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Technical and Scientific Thesis

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Preamble

At the end of each study, a scientific thesis is required. In engineering studies, aspiring graduates may be expected to go through the world with open eyes, recognizing open questions or problems that may be suitable for further investigation. This raises questions such as: Are there any problems that still have to be solved? Are there deficits that need to be resolved?

In the following, a path is shown in which steps, based on ideas and research objectives, a topic is searched for and edited creating the final thesis.

First the question arises: What actually distinguishes a scientific thesis? A scientific thesis is unique, it has a usefulness, it is temporary, i.e. it is completed at a certain point in time. A scientific thesis is a task that can be completed in a fixed time and has a defined goal. Scientific work is a subject to rules. If this list seems familiar: a project is also described in this way. This is another reason why the approach to technical scientific work is based on projects, and many scientific works originate from research projects. In addition, an author demonstrates his or her expertise in a specialist field through the gained knowledge.

Often the question is asked which procedure should be chosen to formulate a thesis. The answer is quite simple: Questions are asked, and these questions are answered throughout the course of the work. Thus, scientific work is similar to reverse engineering.

Reverse engineering aims to reproduce an existing system, to a large extent exactly by examining its structures, states and behaviours. If the term “existing system” is replaced by the term “object of investigation”, the meaning of this statement is not changed.

The question arises whether the methodology of reverse engineering can be applied to a technically scientific work. The formulation proposals could be used if questions are formulated from the text sequences listed there.

Instead of statements such as “This work deals with (or thematizes, deals with the question)” or “This work examines (or presents)” questions such as “What does this work deal with?” or “What is examined in this work?” are asked.

A scientific paper should answer questions. The structure of the work correlates

with the answers to these questions. If the questions are already well structured, the answer to a chosen topic can be traced back to answering such questions.

Similar to reverse engineering, the object of investigation is investigated by answering all questions. Only when all the questions have been answered are the examined interrelationships uncovered. The structure of the questions will often be interlinked, because some of the questions will uncover new problems, which in turn will lead to follow-up questions. In a goal-oriented investigation, this results in a logical sequence that is reflected in the structure of the work and thus ensures logical chains of thought.

With a successful structure, the benefit and thus also the scientific value of a thesis increase. The definition of a suitable structure is one of the most important work steps. They are sketched in the disposition or in the exposé. Dispositions are drafts of a systematic presentation of knowledge; problems are presented in the exposé. Both have in common that the concept and the basic ideas are presented together with the state of knowledge in the planned project. Here, too, there are parallels to the project work, because a realistic time schedule should be adhered to as far as possible.

Gernot Kucera

Preface

by Prof. Dr.-Ing. Stefan Böhm

Writing a scientific text, as required for a thesis in a degree course in engineering, is often a challenge, especially for a bachelor thesis as the first thesis. In technical studies, the "how" is often not conveyed to the necessary depth and scope.

With the work "Technical-Scientific Theses" by Prof. Dr.-Ing. Dr. tech mult. Gernot Kucera is given a compendium to the students, which makes it much easier to overcome this hurdle.

The compendium is based on the author's decades of experience as a teacher, who has supervised and evaluated a large number of theses.

Kassel, December 2019 *Stefan Böhm*

Abstract

The specifications for publications in the field of technical sciences have al ready become a standard. Especially in the field of research, the requirements for publications are therefore very similar. Scientific work also means to present results and findings to a wider audience for discussion and further processing. A (possible) path from the idea to a scientific publication is outlined below.

Contents

1 Topics of Investigation

The last semester of a study is devoted to the constitution of a scientific paper. However, before starting work, a topic has to be found.

The choice of a topic should be in the field of interest of an author. Only those who are interested in a matter will be able to work on the relevant facts in the sense of a scientific paper. There are enough interesting questions, which just have to be found. A title in the form of a headline can be set relatively quickly. However, this is only the beginning of the work.

Each heading is the shortest possible summary of the subsequent section. This applies to the choice of a topic as well as each other headline within the paper. Headings also contain those keywords that adequately describe a topic. Exactly these are suitable as search terms for the literature search.

To turn an idea or a headline into a topic a series of steps are required. At the very beginning stands the idea and the means by which this idea should be transferred into scientific work. In a first sketch, the starting position is record ed and it is considered which results are to be expected. The transition from a starting position to the results are methods that are available for solving and answering questions.

Every scientific work should answer the questions raised. As a rule, questions can be deduced from deficits in the field of technology, if, for example, some thing is to be improved. Already at this point, an evaluation has to be made for the first time: Is the deficit too small, so that a solution can be regarded as trivial, or is the deficit so great that, viewed from the workload, it cannot be pro cessed in the given time? Additionally, it should be determined which interest lies behind answering a raised question. Here the range goes from little scien tific, technical, or economic interest up to highly topical research areas.

It first has to be assessed to which extent answering the questions for scien tific thesis seems suitable. Therefore, it is necessary to obtain an idea by research in publications on where the initial situation of the scientific state of knowledge on a subject is or a development to which it is to be connected. The question is therefore, which authors have already considered and published a question. Only in this way the status of research and development can be ascertained and provides the justification for the existence of a deficit at all. Furthermore, the variety

of possible methods for answering questions has to be considered.

An idea for a work cannot be described with keywords. Everyone will use the keywords to build other associations, increasing the risk of miscommunication. A heading with keywords may be an idea but is not enough to turn this idea into a topic. Only a more precise description of this idea produces a picture or an idea even within another person. Such a description is in the first step a sketch that can be further refined to a disposition. This results in requirements for dispositions so that it can be judged whether a topic is capable of being approved.

In a disposition or an expose, the background of a question is first illuminated. The author should clarify why a chosen topic is on one hand of interest to them and on the other hand makes it clear why there is also a general interest. The author's own interest is, therefore, of great importance, because it is known that only topics and the resulting questions with personal interest lead to well usable work. Practice also shows that if this interest is lost in the progress of the work, then work must be considered below average to inadequate.

The general interest in a topic is defined by the questions, the so called re search questions. First, it must be made clear what the differences are to the known approaches from the research. Accordingly, the results of the research must already be documented in the disposition or exposé.

Even if it is not clear from the start which results can be expected from the answers to the questions, at least the purpose of the investigation has to be documented by establishing expected results.

Through the disposition or exposé, the entire path is already outlined as the future work will be built. In practice this means that in the disposition or exposé the main sections of the future work are already shown at the beginning. In the introduction, this is done by the presentation of the motivation, the introduction leads to the research question and the necessary scientific background. The main part compares and applies the methods and solutions as well as the an swers to the research questions. For this, the solutions are critically considered, justified and evaluated. In the final part, the results of the investigation are compared with the questions from the introduction and critically compared as to how the results and the proposed solution are to be evaluated. In the outlook of the work, the newly raised questions and unanswered questions result ing from the results of the investigation are listed, which could be further treated in a future work.

This illustration shows that the planning already anticipates an important step for future work. By defining a structure, the path for processing is prescribed. The more detailed the individual parts have been described in advance, the more of them can be used as part of the main work.

