what questions. Shortly describe the goal of each sub-questions in your proposal. Explain why you ask that specific sub-question. Each sub-question should contribute to the answer of your main research question. Also beware that your method may prescribe a certain set or order of sub-question (e.g., DMAIC – Define, Measure, Analyse, Improve, Control).

Explaining a theory, a concept is not a sub-question. That is something that can be found in the right books or articles. You need to familiarise yourself and the reader with this theory or concept. Make sure that you only explain theories/concepts that you actually use in your research.

In your research approach you also describe the perspective of your research. This perspective is the theoretical framework that you will use during your research. Compare this framework with a pair of glasses that you put on during your research. Sometimes you have to construct your own framework. You will need to do a literature study in combination with preliminary research (often interviews). This preliminary research will of course be visible in your set of sub-questions.

8.5 And Finally: Check the Consistency of Your Proposal

Obviously, there has to be a fit between the previous four criteria. In other words: Does your research proposal show a good fit between: [The WHAT](#) - [The WHY](#) - [The HOW](#) and [The RESULT](#)

Consider the question of consistency like validation in Systems Engineering. Validation is asking yourself: Am I doing the right thing? For your research proposal that means you have to take a step back and consider for yourself:

- Am I doing/proposing the right thing?
- Are the context, reason, strategy and answer that I am proposing coherent?

Do so by asking yourself the following questions:

- The [WHAT](#):
Is the subject mentioned in the last step of the stepwise refinement really the subject of my problem definition?

- The **WHY**:
Is the problem for my research question really relevant and does solving it add value to science and society?
- The **HOW**:
Do the research question and proposed research methodology really fit?
- The **RESULT**:
Is the subject mentioned in the last step of the stepwise refinement really the subject of my research question, is it really the answer I am looking for?

8.6 Basic Elements of Your Research Proposal

Once you have critically looked at the four criteria of a good research proposal, it is time to put it all to paper. But what are the basic elements of a research proposal?

Below is an example of 10 basic elements that should somehow be part of your proposal. But this example is in no way a prescriptive format.

1. Front Page

As with any other report, it should have an attractive title and subtitle and bear the relevant official data such name, student number, version, date.

2. Summary

The summary gives an informative abstract of your proposal in a limited number of words. Follow the structure of your proposal.

3. Introduction

Here you can explain the broader context and reason for the research. This will be based on your literature research (ref. relevance!). The introduction also gives the reader an overview of the structure of your proposal.

4. The Problem

This is the paragraph where you explain the nature of the problem. Here you make clear what we already know of the problem, you do your step-wise refinement of the problem leading to a problem statement. You identify the knowledge gap you want to fill in and also present the theoretical perspective that you are going to use.

The relevance of the research is highlighted in 'Problem' paragraph, in combination with the objective and expected results of your research.

5. Research Question

In this paragraph you translate the problem statement and research objective in a main research question and related sub-question. Motivate your sub-question by showing how they will contribute to answering the main research question.

Make sure that all of your questions are:

- Doable in time
- Financially Doable
- You have the right capabilities (remember: link with your area of knowledge!)
- You have access to data (both people and documents)

6. Research Method

Here you underpin the choice of your research method. Make sure you explain why you have chosen this method and show that you are aware of the limitations and drawbacks of this method. Again make sure you can apply this method in the time given for your thesis.

7. Data Gathering and Analysis

Mention here what the requirements are of the data you need, where you expect to find the data (sources) and how you plan to analyse the data.

8. Thesis Outline

Give an outline of your thesis. You can use a flow diagram to explain your research.

Here you can present an overview of the chapters of your thesis. What really helps here is adding some comments at each chapter. What are you going to deal with in that chapter? What is going in and what is the result of that chapter?

9. Planning

Give an overall planning of your graduation project. Include the (preliminary dates of the milestone). And again: check whether your ambitions are really doable!

A good way to present your planning is a Gantt chart.

10. Literature List

And again as usual: make sure you have the right references (correct and consistent) at the end of your proposal. Without giving an exact number: also make sure you have a sufficient number, variety and quality of referenced sources.

