Contents

1. Introduction

This guide is meant to provide the students with guidelines for the preparation of their BSc Thesis, Study Projects and MSc Thesis, including a general overview of these activities, milestones, interactions with supervisory team and the major deadlines. These guidelines supplement the information in the study and examination regulations and the module handbook.

A BSc thesis, a Study Project or a MSc thesis are scientific works, so a basic requirement is to work according to scientific methods which include: traceability and accuracy in data collection, objectivity and logic in the analysis and reproducibility of the obtained results. The students should familiarize themselves with the principles of good scientific work (2021 KIT 061 Satzung zur Sicherung guter wissenschaftlicher Praxis am Karlsruher Institut für Technologie (KIT), https://www.sle.kit.edu/downloads/AmtlicheBekanntmachungen/2018_AB_032.pdf).

We expect a BSc thesis to use state of the art approaches, using recognized technical and scientific methods, to solve engineering problems. Study Projects should approach preliminarily a research or technical question (examples are exploratory and commented literature review; preparation of an experimental setup; numerical simulations to a running project, etc.). We expect a MSc thesis to question and, if possible, go beyond the state of the art, in the approach of research or technical questions, bringing new insights and innovative approaches regarding applications.

The tutoring of Students of other courses and study programs, e.g. Geoecology, is possible. Students must inform themselves about the examination modalities in their study programs. This also accounts for exchange students originating from other universities (e.g. Erasmus students).

2. Time planning

The research leading to the BSc Thesis (12 ECTS), Study Project (15 ECTS) and MSc Thesis (30 ECTS) are similar in structure and are divided in five major phases (see Figure 1), each with different timings and responsible persons:

1. **Preparation** and announcement of topic made by the supervisory team.
2. **First contact**, which is informal between the student and the advisor.
3. **Inception meeting**, short presentation and discussion with the supervisory team.
4. **Thesis development**, along which the mid-term presentation occurs.
5. **Thesis completion**, including submission of the report, exam and feedback meeting.

Phase	1. Preparation of topic		2. First contact		3. Inception meeting
Actions	Formulation of task	Announcement in the website	Expression of interest	First meeting	Presentation and discussion
Who	Co-Supervisor	Co-Supervisor	Student	Student Co-Supervisor	Student Co-Supervisor Prof. Mario Franca

Phase		4. Thesis development			5. Thesis completion		
Actions	registration	Organization case by case *	Mid-term presentation and discussion	thesis submission	Submission of the report	Exam	Feedback meeting
Who		Student Co-Supervisor	Student Co-Supervisor Prof. Mario Franca (MSc Thesis)		Student	Student Evaluation commission	Student Co-Supervisor
		MSc 6 months, BSc.: 3 months, SP: tbd					

** Organization to be discussed with candidate and depending on topic and initial arrangements (external participants, etc.)*

Figure 1 General calendar of activities towards BSc Thesis (12 credits), Study Project (15 credits) and MSc Thesis (30 credits)

3. Supervisory Team

The students are followed by a supervisory team which consists of the professor and one or more co-supervisors, who can be specialists external to KIT. The supervisor team represents the principal reference for issues related to the development of the research project. As experts, they may provide literature references, data and/or models to start student's work. Each supervisor has his/her own style while performing these activities and the relationship that the student will establish with them will depend case to case. A short update to the co-supervisor, at least every two weeks via mail or personally, is advisable. The supervisors are also meant to clarify/solve problems. Nevertheless, students are expected to be independent, to reflect about solutions to a problem, before discussing with the supervisors.

4. Inception meeting

Before starting the research, the student and the supervisory team will have an inception meeting. Within this meeting, the student can present his/her background and motivation for the specific topic and a discussion on the topic with the supervisory team is held. The language of the presentation and the thesis (English or German) should be defined by this point in consultation with the supervisory team.

A suggested structure for the meeting is the following:

- Presentation of the student
  - Background and motivation
- Discussion of the topic (led by the supervisory team)
  - Research/technical questions
  - Methods, including resources and risk assessment
  - Timeline
  - Expected results
- Final considerations

At the end of the preliminary talk the supervisory team will provide a feedback and will confirm the student admission to the subject. At this point, the thesis will be registered in the campus system (MA and BA) or registered via the process slip (SP) of the Master's examination board.