In general, dispositions or exposés must be approved. In this process, it is au dited whether a chosen topic seems suitable for leading to a appropriate work. The assessment of this requires the accuracy in the topic description. Fur thermore, dispositions and exposés help examine whether the topic, in the proposed form, can even be processed, e.g. whether the required infrastruc ture is available.

So, coming from an idea to a topic is a tedious process. Those who take care of a topic only in the last semester will hardly be able to create aviable frame work for a scientific work in the given time. It is therefore generally recommended to take care of a topic at a very early stage. Particularly in the field of technology, there are many exciting questions that are waiting to be answered. Therefore, students are also expected to see problems or technical difficulties in their processes with open eyes, which should be given a solution or where potential for improvement is seen.

Scientific approach

A scientific or technical approach is very different from a humanistic one. Be cause of the different approaches and methodology in the treatment of the re search question raised there, there are considerable differences in the mode of operation, type and scope of scientific thesis, which make comparison difficult and sometimes even impossible.

Hermeneutics is the interpretation and understanding of texts. Hermeneutics is a methodical claim to autonomy in the humanities and cultural sciences. For the humanities, the scientific methods are usually not suitable. In contrast, the task of the natural sciences is to explain the behaviour of the objects of investigation. In the field of technology, the goal is to use quantitative-empirical researches to prove whether results are correct or not.

This raises the problem that quantitative-empirical research considers the hermeneu tic method to be unscientific because it is subjective and not verifiable. Among other things, the theoretical foundations of the scientific approach lie in recording facts and not in the subjective experiences regarded as accidental. Nevertheless, in many works, e.g. surveys are used as the basis for investigations that are based on such subjective assessments and experienc es. The broad distribu tion of opinions and thoughts usually remains restricted insofar as the necessary overall breadth and diversity are rarely achievable. In the humanistic approach there exists a gradual scaling between “full matching” to “non-applicable”. In the scientific approach, especially in engineering, such limits contradict each other, because there are no ifs and buts only “right” or “wrong”.

From this point of view, scientific thesis with the claim to quality in the field of technology are much more elaborate and critical in the supervision than those works that allow room for interpretation. “A bridge must be sure that it does not collapse under load” is a catastrophic failure, if this assessment is false, while the derivation of a human behavioural pattern or knowledge will remain without serious consequences, because it can be corrected in other works.

Working in the field of technology

Solutions are sought in technology. At the beginning there is the profound analysis in order to discover starting as well as weak spots. If such starting points are found in a further step, the causes that might have led or could lead to misconduct are examined in more detail. This can be used to determine which options can be found and used to solve the problem that has been solved. Basically, a scientific work in the field of technology is constructed according to this scheme. Rough classifications into sections of a scientific study are

1. definition of problems with analysis of influencing factors,
2. the purpose of presenting what is to be achieved, where appropriate, explaining why a solution to the given problem appears,
3. the study of different solution variants,
4. the consideration of possible solutions in terms of usability, cost or timing,
5. the decision based on the chosen solution,
6. the development of a solution, and finally the
7. evaluation of this solution.

By analysis it must first be shown why a recognized problem is a problem at all. As a rule, this already gives rise the motivation to seek solutions for the chosen task. Not only in a disposition or expose, but also in the finished scientific work should be made clear very quickly to the readers, what are the questions of a thesis and why these questions are of special scientific interest.

It is always the case that problems are to be dealt with in accordance to the current state of technology or science. Both the state of the art and the scien tific examination of problems are published in the literature. For this reason, the beginning of every work is the confrontation with literature. By studying related work, it is determined which group of people has already dealt with similar problems and what conclusions have arisen from the investigations published there. Such discoveries are the starting point of the own research.

There is also a wide range of possibilities in the variety of methods for solving problems. Before these possibilities are examined in more detail, it must first be asked whether there are already standard solutions to similar problems. In this context, it is important to determine how the state of the art or of science has already dealt with such or similar problems and to what extent proposed solutions have already been published here.

The own approach is then the consideration of possible solutions. When considering possible solutions, the various aspects, such as the required effort, must be considered. This specific use of the term effort can be very manifold, because in addition to the technical feasibility the meaningfulness of a solution, the needed time for the realization, or the benefits in relation to the expected costs play a role. The term cost is also to be understood in multiple ways. Costs in this context are not only the costs of production, but also, e.g. the time expenditure. The term benefit also has multiple understandings. For example, the real benefit could only be given by the development of a new method in later applications.

The the abovementioned considerations may lead to a particular solution and mark it as preferable. Once the specific approach has been established, the raised questions will be answered. However, in some cases it may not be possible to determine in advance which alternative will most likely lead to the goal. In this case, it may become necessary to use the different variants of the solution and only decide based on the result, which solution should ultimately be used.

The evaluation of a final solution is the critical examination of whether an originally asked question could be adequately answered or not. During the evaluation, it is also ascertained to what extent further potential for improvement can be identified in already existing solutions and what possibilities there are to use it.

In the following, a simplified way answers the question of how the path from an idea to a topic for a scientific work can be shaped. If the points one and two, contained in the above enumeration, have been answered, the scientific value can be estimated as a “scientific research problem”. This means that points one and two have to be dealt with as comprehensively as possible in a disposition or exposé, in order for the supervisor and / or the course director to get an idea of the planned work. The disposition or exposé are already part of the scientific work, because they must convince others that the planned investigation has sufficient potential for a thesis. In comparison, the disposition functions as a socalled “proposal”, i.e. the type of documents that are required for the submission of scholarly publications. Furthermore, parts of a disposition or exposé can already be structurally incorporated into the work to be created later. A wellprepared disposition or exposé therefore already constitutes a fundamental part of the nascent work.

Summary

A chosen topic should first raise an author's interest. But even a supervisor only shows interest and will be ready to provide support if a scientific question is answered satisfactorily.

When choosing the topic, it is noteworthy that the expenditure of time should not be underestimated when deadlines for submissions exist. It should be remembered to safe enough time to thoroughly edit the paper. Additionally, it is important to keep up the enthusiasm and not let too much time pass, as the longer it takes, the harder it will be to continue. Once the enthusiasm is lost, the job is likely to "crash" very quickly with no output.

As for the general topic treatment, it should be noted that every work must be within a certain scope. In the process, emphasis is placed on contentrelated editing, without the work degenerating into the epic breadth of a "narrative" since it should be a scientific work.

Firstly, an idea arises. Afterwards, a disposition or an exposé is required. With the disposition or exposé, the supervisor can be contacted. It is judged whether the idea for a thesis emerged from the originally raised questions. It should also be remembered that the higher the level of completion, the higher the requirements for the work. It follows that nobody can only start with phrases and thought sketches, but that only wellstructured ideas can be accepted in the assessment.