8.7 What About the Assessment Of CME2001?

Master Thesis Learning Goals

First of all, it is important that you are aware of the learning goals of your master thesis and the assessment criteria. You can find the assessment criteria of the master thesis on Blackboard (under CME2001 and CME2000).

The learning goals of the master thesis (preparation) are:

After completing their master thesis graduation project, you are able:

1. To plan and execute a research project at an academic level;
2. To work independently;
3. To apply scientific and technological skills at an academic level;

How Will My Thesis Preparation Be Assessed?

Not actually. There will be no assessment of your thesis preparation by the lecturers of this course. Your result of this course is your research proposal that is input for your kick-off meeting. The proof of the pudding is in the eating. Your research proposal will be subject to assessment by the members of your graduation committee. The 4 EC of CME2001 will be awarded in conjunction with the 32 EC of CME2000, your master thesis. The grade for your master thesis will also be the grade for your master thesis preparation.

9 RECOMMENDED LITERATURE

9.1 General

De Haan, A., de Regt, E. (2014), Graduation – Challenge Accepted, Eleven, The Hague

A hands-on guide to take you through your graduation project. Written from the point of view of a student.

Oost, H. and A. Markenhof (2002) Een onderzoek voorbereiden, Baarn: HBuitgevers.

Buzan, T., B. Buzan, and J. Harrison, (2010) The Mind map book : unlock your creativity, boost your memory, change your life. 1st ed., New York, NY: Pearson BBC Active

9.2 Report Writing And Presentation Techniques

Cottrell, S., (2003), The Study Skills Handbook, Palgrave, New York, NY

Eco, U., (1990), Hoe schrijf ik een scriptie?, Amsterdam, Bert Bakker, 1990

Subjects are: structure of thesis, information source research, literature references, formulation, etc.

Elling, R., B. Andeweg, J. de Jong, C. Swankhuisen, (2005), Rapportagetechniek. Groningen, Wolters Noordhoff.

Practical recommendations for writing a report, feasibility studies, procedures etc. Developed especially for students at technical and business-oriented educational institutions.

Mirande, M.J.A., E. Wardenaar, (1990), Scriptieproblemen. Groningen, Wolters Noordhof, 1990.

A practical tool for assistance when in doubt about the proper approach and for analysis of a tedious graduation progress. Especially part 2 is focused on this.

Tufte, E., (1997), Visual & Statistical Thinking: Displays of Evidence for Decision Making. Graphics Press.

Publication about visualization of all sorts of data.

Tufte, E., (2001), The visual display of quantitative information. Graphic Press. 2nd edition.

Publication about visualization of all sorts of data.

White, B., (2003), Dissertation Skills for Business and Management Students, Continuum, London

9.3 Research Methodology

Baarda, D.B., M.P.M. de Goede en J. Teunissen, (2009), Kwalitatief Onderzoek. Praktische handleiding voor het opzetten en uitvoeren van kwalitatief onderzoek. Noordhoff, Groningen

Clear, systematically structured guideline for qualitative research, with chapters on three well-known methods of data collection / processing: participatory observations, interviews and information source research. Appendix 1 contains information about additional literature. Appendix 2 deals with specific software ("Kwalitan") and word processing programmes to support the analysis of collected data.

Baarda, D.B., (2012), Basisboek methoden en technieken, Noordhoff, Groningen Kroese.

Practical guide for structuring and executing research. Using flow charts, the research process is followed step-by-step problem formulation, design of the research effort, up to and including data analysis and reporting. Each chapter ends with tutorial questions. Mainly focused on quantitative research methods.

Creswell, J.W., (2009), Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Thousand Oaks, Sage.

The book presents these three approaches side by side within the context of the process of research from the beginning steps of philosophical assumptions to the writing and presenting of research.

Denzin, N. K., Y. S. Lincoln (eds), (1994), Handbook of qualitative research. Thousand Oaks. Sage. 1994.

Elaborate and comprehensive piece of work. The book covers the theoretical points of view.

Fellows, R.F., A.M.M. Liu, (2008), Research Methods for Construction, Wiley-Blackwell, Chichester

Three main sections - producing a proposal; executing the research; and reporting the results - discuss the key issues in research and examine the primary approaches, both qualitative and quantitative.