5. Mid-term presentation and discussion

Roughly in the middle of the working period, the student will be asked to make a midterm presentation to the supervisory team, including the professor (compulsory for MSc Thesis). This should be no longer than 20 minutes followed by a discussion and feedback session of roughly 30 minutes. This session aims at a close monitoring of the evolution and progress of the student's work by all the supervisory team, to discuss the main difficulties and eventually take actions for correcting them. It should be a lively discussion about the results and developments. The discussed points/corrections/improvements should lead the students work subsequently. A suggested structure for the student presentation is the following:

- Cover slide
- Background and motivation
- Research/technical questions
- Methods
- Preliminary results
- Main challenges
- Timeline and next steps

6. Thesis development

Students are strongly advised to write their thesis in parallel with the other research activities. The frequency of meetings with the supervisory team can change depending on the student's independence level, preferences or the different activities. It is always recommended to promptly inform the supervision team in case of unexpected personal or work/study related issues that might crop up, in order to properly act on them.

7. Template and General Content

The template available on the website of the IWG should be followed. The students may use Latex (advisable) or MSWord for the redaction of their thesis, however the final document to be handled should be a **pdf document**. For students not familiar with Latex and willing to use it, an explanatory video with the basic principles is available on the website of the institute. In the template, there is a fixed structure for the documents. In the so-called "Main Part", the structure is free, however it should contain the following elements:

- **Introduction** (with the following structure: framework + scope + objectives and research questions + brief reference to methods + general reference to the type of expected results + work organization): it should contain an introduction to the main problem, the motivation and goals, indication of the main methods, boundary conditions and an overview of the structure of the document. In many cases it has proven to be useful to insert a figure at the end of the section, from which the structure, the argumentative process or important core statements of the work emerge. One to three pages are enough with no need of further subdivision. Experience shows that the introduction should be formulated at the end of the work to avoid repeated changes to the text.
- **Literature Review:** here the student presents the state of the art regarding the topic of the research, based on a complete literature survey of scientific articles, technical reports, credible websites, etc. (for appropriate referencing and survey of literature sources cf. the Template). Here, introduction and explanation of theories and key technical terms relevant to the work are expected as well. Note that, when introducing a theoretical framework and literature survey, only the information which is relevant to the work should be included to which reference will be made again in the course of the thesis. In this section, the student needs to show that is able to understand the relevant fundamentals carefully and reproduce them in a short and concise form, deriving the consequences for one's own work. The section is to be divided into meaningful sub-sections in order to facilitate the flow of reading and separate subject areas from one another. A final sub-section should contain the main knowledge gaps or technical needs identified in the Literature Review, from which the problem statement and the research questions are elaborated.
- **Methods**: here is where the presentation and justification of the chosen methods which allow the student to develop his/her research are made. The research is typically based on physical modelling, numerical modeling or field work. Other methods may include artificial intelligence algorithms, citizen science, remote sensing, etc. In case of physical experimentation, include: the choice of materials, experimental setup and instrumentation, measurements methods (water level, flow velocities, altimetry, pressure, etc.) structure and functionality of the model, theoretical analysis of the model, application of the similitude laws, dimensional analysis when applied, boundary conditions, processes of models, etc. In case of numerically-based work, include:

numerical software or algorithms, implementation of the numerical model (grid, time step, etc.), analytical base equations and respective numerical schemes and closures, assumptions and parameterization, initial and boundary conditions and variables to be extracted from the simulation (water levels, velocities, sediment transport, geomorphological changes, etc.). In case of field work, include: measuring instrumentation and setups (velocity, discharge, water level, sediment concentration, etc.), description of the study area, hydraulic characterization, physiography of the catchment area or river reach, period when the tests carried out (time of the hydrological year), hydrology and hydraulic boundary conditions. Use as much as possible diagrams, figures and graphs. If the data acquisition, treatment and analysis is non-trivial, these processes should be here described. Finally, when applied, a final sub-section should contain a table with the planning of experiments/simulations/measurements, e.g. with the several combinations of variables.

- **Results**: these need to be presented in graphical and tabular form, as much as possible. The text should describe the results; however, it is not necessary to describe every single experiment. When having multiple similar repeated results, consider presenting one in detail as example and leave the remaining in the appendix. The results which are presented here should allow the reader to understand the type of data and its quality, and they should convey to the reader the central statements of the work.
- **Discussion**: in the discussion, the results should be evaluated and discussed internally (among themselves) and externally (with research work from others which should be referred to in the literature review). The following should be considered: boundary conditions, sensitivity and error analysis; relation to existing theories mentioning and providing a justification for similarities and differences; use of cross references; how to derive consequences from the results and a critical consideration of the student's own work. It is in the discussion, where the conclusions from the results are drawn.
- **Conclusions**: the final section of the report should be brief and precise, describing the main results and conclusions in face of the goals set earlier in the introduction (research questions should be revisited); providing a short evaluation of the implementation and the entire work including the limitations of the results and conclusions drawn; evaluating one's own work with a view to possible further research which should conduct to an identification of unsolved questions and needs for further research. In the conclusions section a mention to the practical relevance of the work, highlight its scientific/technical novelty and how it contributed to advance the present knowledge, should be made.