Convince the supervisors

The supervisor has to understand and judge a chosen topic and the manner in which it is to be treated. If necessary, comments will also be issued. Future supervisors want to be convinced and "won over". The disposition or exposé should reflect the author's conviction and "enthusiasm" for the chosen question of research and must therefore provide information on the following points, irrespective of the choice of topic:

1. Type of topic treatment
   Problem cases - problems (subproblems) are defined, the options or hypotheses for the solution are presented and their relevance ascertained
   Decision case - the possible solution and their relevance are determined for an already known problem (partial problem)
   Appraisal case - Solution methods assessed for their suitability
   Information case - the available information is assessed for completeness and relevance
   Investigation case - Problem or partial aspects of a problem are investigated

Depending on this, as a general scheme, the disposition or exposé can be subdivided into the following subareas:

2. problem and background of the problem (previous history),
3. description of the system / program / process,
4. what is the subject of investigation, what should be achieved (improved)?
5. motivation (background: existing systems, history, operation, problems for example special interest, important event, development over time, larger context of topic),
6. procedure (procedure of the investigation, the planned procedure),
7. reference to relevant work and common knowledge,
8. concrete problem, research question and hypothesis survey objective,
9. methods used: the general question is: "with what tools (methods) will the results be obtained?"
10. demonstrating and explaining the analytical and methodological approach,
11. use of and reference to existing and established methods (reference to literature, other references),
12. argumentation for the methods used and semantic linkage of the topic to the methods should be apparent (described or explained),

13. examination of “alternative methods” and approaches to problem solving, which are not going to be used the work to achieve the results,

14. information on the main literature.

The above points are to be discussed in detail. In every work the logical structure and the traceability of the thoughts are important. In addition, there are further points to be dealt with in the finished work:

15. presentation of the fundamentals / state of the art, but no replicas from textbooks or teaching materials,

16. work on the current state of science and technology, but only as far needed and applied in the work,

17. differences between the working hypothesis and state of the art,

18. requirements (also for systems and processes),

19. findings, discussions and conclusions,

20. what should be achieved as opposed to actually achieved, with outlook and limitations (what is excluded from the treatment?).

2 Writing the Thesis

A good preliminary work makes writing a thesis easier. Often the value of the preliminary work is significantly underestimated and rather considered as an inconvenient task. Often, at a very late stage, one realizes that better preparation involves significant time saving potential. In every scientific work, the sources and references significantly influence the quality of the result. On one hand, this relates the correct choice of sources, that must meet the scientific claim, and on the other hand, the citation method.

It is shown below how a “model” structure can lead to a wellstructured work, how a common theme reflects the logical structure and which sections are of interest. It is interesting to note that the before mentioned 20 points can be well integrated into the scheme, so that the preliminary work already provides the basic framework for the final work.

The purpose of the outline is to show the way the topic has been understood, edited and structured. Thus, the structure reflects consequential and selfcontained thought guidance in logically perfect form.

The 4 most important principles for scientific work are:

1. **Principle of honesty:** all work done by other authors must be labelled as such.

2. **Principle of objectivity:** the critical examination of previously known knowledge is necessary.

3. **Principle of timeliness:** the latest state of research must be included.

4. **Principle of relevance:** the editor must be able to distinguish what is im¬portant from the unimportant and to structure the acquired knowledge in an appropriate way.

Recommended structure for a thesis

Depending on the institution, there may be different requirements for the structure of a thesis. However, the following points are largely similar, only the order could differ from case to case.

STATEMENT

It is expected that the author of a thesis will mention all sources used for his own work. An affidavit is required for this. There are various forms such as e.g. “Hereby I declare that I have written this work independently, that I have fully specified the sources used, and that I have marked the wording of the work which is adopted either partly or in its original state (this includes tables, maps, and illustrations) either from other works or the internet.”

For this reason, all references used must be cited. There are several citation methods available for reference formatting, e.g. Citation according to the Harvard method or with sequential numbering in the text and respective ordering in a list at the end of the thesis.

ACKNOWLEDGEMENTS

The author is free to decide whether to include acknowledgments or not. Usually, the acknowledgments section includes the names of people who have contributed to the work in some way or other. This section of a thesis can also include information about funding institutions.

ABSTRACT, KEY WORDS

The abstract should briefly introduce the manuscript, not exceeding more than one page. The abstract should not contain citations.

Key words are given at the end of the abstract. At least 3 keywords or phrases should be included. Keywords identify a work. They serve to find the work and related work in the literature search during the research.

Chapter 1: INTRODUCTION

The introduction should include the background to the thesis, the problem definition, and the paper’s objectives as well as its structure. This section should also provide a context for the thesis. When preparing the introduction, bear in mind that some readers will not be experts in the field of research.

Firstly, the author has to be certain about which target group the work is aimed at. Anyone who reads a paper wants to know as quickly as possible what it contains. For this reason, the background of the raised problem is the first thing to be illuminated. All in all, a reader is first interested in the problems to be dealt with in the present work and the objectives to be achieved. For the reader, the subchapter “Outline of work” shows the way in which the issues raised are handled. The reader guidance also serves to point out later chapters in which work on the

subject is explained.

The introduction familiarises readers with the topic, limits the topic, and raises the relevant issues. It is to be explained, which discussion is taken up or which scientific controversies exist in the treated topic, in order to justify the relevance of the topic and the questions.

The main task of the introduction is to make the readers of the work “curious”. The introduction is one of the most important parts of a work. Ideally, other readers should be able to decide in their own literature research after reading the introduction whether the present work is relevant for their own research.

Chapter 2: STATE OF SCIENCE (TECHNIQUE)

State of science, methods and empirical investigation, are the main part of a work. The main part can be broken down into chapters and should contain the main ideas, results, and discussions proposed.

The state of science is described by the basics, by definitions and by related works. Following the introduction, the current state of research will be presented in the basics which make up the ground work.

On the one hand, the basics refer to the technical-scientific background and the related works as well as to any definitions and norms. To underpin one’s own contribution, reference is also made to the section of socalled “related works”, where other authors have dealt with similar or comparable questions on the chosen topic.

The state of science as the bases of a work comes from publications, so the literature. The treatment of literature requires great care, especially of the distinction between the own work compared to already published research. Simplified, it applies to all types of scientific work that they must meet the reproducibility of the results found there. This answers the question as to how extensive and at what depth the basics are to be dealt with.

Chapter 3: METHODS

Chapter 3 shows the related conditions, parameters, influencing factors, chosen concepts and procedures, concept and process comparison to related works and useful or necessary definitions.

The question is which methodology should be used to close a research gap in the context of the work. For this purpose, the procedure is justified after weighing

the possibilities in question.

In the section “methods”, the procedure for the treatment of the questions is discussed in more detail, e.g. requirements for the accuracy, parameters and factors that influence measurements are of special interest for them. The aim is to give the reader the opportunity to recreate experiments to make the values obtained verifiable. Correspondingly, in the section “methods” it is of interest, which concepts and procedures have been used in other works or to what extent changes in the process have impacted on the obtained results.

Again, the requirements for the reproducibility of assumptions, ideas, and thoughts apply. In many cases, these terms are summarized as “traceability”. Therefore, the presentation of assumptions, ideas, and thoughts that have led to experimental arrangements and results, is also of special interest.