Grit, R., M. Jusing (2012), Zo doe je een onderzoek, Noordhoff, Groningen

Maylor, H. K. Blakcmon (2005), Researching Business and Management, Palgrave MacMillan, New York

Segers, J.H.G., (1987), Methoden voor de sociale wetenschappen, deel 1; Inleiding tot de structuur van het onderzoeksproces en tot de methoden van dataverzameling. Van Gorcum. Assen/Maastricht.

Pays pays attention to the "conceptual model, comparable to Swanborn (1987) and Baarda (2012).

Swanborn, P.G., (1987), Methoden van sociaal-wetenschappelijk onderzoek. Inleiding in ontwerpstrategieën. Meppel. Boon.

A classic in the academic world. Emphasis on research methods and techniques

Verschuren, P., H. Doorewaard, (2010), *Designing a Research Project*, Eleven, The Hague

Verschuren, P., H. Doorewaard, (2010), *Het ontwerpen van een onderzoek*, Eleven, Den Haag

This book has primarily been written for the initial phase of research. Most books deal with the actual execution of research work, whereas the beginning is the hardest part.

9.4 Research Techniques for Data Collection

Baarda, D.B., M.P.M. de Goede, A.G. van der Meer-Middelburg, (1996), *Open interview*. Stenfert Kroese, Leiden.

Practical guide for preparing and carrying out open interviews, approaching respondents and processing and analysing interview material. Emphasis is on data collection.

Baarda, D.B., M.P.M. de Goede, M. Kalmijn. (2000), *Basisboek enquêteren en gestructureerd interviewen*. EP Houten.

Emans, B. (1990) *Interviewen. Theorie, techniek en training*. Wolters Noordhoff, Groningen.

Fowler, F.J., (1993), *Survey Research Methods*. Sage. Newbury Park. (1993).

Fowler, F.K., T.W. Mangione. (1990) *Standardized Survey Interviewing*. Sage, Newbury Park.

Gorden, R.L., (1998), *Basic Interviewing Skills*. Waveland Press, Prospect Heights.

Gordon, W., R. Langmaid, (1998), *Qualitative Market Research*. Gower, Aldershot. 1988.

Marshall, C., G.B. Rossman, (1995), *Designing Qualitative Research*. Sage. Thousand Oaks.

Maxwell, J.A., (1996), *Qualitative Research Designing*. Sage, Thousand Oaks.

Meulenberg, M., (1995), *Van vragen tot verslagen*. Coutinho, Bussum. 1995.

Brief guide for interviewers, with tips for preparation, interviewing and processing.

de Schamphelleire, W., (1986), *De techniek van de enquête, een inleiding*, Leuven, Acco.

This publication deals both with verbal (interview) as well as written forms of polling. Random sampling and data description are dealt with.

9.5 Research Using Case Studies

Brasters, J.F.A., (2000), *De kern van casestudy's*. Gorcum. Van Assen.

Hutjes, J.M., J.A. van Buren. (1996), *De gevalstudie. Strategie van kwalitatief onderzoek*. Meppel. Boom.

Miles, M. B., A.M. Huberman, (1994), *Qualitative data analysis*. London Sage, 2nd ed.

Comprehensive work covering case study research. Cited often. Contains many practical hints for setting up and carrying out different types of case study research.

Swanborn, P.G., (1996), *Casestudy's; wat, wanneer en hoe?* Amsterdam/Meppel. Boom.

Elaborate book on how to work with case-research. First chapter starts with a sketch of the differences between 'intensive' and 'extensive' research.

Yin, R.K., (1998), *Case study research. Design and methods*. Thousand Oaks. Sage, 2nd ed.

An often cited, English publication on how to carry out case studies.

9.6 Describing And Analysing Research Data And Statistics

van Dalen, J., E. de Leede., (2000), *Statistisch onderzoek met SPSS for Windows*. Utrecht. Lemma.

Norusis, M.J., (2000), *SPSS Guide to Data Analysis*. Prentice Hall, Upper Saddle River.