The document starts with an abstract in German and in English, which is meant to provide possible readers with a quick overview on the thesis. It should include statement of the problem, methods used and main results achieved. The abstract should not be longer than 300 words.

8. Submission of works

The BSc thesis, Study Project or MSc thesis (final pdf version) must be submitted by e-mail to sekretariat-wasserbau@iwg.kit.edu, with the supervisory team in cc, by 18:00 on the due date. In addition, one printed version, including the signed declaration of authenticity (exam copy), must be submitted to the institute by 18:00 on the due date. It must be clarified with the supervisory team if further printed copies need to be handed in. If the due date is a weekend or holiday, the time and date from the e-mail is considered the submission moment. The hardcopy with the signed declaration must than be submitted the next working day. If the work is not delivered on time, it will be classified as “insufficient (5.0)”. In addition, a pdf version of the main document as well as data, figures (high quality) and codes used for the research need to be organized and an handed over to the supervisory team.

After submitting the thesis, the date for the final presentation will be set by the institute. If a workplace at the institute is provided, this must be left clean and tidy. This also includes the data, figures (high quality) and codes transfer to the supervisory team and storage space clearing. Before deleting data, the students should always talk to and have the approval of their supervisors. After finishing the work, the keys will be returned to Dr. Andreas Kron.

9. Extension of the deadline

Adjustment of the deadline to deliver the work is only possible in cases in which the student is not responsible for exceeding the deadline [examples are longer and certified illnesses, or significant, unforeseeable delays in experiments]. The deadline can be extended by a maximum of three months. A request for deadline extension must be submitted to the supervisory team and the Master's Examination Board (PAM) as soon as the reasons arise.

10. Exam

The final assessment will be based on both the report and the final public presentation. The student will be informed about the date of the public presentation which should be two to four weeks after the submission of the thesis. The exam consists of the presentation (20 min) and Q&A by the evaluation commission (supervisor team and sometimes other specialists) and audience (around 30 min). A suggested structure for the presentation is:

Cover slide
Introduction
State of the art
Research questions
Methods

Results
Discussion
Conclusions and suggestions of further work

In terms of time allocation during the presentation, it is advised to devote a maximum of 20% of the time to cover the four first topics (cover slide, introduction, state of the art and research questions), and reserve the rest of the allocated time to the remaining aspects of the work. After the defense, the supervisory team will agree on a mark based on the Evaluation Criteria described in the next section.

11. Evaluation criteria

At the end of the work students will be evaluated by the following criteria:

- **Autonomy** (needs for support, independent work, familiarization with new tools, setting own priorities, self-organization)
- **Scientific and technical approaches** (framing of own work in the literature, define areas of application and validity, appropriate usage of scientific and technical methods, analysis or results including errors and limitations, analysis and interpretation of physical mechanisms in detail, engineering applications)
- **Project management and communication** (team integration, time management, communication with supervisory team, colleagues and other intervenient in the work)
- **Structure of the written report** (logical order, systematics, balance, topic adequacy)
- **Description of the problem/research questions** (problem allocation, problem presentation, content delimitation)
- **Presentation and application of fundamental theories**
- **Leadership and critical thinking** (methodology, clarity of chain of arguments, understanding the topic, dealing with complexity and unforeseen situations, independence, creativity)
- **Used literature and sources** (quality and quantity of the selected literature, adequacy of this, citation style, references, correct contextualization)
- **Style and formal presentation** (written expression, legibility, transitions, conciseness of the formulations, spelling and phrasing, appearance, illustrations)
- **Results and conclusions** (scope and completeness, degree of innovation of the work, relevance to implementation, discussion and evaluation of the results, conclusions and identification of further developments)
- **Presentation and discussion** (content, slides, respect of allocated time, presentation style, rhetoric, discussion)

12. Final considerations

After the evaluation of the thesis the supervision team offers a feedback talk were the grade is explained and directions of further personal development are provided. We hope that, in the end

of this learning activity, students improved their critical thinking skills, the ability to work independently and that they are able to self-assess their strengths, weaknesses and learn from these.