The author should demonstrate and dissect the analytical and methodological approach and refer to existing and established methods (with reference to literature and other publications). The reasoning of the author for the methods used and the semantic linking of the topic with the methods should be obvious (and is to be explained by the author). Dealing with “alternative methods” and problem-solving approaches that were not used in his work to achieve the results should be discussed in a paragraph discussion at the end of this work (references to the literature and other publications). Dealing with “alternative methods” and approaches to problem solving that have not been used in his work to achieve the results should be also discussed in a paragraph “Discussion” at the end of this chapter.

Chapter 4: EMPIRICAL STUDY

The empirical study covers descriptions of the system, planning and preparation, experimental setup, used methods, test environment, influencing factors and raw findings like measurement data or trial results.

In technical-scientific works, one's own investigations, reflections or developments constitute a decisive point which determines the value of the present work. This means that the greatest possible care, accuracy, and creativity are required in this area of work. If the obtained results do not meet the expectations or if unexpected results occur, the value of a work can be considerably increased by researching the causes. As before, the reproducibility must be ensured here as well.

Chapter 5: EVALUATION

Results must be evaluated and classified. The evaluation may be divided into general terms, e.g. to the course of the experiment, to the results with classification of the results in the context of the research objectives as well as the resulting potentials.

Further interest its possible potentials of the gained insights. Accuracy is also required in the evaluation of results and their classification in the context of the chosen question. If necessary, reasons are to be sought or ideally even evidence.

It is noted that results should be made good and meaningful "visible" so be clearly presented. Graphics or charts are preferable to the number columns.

Chapter 6: CONCLUSIONS, SUMMERY OF RESULTS

A conclusion is where one summarizes the thesis findings and generalizes their importance, discusses ambiguous data, and recommends further research. An effective conclusion should provide closure for a thesis, leaving the readers feeling satisfied that the concepts have been fully explained.

The final consideration is a reflection on the work. In the final analysis, the findings and results obtained are summarized and compared to the questions raised at the beginning. In the outlook, the results are interpreted, and reference is made to possible further questions which have been raised in the present study during the investigation but have not been dealt with in depth in the present work.

DIRECTORY, APPENDIX

Depending on the specific formal requirements for a scientific work, directories (contents, illustrations, tables, literature, etc.), short summaries and, if applicable,

annexes exist. Essentially, work should be easy to read, therefore, more extensive designs such as, e.g. program lists, measurement series, etc. are housed in appendices. In the main text of the work, reference is made to corresponding passages.

3 Value of scientific work

Scientific work has a purpose. This purpose is fulfilled by answering questions. It is assumed that only questions of scientific interest have been dealt with. If questions are raised, the correlations revealed, and the answers are of interest. It is therefore expected from scientific work that new findings have been generated and presented in an appropriate way.

The value of a scientific work lies in their discoveries. On the one hand, discoveries come from the causes of a situation that has been uncovered or results that have been found to solve the problems. To be able to convince others of already discovered findings, one must first be convinced that the findings have contributed to the issues raised. Only those who are convinced of a solution can convince others. First, supervisors and reviewers have to be convinced, after which results of a work are presented to a wider audience. In mathematics, for example, evidence is guided by the gradual deduction of contexts. This is similar in a scientific work and especially in a technical scientific work. Through the logical structure and through a step by step development of trains of thought, a neutral observer can follow the trains of thought presented. Essentially, the results of experiments or other investigations offer the opportunity to prove that a previously theoretically constructed system of thought has been justified and can be confirmed by test results.

Ideally, solutions exist whose correctness could be proven in a suitable form. But to try the example of mathematics again: there are tasks for which either no solution has been found or possibly no solution exists. What are the conclusions of a work in which no solutions to the issues raised have been found? The answers lie already in the formulation of the question. If no solution has yet been found, this does not mean that no solution exists, but only the previously attempted solutions have failed. If the route to the solution is accurately documented and recorded, and if it can be deduced from this record that solutions cannot be used, this means that further examinations can be regarded as pointless because the failure has been proven. If such a question is subsequently taken up by other researchers again, they can exclude all the paths that have already failed, in their consideration of finding solutions, because it has already been proven that it will not work. It is especially important to show the reasons for the failure to disclose. The technical development is progressing rapidly, and it cannot be ruled out that during this development, new opportunities open, which could turn out to be expedient in the case of previously failed projects.

Criteria for measurement

Technically scientific works are based in their results on the one hand on research and on the other hand on the practice. The interpretation of both terms is relatively broad. Research in this context is a careful investigation that is systematically conducted and critically inspected. Originality and innovation characterize the research. Practice refers to the practical possibilities that can be drawn from the results obtained. In many cases, research and practice are combined. Depending on the type of degree, the claims grow.

The measurement criteria increase depending on the type of the desired degree. Essentially, it deals with a chosen topic area of knowledge and understanding, its application and assessment.

For bachelor's degrees, it is required that the topic of the theses is based on the latest discoveries, at least in some respects. In the application, this should be evident from the formulation and substantiation of arguments. Relevant data the topic is collected, appropriately presented and interpreted.

For master's degrees, it is additionally required that the topic of the theses is the basis or at least a possibility for the originality of the development. Frequently we searched here for a research context for the application of the ideas. The ability to solve problems should have been considered in new or unfamiliar contexts. Knowledge should be integrated through assessments when information is limited or incomplete.

For dissertations, it is additionally required that the knowledge of the theses is systematically prepared, and that skills and methods associated with the topic have also been applied. As a rule, an original research is based on expanding the boundaries of knowledge. Dissertations should be based on the standards of international peerreviewed publications. The selfassessment of the topic should be done by critical analysis, evaluation and synthesis of the ideas and methods. Technical articles and scientific publications, e.g. papers, must fulfil similar requirements as dissertations.

Scaling

When evaluating a work, a distinction is made between purely contentrelated and formal assessment criteria. Formal criteria are usually given.

More important are contentrelated criteria. It assesses how the issues raised were methodically addressed. The degree of fulfilment of the extent to which the questions raised have been answered is also evaluated. The creativity, how to find solutions as well as the importance and the weight in the scientific environment

of theses in addition to the technical quality of the found answers and solutions are also criteria for judgement. Of great importance is the fact that relationships, e.g. on neighbouring topics and whether influencing factors have been sufficiently considered.

Summary

Disposition is considered as “the art in which something is placed or arranged, especially in relation to other things”. As such things in this context, the research subjects are seen. The disposition is the basis of a scientific work that ensures a common understanding of the research areas. The exposé represents a problem and the state of knowledge in a field of research. The exposé explains the methods, objectives, and assumptions of the scientific project. Often realistic schedules are required with steps that can be achieved in the work progress. Disposition or exposé create the common understanding of the authors with the supervisors.

Based on the disposition or exposé, special work plans for the scientific work are created. On the one hand, they are used for one’s own progress review and on the other hand for the guidance of supervisors. Based on the work plans, the research questions are processed and answered. The written documentation of these work steps forms the basic framework for the work to be done.