10 APPENDICES - FORMS

CME Master thesis assessment form and criteria

Graduation Procedure	CME-0
Application start graduation and programme approval	CME-1
Kick-off and Committee Approval	CME-2
Exam Application Form – Green Light	CME-3

 Use the electronics version of these forms available at:
<http://studenten.tudelft.nl/en/students/faculty-specific/ceg/master/forms-master/>

Sample Progress Report

Assessment protocol Master's thesis 3TU-CME

This protocol was set up to support the assessment of Master's theses within the 3TU MSc-programme Construction Management & Engineering (CME).

The assessment of the Master's thesis takes place after the public colloquium and the discussion / questioning afterwards. This is done in a short, closed meeting of the Master's thesis committee (the student is not present at this meeting). The assessment is performed by the university members of the Master's thesis committee. External members have an advisory-vote. At the assessment, several aspects are taken into account.

Regarding the assessment aspects, three main aspects are distinguished:

1. With respect to content: quality of research or design¹ (product)
2. Working and learning process during Master's thesis project (process)
3. Communication (presentation)
 - a. Report
 - b. Oral presentation and defence

Appendix 1 lists all aspects within these three main categories. When assessing a Master's thesis, the committee will address these main aspects and determine the strong and weak points of the student's work. This is registered by the main supervisor on the **Assessment Form Master's thesis CME**.

Subsequently the committee determines the final grade for the Master's thesis according to the final grading profiles. Appendix 2 presents profiles for final grading that indicate how the quality of the Master's thesis as a whole can be translated into a final grade. The list of aspects for assessment and the profiles for final grading offer guidelines for a more equalized assessment of master theses and offer clarity to the student about the way he or she will be assessed. The aspects for assessment and the grading profiles were set up according to the learning goals of the Master's thesis and (partially) on the final qualifications of the MSc-programmes.

After determination of the final grade, the Master's thesis committee announces the final grade to the student and presents the feedback on the assessment form orally to the student during the final public assembly.

NB When the research has a balanced focus on technique and management, this will be valued positively. When this is not (or to a lesser extent) the case, this does not have to lead to a negative influence on the assessment.

¹ This aspect has to score sufficient or more to lead to and sufficient overall score

Assessment Form Master's thesis 3TU-CME

Name student: Student number:

Course code: Date:

Main supervisor ('Afstudeerdocent'):

Thesis title:

Final grade:

Duration of graduation project: months

Signature main supervisor:

Criterion	What went well?	What could have been improved?
Content: quality of research or design (project)		
Working and learning process during project (process)		
3. Communication (presentation) 3a. Report 3b. Oral Presentation and defence		

Appendix 1 - Assessment criteria

1) With respect to content; quality of research / design (project)

Assessment criteria	Indicators
<i>Innovation</i>	- Creativity - Inventiveness - Originality - Extent to which the research is innovative - Extent to which the student independently introduces new concepts - Contribution to new knowledge / contribution to a concrete product, design or model
<i>Literature review & Theoretical framework</i>	- Use of earlier results of research (and integration of these results) - Depth (detailed elaborations, use of literature)
<i>Research method / design</i>	- Clear research question - Applying the correct research and design methodologies - Systematic / methodical approach - Data collection and analysis / validation of the design - The extent to which the original research proposal has been met and reasons for alterations (keeping up with a work planning, follow up on appointments made)
<i>Conclusions & recommendations / Contribution to theory & practice</i>	- Reasoning / argumentation of conclusions (are research questions answered?) - Generalizability - Relevance (scientifically, applicability in practice / being able to put research in context) - Able to analyze and discuss the results, to draw conclusions from the results and to reflect on the results in the wider societal and scientific context

NB When the research has a balanced focus on technique and management, this will be valued positively. When this is not (or to a lesser extent) the case, this does not have to lead to a negative influence on the assessment.

2) Working and learning process during Master's thesis project (process)

Assessment criteria	Indicators
<i>Time needed to finish the MSc thesis project</i>	- Duration of the process - The process start is marked by the approval of the research proposal
<i>Independence and professional skills</i>	- Independence - Cooperation - Communication skills - Incorporation of feedback
<i>Attitude</i>	- Commitment / enthusiasm - Attitude to strengthen his / her personal development - Student's attitude during progress meetings (active / passive) - Reflection upon his / her own work - Functioning within the organisation where the project is carried out

3) Communication (presentation)

Assessment criteria	Indicators
<i>Report</i>	- Composition, structure, writing style, use of language - Consistency - Readability: clarity / sharpness of formulations - Lay out, images and tables (usefulness, added value) - References to literature
<i>Oral presentation and defence</i>	- Effective presentation of the content (is the message coming across?) - captivating way of presenting (verbal capabilities, posture) - Distinction between important points and minor aspects - Insight in subject matter and in coherence between different parts of the project - Structure / outline presentation - Care of details / neatness - Answering questions / discussion / defence

Appendix 2 - Profiles for final grading

These profiles are used as a framework of reference to provide general characterisations of the graduation process and product that leads to the final grading. It will not be used to fill out the feedback boxes in the Assessment Form. At CME in Eindhoven and Delft grading in 0.5 marks is possible.

5. Insufficient

The research and / or report are insufficient and the student was strongly directed by his or her supervisors. Weak points can clearly be pointed out. The student did not show an academic attitude. On average, the student scores 'insufficient' on all aspects for assessment.

6: Sufficient / meets the requirements

With respect to content, the research was conducted sufficiently. The report is mediocre. Weak points can clearly be pointed out, but are compensated by aspects on which the student performs better. The student has shown little input of his own and was strongly directed by his or her supervisors. On average, the student scores 'sufficient' on all aspects for assessment.

7: Amply sufficient / good

With respect to content, a solid piece of research was delivered. The report is carefully edited. Either the research process or the mastery of subject matter leaves room for improvement. The supervisors clearly had a steering influence on the final product. The student scores at least 'sufficient' on all aspects for assessment and 'good' on some aspects.

8: Good mainstream/ contains new elements

With respect to content, the research was set up in a solid way and was carried out accurately. The report is carefully edited regarding language as well as lay out. The student has worked independently and was able to put forward his or her own initiatives. The provided guidance by the supervisors was minimal. On average, the student scores 'good' on all aspects for assessment.

9: Very good / excellent

The research is innovative and can be converted to an article for a renowned (scientific) magazine without putting in too much effort. With respect to content, the research is very solid with some points that can clearly be pointed out as strong. The report is carefully edited and shows that the student features good writing skills. The student's own input and independence are large. The student clearly stands above subject matter and is able to defend his or her statements in discussions well. The student scores at least 'good' on all aspects for assessment and 'very good' or 'excellent' on some aspects.

10: Excellent

The research is innovative and can be converted to an article for a renowned (scientific) magazine without putting in too much effort. With respect to content, the research is excellent. The student is capable of conducting research independently. The report and the presentation show that the student disposes of excellent communication skills (written and oral). The student scores on average 'excellent' on all aspects for assessment.

Appendix 3 Profiles for assessing the aspects

Assessment aspects with respect to content; quality of research / design (project)

Assessment Criteria	≤5	6	7	8	9	10
Innovation	Not innovative; no creativity, inventiveness and originality.	Somewhat innovative; limited creativity, inventiveness and originality.	Creative, inventive and original, but some room for improvement.	Student is perfectly able to introduce new, innovative and original concepts.	Very well thought-out innovative project. The concept can be a contribution to a product design or model.	The Master's thesis project is an excellent contribution to a concrete product, design or model.
Literature review & Theoretical Framework	No depth, no use of earlier academic materials. Unclear and inadequately explained.	Limited depth and use of earlier academic materials.	Adequate depth and use and narration of earlier academic materials. Use of a theoretical framework.	Well-explained and critical evaluation of the latest literature. More than average depth.	Profound and critical evaluation of literature and demonstrating that the student is very skilled in integrating this literature.	Excellent and original; suitable for journal publication.
Research method/design	Unsystematic, not validated and unclear. No link to the correct research and design methodologies.	Limited explanation; justified using academic literature and showing some systematic approach.	Adequate use of research and design methodologies. Student is using the literature and dataset.	Well-explained and well justified, using the right research and design methodologies.	Profound and critical use of research and design methodologies. Very clear and validated design.	Excellent demonstration of research and design methodologies.
Conclusions & recommendations, Contribution to theory & practice	Vague, irrelevant, not able to analyze and discuss the results.	Clear and rather relevant, but shortage of arguing the conclusions.	Appropriate conclusions and recommendations. Contributes to theory and practice.	Clearly, relevant and very critical conclusions and recommendations. Valuable contribution to theory and practice.	Profound and original conclusions and recommendations. Very valuable contribution to theory and practice.	Excellent conclusions and recommendations.