In many cases, the workload is significantly underestimated, since intermediate results can have an impact on the work process. In this case, reserves for unforeseen needs to be considered. A regular report to the supervisor is indicated.

4 Text design of scientific papers

The first scientific papers are required by students as part of their education. Generally, in addition to the content requirements, there are also formal ones. Additionally, many times a certain number of characters or pages are set as a standard value. This is where the dilemma begins. Often one manages to fall into a longwinded narrative style. Bases are presented and repeated that have been sufficiently well presented in the literature. This often leads to the actual value of a work being minimized and the ranking of the entire work being reduced.

The wish of every target audience of a scientific paper is to be able to capture the core of the essay as quickly and accurately as possible. It is often the case that scientific papers are of no or less interest if the readership is “told” things that they already know, or that do not really fit directly with the chosen topic and are therefore expendable. On the other hand, it exists the abovementioned measure of the expected scope of a work.

It is also clear that the succinct, consistent presentation of a situation is much better than one that has been included in a work only to meet the required scope of the work by using often ornamental additions such as nonsense texts, figures or tables. Furthermore, an assertion does not become more correct if it is repeated and affirmed several times.

In the following sections text sequences are discussed as exemplary formulations and as sentence fragments and their use proposed. These sequences are assigned to the areas of introduction, main body and conclusion of a work. It is noted that this rather simple order can be further subdivided into the mentioned areas in a work. Consistently applied, the order of such sequences already forms a basic framework that can already be used as an order for the treatment of different questions of scientific work. If this is considered as an outline, it represents a possible procedure for dealing with a topic.

The selected formulations and sentence fragments can be found in almost all scientific papers in various variations. [1] It could be argued that they have become

[1] Universities and institutions have also published guidelines for the formulation of scientific texts. As an example, among many, the writing centre PH Freiburgprovides a list of such formulations to the students titled „Redemittel für schriftliche, wissenschaftliche Texte “.

the standard language in scientific publications.

Formulations useful in the Introduction

In the introduction the topic is developed step-by-step, the methodology of the investigations is presented and substantiated. Clarification serves to ensure mutual understanding.

Introduction to the topic of a work

At the beginning of each scientific work the specific topic should be introduced. As already mentioned, the target audience wants to know as soon as possible what is being dealt with in the present work. Suitable formulations for general introduction are:

• *"This thesis deals with (or discusses, deals with the question)"*
• *"This paper examines (or investigates, evaluates, analyses)"*

Or already restrictive:
• *"This work is limited to the investigation of ..."*
• *"In this work we take a closer look at . . . "*

In addition, the focus of the work for the chosen topic is given. This is the first opportunity to place the topic in the context of current research. A distinction is made between new questions and already known questions that have not yet been sufficiently answered:

• *"Answering these questions ... has been preoccupying the experts for sometime (discussed extensively in the literature)."*
• *"It [this topic] is a wellknown fact that ..."*
• *"It [this topic] is a widely used topic that ..."*
• *"On ... [this topic] ... a lot has already been publicized and expressed"*
• *"There is a consensus that ..."*
• *"It is generally accepted (or agreed) ..."*

For the elaboration of the topic, the factors influencing the questions are emphasized:
• *"Subsequently we review the factors that ..."*
• *"The work relies on the analyses [source disclosures] to ... determine ..."*

Thus, the addressed faults, i.e. the research questions, are already shown. Now it is interesting to know why the issues raised are of any interest to emphasize the

https://www.ph-freiburg.de/fileadmin/user_ upload/Redemittel_ f%C3%BCr_ schriftliche_ _ wissenschaftliche_ Texte_ 2-2018.pdf (Recherche im Dez. 2018)

importance of a work:
• *"The question of ... is of great or special interest, because ..."*
• *"As an (empirical) phenomenon it has been repeatedly observed that ..."*
• *"Against this background, the central question that motivates this thesis is . . . "*

Hereby, a first general introduction to a topic has been further developed. In the targeted presentation of the topic, specific statements are made about the aim of the present work:

• *"Against this background, this work deals with the (central) issue of ..."*
• *"This research explores the causes of ..."*

Introduction to the methodology of investigations

Once the relevance of the research questions has been clarified, the procedures and methods used in the work are presented. Even methods are often contentious and are discussed in the literature. Methods are also varied or adapted to specific conditions of the research question.

• *"Underlie ... (methods and considerations of usability)"*

Then, the structure of the work is displayed in a preview. This area serves the readership. It provides information about what a reader may expect in the following sections of a paper. For the exact formulation of this section, the structure of the work must already be known. This area grows with the progress of a paper.

• *"The first part is dedicated to clarification",*
• *"The focus of the ... chapter is ..."*
• *"The analysis is limited to ..."*
• *"Based on . . . "*
• *"The second part discusses or shows that ..."*
• *"A summary and prospects ... conclude the work"*
• *"Finally, ..."*

In many cases, it will not be possible to fully comprehend all details and aspects in a work. It is quite permissible to exclude the investigation of partial aspects. It is simply made clear what the work is exclusively concerned with or untreated aspects are already excluded in advance. This focuses on the expectations of the readership.

• *"The present work is (exclusively) about ..."*
• *"The present work deals with ..."*
• *"The present work deals with the question of whether or how ..."*
• *"... cannot be dealt with in this work (or only marginally)"*

• *“The basis of the considerations are the theories / approaches of ... and can only be discussed briefly in this work”*

To explain the applied methodology the following formulations can be used:

• *“Contribute to a broader understanding of ... through empirical research from ...”*
• *“The procedure is ... [number] ... of steps”*

When proceeding in steps, these should be briefly mentioned. Shown is the logical order, for example:

• *“First ... is examined (considered)”*
• *“Then ... is being developed (discussed)”*
• *“After that ... is reviewed ...”*
• *“Finally, ... are evaluated (and compared) or designed”*

Finally, the readership is also interested in the objectives associated with this text. It is therefore advisable to briefly describe the main objectives. Exactly this representation is the measure for determining to what extent the dealt topics of the work in the result are regarded as new insights.

In the related works, the current state of science is collected and documented. The chapter on related work should be found in the introductory section, as related work forms the basis of the entire work. This chapter can either be formulated as a unit or be broken down into parts and assigned specifically to individual parts of the text. It serves to differentiate one’s own work from the literature. Formulations to initiate and represent the reproduction of research positions include, for example:

• *“The authors of recent studies have found that ...”*

In detail:

• *“In the work of [... name of the author ...] [... title of the mentioned work ...] [reference of the work also in the bibliography] ...”*
• *“The following lectures (based) research results (examinations) of [... name of the author ...] [... title of the mentioned work ...] [reference of the work also in the bibliography] ...”*
“[• ... name of the author ...] [... title of the mentioned work ...] [reference of the work also in the bibliography] in their work represents the following theses (interpretation, position, view) ...”
• *“The following results are from the study on [... title of the mentioned work ...] [reference of the work also in the bibliography] of [... name of the author ...]”*

• "[... name of the author ...] [... title of the mentioned work ...] [reference of the work also in the bibliography] presents the following conclusions in their work (comes to the following conclusion) ..."
• "[... name of the author ...] [... title of the mentioned work ...] [reference of the work also in the bibliography] claims in their study (assumes) that ..."