Assessment aspects with respect to working and learning process during Master's Thesis project (process)

Assessment Criteria	≤5	6	7	8	9	10
Time needed to finish the Master's Thesis project	Master's Thesis finished in >1 year.	Master's Thesis finished in 10-12 months.	Master's Thesis finished in 7-9 months.	Master's Thesis finished in 6 months.	Master's Thesis finished in 6 months or less.	Master's Thesis finished in 6 months or less.
Independence and professional skills	Inadequate to work independent, incorporate feedback and cooperate with others.	Limited communication skills. To some extend skilled in working independently, incorporating feedback and / or cooperating.	Adequate in cooperating, incorporating feedback and / or cooperating. Can work independent.	Independent; very good demonstration of skills.	High degree of independence; superior demonstration of skills.	Excellent professional skills.
Attitude	Not the attitude to strengthen his / her personal development. Very passive attitude in meetings.	Limited commitment and enthusiasm. Limited active attitude in meetings.	Positive attitude in strengthen his / her personal development. Active and enthusiast.	Professional attitude. Active attitude during meetings.	Strives for personal development. Very committed, enthusiast and positive attitude during meetings.	Excellent attitude.

Assessment aspects with respect to Communication (presentation)

Assessment Criteria	≤5	6	7	8	9	10
Report: writing style and structure	Poor illogical structure	Readable, clear and consistent	Adequate consistent report with a readable writing style. Adequately argued.	Professional report with a very clear composition.	Profound report. Very clear writing style and structure. Potentially worth journal publication.	Excellent report.
Oral presentation and defense	Vague and unclear presentation and defense.	Clear, but limited based on the reported findings. Satisfactory.	Effective and structured presentation of the content. Insight in the subject matters. Good presentation.	Very clearly and takes much care of details. Good answers on questions and discussions. Gives much insight in the subject matter. Very good presentation.	Profound presentation with eye openers. A lot care of details, without going off-topic. Very strong presentation and defense.	Excellent presentation and defense.

At start of graduation work:	
CME-1	Complete the form CME-1
	Send the completed form <u>electronically</u> to the Secretary CME: s.c.m.schuchmann@tudelft.nl
	The Board of Examiners will check whether the list of courses taken meets all requirements of the CME master programme and the Examination Regulations.
	If anything is unclear, the Board of Examiners will send the list of courses taken back to the coordinator with any comments or suggestions from the Board of Examiners.
	The OSA will enter the information in the ISP (visible to students on Blackboard).
	In case you do not comply with the requirements, you will be notified by email.
After kick-off meeting	
CME-2	Complete the form CME-2
	Send the completed form <u>electronically</u> to the Secretary CME: s.c.m.schuchmann@tudelft.nl
	The Board of Examiners will check the composition of the thesis committee, sign and approve the document.
After Green-light meeting and at least 20 working days prior to presentation date:	
CME-3	Complete the CME-3
	Send the completed form <u>electronically</u> to the Secretary CME: s.c.m.schuchmann@tudelft.nl
	A final check of your CME programme against the requirements of the CME programme will be executed
	The Graduation Committee will check your thesis on plagiarism
No later than 7 working days prior to presentation date:	
	Submit a hardcopy (if requested by your committee) and pdf version of your final report to each member of the graduation committee and the CME secretary If not handed in on time, the presentation will NOT take place
Right after the presentation	
	The chair of the Graduation Committee will hand out the diploma.
	Upload your thesis to the TU Delft Repository
	The chair of the Graduation Committee will submit the grade to the Secretary of CME, followed by official registration and compilation of the diploma supplement If do not upload your thesis, the diploma supplement will NOT be sent to you
Unenrollment	
	If you no longer wish to be enrolled for your degree programme(s) at TU Delft you should submit an application to terminate your enrolment via your Studielink account (www.Studielink.nl) You need to take this action yourself. It is possible to unenrol by the first of the month succeeding the month in which the request for unenrolment was made. It is also possible to request a different month of unenrolment, as long as this period is in the future. If you terminate your enrolment as of 1 July or 1 August you will not be entitled to a refund. Visit the website for more information: www.csa.tudelft.nl/Unenrolment