Definitions and terms

To present something beyond doubt, facts are defined. For the readership to develop the same understanding as an author, it is convenient to clarify definitions and terms that allow room for interpretation.

• "The meaning of . . . [definition, term] . . . In this work the term is used in the sense of ..."
• "To clarify the definition of [source], it is important to clarify that ..."
• "The term used refers to ..."

• "... can be interpreted differently. [... on the one hand on the other hand ...]. In this work, this term always means (this term is used in the sense of) ..."

To justify the relevance of definitions and their interpretation, it can be said:

• "It is important (... for understanding the following ...) because ..."
• "There are several explanations for this ..."
• "The explanations originally came from [source] and were used there ..."
• "Following [source], the use of ... has become generally accepted."

Hypotheses, working hypotheses

Hypotheses are those assumptions on scientific relationships that are substantiated in a work, usually in several steps, and finally proven and thus are considered facts. They form the starting point of a work and are presented:

• "This raises the crucial question: how (by what, this) ... is influenced ..."
• "Given the results of [source] available so far, an investigation of ... factors that influence ... seems justified ..."
• "The planned investigations deal with ... in which a series of assumptions are made, developed and tested that will show how ... which ... influences ... what ..."
• "Based on the arguments of [source], the following hypothesis emerges: ..."
• "Some theses have been formalized [source], but so far there are still insufficient test results."
• "The results of these studies [sources] reveal a number of factors that should be reviewed with regard to ..."

Formulations useful in the Main Part

In general, the main part of a thesis can include several chapters. The main part is the core of a work. Usually, at the beginning of each chapter or subchapter it should be stated in a few sentences' information what the corresponding section deals with. This results in an extra short executive summary of the corresponding section:

• "The following chapter (or section) deals with ... (or asks for ..., leads to the question ..., starts from the fact ... focuses on ..., ... etc.)"
• "The following chapter (or section) is being reviewed ... (or examines ..., proves ..., explains ..., describes ..., develops ..., analyses ..., illuminates ..., discusses ... etc.) "

In the main part of the work concepts are developed, an overview is given, proof is conducted, and analyses are carried out. In the critical examination of the contents of an investigation the author:

• "sets out, explains, describes, interprets, compares, outlines, contrasts, presents, collects evidence, verifies, etc."

Additionally, the exact goals of the work are described in a similar way.

Special features are highlighted, but without using superlatives. The neutral presentation is important. Readers need to be persuaded and able to judge from the given arguments why the process was appropriate and how the usefulness of the results can be categorized. Nevertheless, it may be important to emphasize

core elements of a chain of reasoning. The text is then highlighted, emphasized, underlined, or emphatically noted. Examples of such a formulation are:

- *"At this point it is especially emphasized that ..."*
- *"It is emphasized that ..."*
- *"Mainly ..."*

Additional comments on topics already dealt with are noted, mentioned or raised. Examples of such a formulation are:

- *"It should not go unmentioned that ..."*
- *"Briefly, it is stated that ..."*
- *"At this point it should be noted (or may not go unmentioned) that ..."*

Good style is also to raise questions and then to give the answers right away:

- *"The question comes up . . . "*
- *"This question can be answered as follows ..."*
- *"One possible answer to this question is ..."*

The important thing is to be selfcritical. Criticism is also part of the good style of a work. Selfcritically questioning one's own work will only be interpreted as uncertainty if the reasons for possible deviations and differences are missing. Therefore, criticism should be voiced in the interaction of arguments and counter-arguments. But it does not necessarily have to be criticism. Also, the weighing up of advantages versus disadvantages is a kind of reasoning that counts to the good style of a work. It shows the readership, as argumentation chains of a work have been completely dealt with.

Formulations for the methods used may be:

- *"This work uses the method,"*
- *"This work leans methodically ...,"*
- *"This work varies the methodological approach of the work of ..."*
- *"This work adopts the procedure from the work of ..."*
- *"This work applies the method of working from ..."*
- *"This work analyses the data according to the work of ..."*
- *"This work is based on the findings of the work of ..."*

Describing a model:

- *"A model is explained, correlated, developed, modified, reviewed, assessed, verified, validated, or adapted, constructed, discussed, illustrated, clarified, displayed ... etc."*

Conclusions and deductions are drawn, for example:

• *"This leads to the conclusion that ..."*
• *"It follows that ..."*
• *"From this one recognizes or can be deduced that ..."*
It can be concluded that ..."

In many cases, different views are taken in the literature. It is necessary to specify the sources, as these details must be verifiable:

• *"This question is controversially discussed ... (who with whom, sources)"*
• *"There is still no agreement on this question ... (who with whom, about, sources)"*
• *"It is controversial ... (what exactly, by whom, sources)"*
• *"Controversial (different, different) positions (views, views) are represented ... (who, what, sources)"*

During every work, results must be achieved. It should be noted that there will be demonstrable results that cannot be doubted, and others where at least some residual uncertainty will remain. Since no evaluation can be made in the work itself, but must be left to the readership, the correctness or unsureness of statements and conclusions can be made clear. Sureness in the argument chain is for example expressed by:

• *"without question that ..."*
• *"it is undisputed that ...,"*
• *"there is no doubt that ..."*

Unsureness in the argument chain is for example expressed by:

• *"it is doubtful that ..."*
• *"it is questionable that ..."*
• *"it is not yet clear that ..."*

A result may also be put up for discussion, with the pros and cons of arguments contrasting each other to entrust the readership with the judgment.

An argument becomes even stronger when evidence is given:

• *"It can be proved by [... the evidence ...] that ..."*
• *"The following evidence is available: ..."*

In the main part, the object of investigation is looked at from all directions. Based on the previous introduction and the investigations carried out, approval or re-

jection is expressed, or rather comparisons are made. Opinions can also be conveyed in the main body, but the wording has to be neutral. For the transfer of one view into another, certain language elements help.

Approval, rejection (different wording can express what the level of consent or disapproval is):

• *"Basically, the statements of [source] can be approved because ..."*
• *"The line of argument is conclusive and consistent ... [with the results obtained in the experiments]."*
• *"The perspective of [source] is understandable because ..."*
• *"Basically, the statements of [source] cannot be approved because ..."*
• *"The chain of reasoning is conclusive, but ... [the research presented here shows a completely different picture]."*
• *"The statements of [source] must be rejected firmly because ..."*
Comparisons (informal description of similarities, emphasis on differences)
• *"[Source A] and [Source B] are similar (differ in terms of) ..."*
• *"Unlike [Source A], [Source B] indicates that ..."*

It is advisable to wrap up opinions in a discussion in which the pros and cons are contrasted. This can be used to gradually express agreement or disagreement of one's own research and its results. This will be particularly the case when it becomes necessary to incorporate unexpected results into the context of the work.