Your registration will not be terminated automatically. You pay tuition fees up to and including the last month of registration. This means you need to deregister as soon as possible.
RETROACTIVE DEREGISTRATION IS NOT POSSIBLE.
When you are about to graduate, you should deregister during the month of graduation
You do not have to wait until graduation; you may submit the request for deregistration prior to it.
Visit the CSA website for more information regarding deregistration and/or a possible refund of tuition fees.

Name student		
Student number		
Student e-mail		
Personal e-mail		
Phone number		
Starting Year CME (Cohort)	Not calendar year	
Bachelor Diploma		
HBO	☐ Yes	☐ No
Specialisation	☐ Asset Management (AM)	
	☐ Project Management (PM)	
	☐ Infrastructure and Environment (I&E)	
	☐ Legal and Finance (LF)	
	☐ Free study program	

You are allowed to start the master thesis after the completion of all the courses of the master programme (+ the Bachelor programme and/or deficiency programme).

Signature of the graduation coordinator and signature on behalf of the Board of Examiners only valid on the condition of at least a total study load of 120 EC's.

Signature student	Name and signature of graduation coordinator	Name and signature on behalf of Board of Examiners
Date	Date	Date

Check the course codes and add (certified) copies of courses from outside TU Delft

TICK ALL THE BOXES OR ADD COURSE CODES AND COURSE NAMES OF ALL THE COURSES IN YOUR CME PROGRAMMA – NOT JUST THE ONES YOU HAVE COMPLETED SO FAR

1) Compulsory Courses (based on TER 2017-2018)

Course code	Course name	EC
☐ AR8002	Legal and Governance	7
☐ SPM8000	Project Management	7
☐ SPM8001	Process Management	7
☐ CME1200	Collaborative Design and Engineering	7
☐ CME1210-14	Infrastructure Asset Management	7
☐ CME2200	Dynamic Control of Projects	4
☐ CIE4130	Probabilistic design	4
☐ CME2300	Financial Engineering	4
☐ CIE4030	Methodology for Scientific Research	3
☐ EPA1433	Intercultural relations and project management	5
☐ WM0312CIE	Philosophy, Technology Assessment and Ethics	4

2) Elective Courses (according to the specialisations)

The agreement of the Board of Examiners and the education management on beforehand is required for all elective courses, except for the courses which are mentioned below in article 4 of the implementation Regulations of the TER. For approval, the student must draw up his entire examination programme and present it to the Board of Examiners. The Board of Examiners will take the student's entire elective programme into account when assessing the requested electives from the student.

	Course code	Course	EC	Specialisations			
				AM	PM	IE	LF
☐	AR0880	Real Estate Valuation	7				✓
☐	CIE3380	Infrastructure Management	4	✓			
☐	CIE4120	Information Systems For The Construction Industry	4	✓			
☐	CIE4480	Integral System Design	4	✓			
☐	CIE4760	Assessment Of Transport Infrastructure And Systems	6			✓	✓
☐	CIE5981	Forms Of Collaboration In Civil Engineering	4		✓		
☐	CME5000	Procurement of Large Infrastructural Projects	4		✓		✓
☐	EPA1144	Actor and Strategy Models	5		✓		
☐	IN4086	Data Visualization	6	✓			
☐	IN4152	3D Computer Graphics And Animation	5	✓			
☐	SPM9537	Integrated Plant Management	5		✓		
☐	SPM9715	Intermediate Economics	5				✓
☐	SPM9716	Cost-Benefit-Analysis: Theory And Applications	4				✓
☐	SPM9750	Environmental Sustainability In The Built Environment	4			✓	
☐	WI3421	Risk Management	3				✓
☐	WI4050	Uncertainty And Sensitivity Analysis	6	✓			
☐	WI4138	Decision Theory/Expert Judgement	6	✓			
☐	CIE5050-09	Additional Graduation Work	10*				
☐	CIE4061	Multidisciplinary Project	10*				
☐	CME2100-11	Internship	10*				