• *"From this point of view, ..."*
• *"There are a number of reasons that ..."*
• *"Cause could be that ..."*
• *"The trend of the results, however, shows that ..."*

It is generally known that scientific works are no picture books. This fact is not considered in many works, because the amount of work increases much faster than with the preparation of texts, formulas, and calculations. In general, graphics, pictures and diagrams should emphasize and clarify contexts in writing. The general saying: "A picture is worth a thousand words" should not be taken literally, because otherwise the scientific work degenerates into the picture book mentioned above. Strictly speaking, therefore, every graphic, every picture and every diagram fulfils its purpose only if it is referred to in the text section and the specifics of a graphic, an image or a diagram are described. This description must be such that the illustrated relationship is fully given even without considering such a figure.

• *"The graph [Reference] shows that the reading initially increases steadily until it reaches its maximum level, remaining at that level before it starts to sink after*

a relatively long time, and the decrease begins very slowly, falling but then faster and faster. “
• “The measurement series is illustrated in a diagram [Reference]. It shows that the values ... “
• “The Graphic [Reference] shows stabilization at the level of ...”
• “The graphic [Reference] can be interpreted in different ways. On the one hand (firstly) it is clear that ... “
• “Figure [Reference] shows ...”
• “In the middle of the figure [Reference] is included ...”
• “In the marked area of Figure [Reference] ...”
• “Top left (right) (bottom) of Figure [Reference] is ...”

Formulations useful in the Summary, Results

In the result part of a work its value is made clear. As is known, the term “innovation” describes the difference from the initial state to the final state, i.e. the results achieved. The result section thus determines the meaning and value of a work.

The importance of this part of the work is often significantly underestimated. The phrase “all problems (questions) have been solved (answered)” is not only insufficient but also reduces the value of a work.

It is important to summarize the results at the end of the work. If intermediate results have already been obtained in previous sections, they will be presented and reflected upon once more in the summary in the context of the raised questions. In doing so, both the results and the original research projects are being examined to determine which questions could be answered to what extent and in the outlook on the work, which further investigations still must be made.

• “The work was started by finding ...”
• “In the previous discussion an attempt was made to ...”
• “The input hypotheses were verified and tested using the ... collected data ...”
• “Result of this work is that ...”
• “The investigation (work) has shown that ...,”
• “In summary, it can be said that ...”
• “This work has proven that ...”
• “It follows that ...”
• “The focus was on ...”
• “The results presented justify the statement that ...”
• “The results obtained show parallels to ...”

The outlook classifies the usability of results. Unresolved or only partially solved questions are presented. Disclosure should lead to a reflection of the work to

uncover remaining weaknesses and deficiencies that may lead to future research approaches.

- *"A question that could not be clarified by this work is ..."*
- *"A question requiring further empirical research is ..."*
- *"A clear answer to this question is not possible in this form, because ..."*
- *"To answer this question unequivocally, further investigations are needed."*
- *"Desirable is a long-term study to ..."*
- *"... could not do this job because ..."*
- *"... is a worthwhile task for future investigations, because ..."*
- *"... could only be marginally treated in this, because ..."*
- *"The restrictions and restrictions made in the work ... mean that there is still room left for future research ..."*

5 Main problems when writing scientific papers

Scientific theses are often subject to time pressure. The goal in mind leads to motivation lows when progress is considered as too slow. Even phases of hec¬tic writing can be observed. Because of such phases, drafts are rejected thereby further increasing the time pressure.

According to the definition, future graduates should demonstrate their ability to be able to independently work on a specific topic within a specified period according to scientific guidelines. A scientific work becomes a problem if it is tackled incorrectly.

There are no patent recipes for writing scientific papers. The following notes are intended to help avoid common mistakes:

Choice of topic: It is difficult enough to devote to a topic. A topic that does not interest an author will struggle with motivation issues and writer's block. In ad¬dition, the success of the theses is more than questionable.

The chosen topic is too broad: A topic should not be too general and be re¬stricted to a certain area.

The previous knowledge is not enough: The topic is interesting, but it lacks special knowledge. Instead of a change of the topic, one should reorient oneself professionally and, if appropriate, specialize in certain aspects of the original question. A conversation with the supervisor is indicated.

The workload is underestimated: The topic is interesting. It reveals every detail of the work, facets that need to be considered. Also, in the practical im¬plementation, one can arise to many wrinkled problems. The time required for the practical experimentation is often considered too optimistic. This normally leads to not being able to answer the original questions. The preparation be¬fore starting a work should be carried out. A pessimistic work schedule with reserve times protects against unusual surprises.

The work started too late: As soon as the topic is established, work should start. Even if the disposition or the exposé is not yet officially approved, writing and further research can begin. All ideas for handling the topic should be not¬ed. Required literature must be obtained to work on the topic.

The structure is not fixed: Already at the beginning of a work, the structure offers a work plan, which can be processed point by point. At least the rough scaffolding should be fixed before starting the actual writing.

Interview with the supervisors: The task of the supervisor is not only to propose topics, to approve them and to accept the finished work. Criticism during the work helps timely by corrections to steer the direction of research. Correspondingly, the pressure to regularly report on the progress, can drive the writ¬ing process.

Writer's block: If there is no significant progress for a few (e.g. three) days, you should get away from work by taking a break of one to two days. After the break, the previously written should be read and checked. The critical opinion of others helps to recognize dead ends. Thereafter, the work should be continued. If started early, such interruptions are possible without missing the dead¬line.

Eliminating bad texts: It is better to reject a bad piece of text than to try to improve it. Even if it is difficult to part with a piece of the own work: Formulating is an ongoing process.

Details are underestimated: The text also includes tables, graphics, drawings, listings, diagrams, directories, footnotes and formatting.

Backup is missing: A job should definitely be backed up multiple times. Problems arise when they are least expected

Proofreading: A common mistake is underestimating formal criteria. These are included in the evaluation. Pay attention to consistency of references, labels and citation. Attention must be paid to spelling and grammar. A paper should be proofread by several people. Even reading correction on screen often means that words and sequences of thoughts are not read as they were written, but rather as they were intended to be formulated. Less prone to errors is reading printed texts.

Choice of language style: The right choice of style makes it easier to write a scientific paper. In contrast to poetry, the language style of the technique is guided by rules, facts and contexts. Therefore, the idiom is as simple and clear. A technical work is not considered to be good if it has been written in wellchosen words. A technically scientific work is useful if its results and insights were developed and reproduced in an easily understandable way from the questions.

The best form of representation in technical works is therefore the juxtaposition of logically ordered thought steps. The sentences should build on each other and represent facts easily understandable. To increase the intelligibility, the sentences should be short and precise.

Avoiding the unfavourable: The presentation of the basics focuses on the target audience. Bases are therefore only to be explained so far that the target audience can follow the lines of thought developed in the work. Generally known therefore does not need to be explained in detail but is assumed.

6 Concluding Remarks

Technically scientific works are based on the technical interest in a situation. The introduction usually includes an overview of the work that others have already done in this field and an overview of what work in this area will do. In the section on theory, experimental setup and methods data or new findings are collected. How data was collected and what methods are used is documented. Data or new insights are structured, processed and analysed. The methods for this processing are also described. The presentation of the results conveys the results achieved with the selected methods. For this purpose, theoretical results are used to investigate the results of the application of the theory, and experimental results are used to discuss results of the experiments.

The processing of scientific questions requires time. Most problems with writing are since the time factor has been underconsidered. The duration of investigations is often unpredictable. Even with careful planning, delays of a purely technical nature such as the failure of test equipment or missing materials cannot be foreseen.

The main time factors are the preparatory work, the examinations, the writing and summarizing of the results as well as the postprocessing. As the most important phase, good preparation can greatly facilitate the subsequent work. The postediting and especially the proofreading are often neglected or started too late due to approaching deadlines. Not only because of this, is timing one of the important aspects of scientific work.

The structure of a scientific work creates the environment in which a problem is posed as a research question. There are actions e.g. suggested as experiments. This is followed by the results and findings. The acquired knowledge will be discussed, and further actions may be proposed to achieve further improvements at specific points or even in general. If the scientific work is structured logically, the train of thought developed in the work can be followed well: the work becomes comprehensible.

Important questions are: Why is a scientific work interesting at all? How can the audience be won over to read the title first and then work in it? The title of a work must be informative and concise. The title must interest readers and cause them to want to know more. We remember: the title is the shortest possible summary of a work. The most important part of the whole work is the short version, the abstract followed by the introduction. It depicts the central evolution of a work. It should be clear why such an evolution deserves to be told. Presented there is the scenery with the associated background. It is intended to give the readership the context in which one understand the meaning of the work.

A thesis gives the research questions, methods, findings and conclusions of a research topic. If the author manages to convey exactly these points, the purpose of the work is fulfilled.

A brief overview

Depending on the institute, templates are offered in the download area of the portal. The templates must be adapted individually on a case-by-case basis.

First-person narrative only in the acknowlegdements

The acknowledgement is optional, i.e. if no acknowledgement is written this page has to be removed from a template.

Abstract (German and English)

Neutral short description of the work: starting position, raised question with the objective of what must be achieved, applied methodology, results, outlook.

Keywords are search terms for the work.

Keywords are usually prominent in the work (e.g. in the title of the work, in headings ...). 3-4 keywords are sufficient.

List of abbreviations

The list of abbreviations should not contain any generally known abbreviations. The list of abbreviations is optional and can also be omitted. Note: a list of abbreviations does not release the author from the obligation to introduce every abbreviation used in the text at the first occurrence.

Directories

Content, figures (only if available) and tables (only if available), literature - it is particularly important that all directories are updated. Please note that after converting to a different format (e.g. PDF) not only the formatting of the work has to be checked, but also the formatting of the directories.

Literature, citation method

In the declaration of work, you confirm that you have indicated all sources in your work. These sources are listed in ascending alphabetical order in the bibliography and marked with suitable references in the text. The citation according to Harvard is usual: e.g. [NFjj] (N: family name, F: first name, jj: year of publication).

Tip: create a table where you can hide the frame lines later on

[NFjj]	Family name, F: "...Title of thesis ...: Subtitle of thesis (if applicable)", Type of thesis (e.g. book, scientific thesis such as Bachelor's thesis, Master's thesis ...), Publisher, Place of publication, Year of publication, Bibliographic information such as ISBN No. or Internet address (for Internet with the addition e.g. "queried on").

If the work has been written by several authors, the first author is used with the addition "et alias" (and others) e.g. [NF et al. jj]

[NFjj et al. jj]	Family name, F, (first author), family name, F, (other authors), ...: "...Title of thesis ...: Subtitle of thesis (if applicable)", type of thesis (e.g. book, scientific thesis such as Bachelor's thesis, Master's thesis ...), publisher, place of publication, year of publication, bibliographic information such as ISBN no. or address on the Internet (for Internet with the addition e.g. "queried on").

Note: Quoting means that a work exists in which certain facts are sufficiently described. Your own work is also regarded as preparatory work if it is related to the chosen topic. This means that the repetition of text blocks from one's own work is unnecessary, because everything has already been described in detail in the cited work. In the continuation of one's own or another's preliminary work, therefore, only the differences and peculiarities of the preliminary work are emphasized.

Direct quotations shall be reproduced verbatim and to the letter. At the end of the text the source is indicated, e.g. ([NFjj])

Indirect quotations are written in their own words. At the end of the text, the source is indicated with the remark “compare”, e.g. (cf. [NFjj])

Figures, tables

For each figure and table, consider whether the figure or table contributes to a better understanding of a work. The content of this contribution must be described in sufficient detail in the text of the paper that the illustration underlines the text. This means that certain features in the illustration or table are referred to. This also means that figures or tables that serve only as placeholders and do nothing to solve the problem are superfluous.

Example: Many of the measuring instruments or testing machines used in work are shown. The question to be asked is what value this illustration contributes to the scientific work - in other words: is the work not understood in the sense of the author if this illustration is missing?

Thesis

1. **Design texts value-free**
2. Overall description of the task.
   Initial situation, question raised with the objective of what needs to be achieved, concepts and methodology applied, investigations and tests, measurements and simulations, interim results and their interpretation, related work (how have comparable questions been treated in the literature, design and considerations for software (program fragments are permissible), tests and problem solutions during commissioning, summary of the results to a final result (value-free), selfcritical discussion of the potential for improvement, outlook (what or how could the development be continued or further improved).
3. The work usually begins at page 1. Pages up to the actual beginning of the work are usually marked with Roman numerals. (Attention: there may also be differences in the templates)
4. Each main chapter shall begin in a new section
5. The headline contains the names of the chapters
6. The font of the headers and the page numbering is the same as the font of the work.
7. Sub-item rule and paragraph rule are observed: There must be at least two paragraphs per sub-item. There must be at least two or three sentences per paragraph. If there is only one sub-item, it must be removed. Instead, however, highlighted subheadings (which usually do not appear in the table of contents) are permitted.

8. Lay Out of the work: justification, appealing form of the arrangement of figures and tables, no unnecessary blank spaces, no excessive line spacing, blank lines between the paragraphs are permissible, but must be uniform in the entire work, tables may not be divided, labels of figures and tables not on different pages but directly below (preferred; before this would also be possible), no subchapter labels at the end of the page.

Appendices:

1. Several annexes are also permitted. Annexes shall normally be numbered alphabetically if more than one Annex has been provided (Annex A, Annex B, etc.).

2. Examples:
   Annex A: Extensive tables of measurements or extensive calculations, if not already included in the main text.
   Annex B: Simulations, if not already included in the main text.
   Annex C: Studies which are not directly attributable to the task, but which contribute or could contribute to solving the problem.

3. Nothing has been lost in the work or in the annex: logos, brochures, data sheets (if absolutely necessary at best as an extract in the annex).