* = Only one of these courses is allowed as elective

3) Deficiency Courses (EC's count as Elective)

BSc Architecture, TU Delft

See CME IR for equivalent mathematics courses

Course code	Course name	EC
☐ WI1708TH1	Analyse 1	3
☐ WI2031TH	Kansrekening en Statistiek voor HBO-instromers	3
☐ WI1807TH	Lineaire Algebra	3
☐		
☐		
☐		

BSc Civil Engineering and Geosciences

Course code	Course name	EC
☐ WM0201TU	Technical writing	2
☐		

BSc Technology, Policy and Management

Course code	Course name	EC
☐ CTB2410	Waterbouw	5
☐		

BSc TU/e or UTwente

The necessity and the content of a deficiency programme will be assessed by the Board of Examiners **before** the student will be admitted to the degree programme.

Course code	Course name	EC
☐		
☐		
☐		
☐		

Bridgingprogramme CME at TU/e or UTwente

See CME IR for equivalent mathematics courses

Course code	Course name	EC
☐ WI1708TH1	Analyse 1	3
☐ WI2031TH	Kansrekening en Statistiek voor HBO-instromers	3
☐ WI1807TH	Lineaire Algebra	3
☐		

4) Graduation work

Course code	Course name	EC
☐ CME2001	Graduation Thesis Preparation	4
☐ CME2000	Graduation Thesis	32

5) Additional courses (if any, and above Exam Programme of 120 EC)

Course code	Course name	EC
☐		
☐		
☐		
☐		
☐		

Mail this form to secretary CME: S.C.M.Schuchmann@tudelft.nl

Name student		
Student number		
Student e-mail		
Personal e-mail		
Phone number		
Starting Year CME (Cohort)		
Specialisation	☐	Asset Management (AM)
	☐	Project Management (PM)
	☐	Infrastructure and Environment (I&E)
	☐	Legal and Finance (LF)
	☐	Free study program

Thesis Title

| Signature of the chair of the graduation committee for approval of research proposal

Kick-off Research Proposal

Signature student	Name and signature Chair graduation committee
Date	Date

Graduation Committee

Name and titles members Graduation Committee	Section/Company

| Signature of the Board of Examiners for approval of graduation committee

Name and signature Board of Examiners
Date

Mail this form to secretary CME: S.C.M.Schuchmann@tudelft.nl

This form must be submitted 20 working days
prior to the date of the presentation of your Master Thesis

Name student	
Student number	
Student e-mail	
Personal e-mail	
Phone number	

Title Master thesis	
Date Presentation	
Time*	
Location*	

* in case already known

Green Light Approval

Chair Graduation Committee	Name:
Chair Graduation Committee	Signature
	Date:

Plagiarism test

Supervisor	Name:
Remarks	
Supervisor	Signature:
	Date:

Annotation (if applicable)

Responsible professor	Name:
Name of annotation:	Signature
	Date:

Student:	Signature:
	Date:

Attention

Ending your enrolment

If you no longer wish to be enrolled for your degree programme(s) at TU Delft you should submit an application to terminate your enrolment via your Studielink account (www.Studielink.nl). You need to take this action yourself. It is possible to unenrol by the first of the month succeeding the month in which the request for unenrolment was made. It is also possible to request a different month of unenrolment, as long as this period is in the future.

If you terminate your enrolment as of 1 July or 1 August, you will not be entitled to a refund. Visit the CSA website for more information: www.csa.tudelft.nl/unenrolment

Mail this form to secretary CME: S.C.M.Schuchmann@tudelft.nl

Progress Report	
Representatives	
Report Period	
Date	

Most important results and actions

[What has been done during the last week?]

- ...
- ...

Progress

[Are you behind, on, or ahead of planning, mention possible causes and actions taken?]

- ...
- ...

Challenges and possible problems that influence progress

[What are the challenges and problems you face, and esp. those that may need client intervention?]

- ...
- ...
- ...

Planned actions in next reporting period

[What are the actions you having planned for the next week?]

- ...
- ...
- ...

Risk management

[Are your risks and mitigating measures still valid and acceptable?]

- ...
- ...