

# Master Thesis Information

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# 1. Introduction

This document will contain the demands and criteria for completing and passing the masters thesis course at the Department of Computer and Systems Sciences at KTH/SU. It includes the basic requirements as well as an introduction to planning, organizing and writing your thesis. The actual application of these demands in practice depends however on your supervisor. This document only gives you an overview. If you want to successfully complete a thesis of high quality you must not only follow the requirements stated here and be knowledgeable about your research topic but you also need to read about and use a/several particular research methodology(s) that you are to use. These will not however be discussed here.

It is your supervisor who has the ultimate responsibility that your thesis meets all the relevant requirements. Hence, if you have any questions about anything in this document, ask your supervisor. If however, you cannot find a supervisor or are having a problem with your current supervisor, you should ask the person responsible for master's theses at your unit.

## 1.1. Background

The final semester of the master's program is dedicated to writing your thesis. As such it needs to be of high standard, representing your accumulated knowledge over the period of studies. At the same time, it may be a stepping stone to beginning a professional occupation in business, industry or academia. It is your chance to make an impression! Given the importance of the thesis it is highly recommended that work on it is really done on a full time basis during the twenty weeks that you have to conduct your research, write it and present a final document.

## 1.2. Goal

The goal is to produce a master's thesis that adds an original, relevant and useful contribution to the accumulated body of knowledge in a relevant subject domain, using a scientific research method and based on intensive studies and research in the field of study.

## 1.3. Purpose

The purpose of the thesis is to add to the accumulated knowledge in the domain of choice. The research process should also make you aware of the process of science and research in general as well as increase your knowledge of the research domain. This knowledge should then be useful for you whether you are going on to Ph.D. studies or working in industry or the public sector.

## 1.4. Formal Requirements

*This subchapter includes the relatively few formal requirements about the writing process.*

### 1.4.1. Writing together

You should write your thesis in co-operation with another student (group of two students). When you work together, it should be clear in the thesis which part you worked together on, and which parts you wrote separately.

This should be stated in the Preface that comes after the table of contents. You must get permission from your supervisor if you cannot or do not want to work together with another student.

#### **1.4.2. Number of pages**

There is no fixed number of pages that is required, but a determination of the sufficiency of the work is instead to be made by each supervisor. The criterion for this determination is that work is deemed to have required 20 weeks of full-time work *per student* (equivalent to 800 hours per student). In other words, a two-student thesis must be the result of twice as much work as a one-student thesis.

At the same time, a general recommendation of 60-100 pages is given excluding title page, table of contents, references and appendices. It is however, as mentioned earlier, up to the supervisor to determine the required scope of the thesis.

#### **1.4.3. Time frame**

The thesis is to be completed and presented within the allocated period of study of twenty weeks at a Final Seminar that is to be held at the department at an agreed upon date and time when the supervisor has given his/her approval. If the thesis is not finished within the allocated period of study, you need to request further supervision, since supervisors take on new tasks and students. Any such requests for additional supervision will not automatically be given but will be decided upon by the supervisor at the time. Do not take extra supervision for granted.

## 2. What is a master's thesis?

*Writing a master's thesis is one way of conducting scientific research. As such it is not intuitive but requires considerable reflection, reading, planning, organizing and communication skills. Writing a thesis is not about writing all you know about something or all you could find on the web about a certain subject. These two approaches are completely irreconcilable with the essential principles of science and can hence never be acceptable as master's thesis.*

### 2.1. Science and knowledge

The purpose of science is to discover new knowledge. This knowledge is communicated in a way that can be followed through the whole text. The scientist must argue their case. The scientist must convince the reader of the truthfulness of the knowledge. Truthfulness is determined by the correct use of accepted research methods. All this should ensure credibility. These underlined words are explained in the following subchapters.

#### 2.1.1. Discovery of new knowledge

It is essential that you point out early on what your contribution is, in simple and clear terms. Explain exactly what is new and original about your contribution. The argumentation for originality is based on you demonstrating your knowledge of the current state in the field as well as historical developments. The current state as well as historical developments are determined from substantial reading of (and relating to) relevant literature. You must convince the reader that your work is new and not just what you believe to be true or important.

#### 2.1.2. Communicability

The logic of the text should be such that a reader can easily follow all the steps throughout the text. This entails including forward and backward referencing in the text. When a discussion follows on from one chapter to another you should point that out. For example, "...and the implications of this difference will be explained in chapter 3.4 as part of the ....". Backward referencing could be something like, "...as was initially defined in chapter 2.3 when the purpose...."

From chapter 2 onwards begin each chapter and any breakdown from one level to another level with an introductory paragraph. For example when chapter 2 breaks down into 3 subchapters, 2.1, 2.2 and 2.3 or when chapter 3.1 breaks down into chapter 3.1.1, 3.1.2 and 3.1.3. This introductory paragraph will help the reader (and yourself) follow the logic of the division of sub-chapters. It should include a 1) presentation of the subchapters (possibly the headings), 2) the reasons why these particular subchapters have been included, 3) how they have been derived from the problem definition and 4) how will they contribute to achieving the research goal.

Another way of increasing communicability is to "deal with" all the verbs and nouns that are used. If for example you write that you are going to do something (a verb) such as describe, measure, study, investigate etc, etc. then you must deal with that. Either you actually explicitly "describe" somewhere and it's obvious that you have done so or you don't "describe" and you explain why you won't "describe". Nouns are dealt with in the same way. If you introduce nouns, such as computer, model or framework then you need to discuss it, its relevance and usage in the text. If you are not going to mention the noun anymore then write that and explain why.

Don't let it just disappear without a trace. The reader will be left wondering what happened to that noun. When using nouns, don't use synonyms. For example if you write "computer system" don't change to information system later on if you mean the same thing. It just adds to confusion. More about choice of words is to be found later on.

### **2.1.3. Argumentation**

*When you are conducting research you need to argue your case. A thesis contains two main types of arguments, i.e. claims and choices. These will be discussed here.*

#### **2.1.3.1. Claims**

Claims are when you write that a certain situation is, or has been, in a certain way. You may have for example claimed that Internet usage is widespread. This needs to be specified (country, population, time period, definition of Internet usage) and argued for or shown. It's not enough that you believe something is true or that you have some personal experience of something. You have to convince the reader. There are two ways of doing this. The most common approach is when you base your claims on relevant literature. Details concerning using literature are discussed later in this document. It is sufficient for now to say that basing claims on literature does NOT mean using one or two web sites.

Another approach is to base a claim on well-known and accepted knowledge. This is however difficult in that what you believe to be well known may not be well known at all beyond you and a few friends. In case of any doubt it's always preferential to refer to literature rather than hope that your claim is well known.

At the same time there are some claims of correct descriptions that are so well known and accepted that little argumentation is needed. It is difficult to say precisely where the line is between known and unknown so that this has to be considered from case to case. Discuss it with your supervisor.

#### **2.1.3.2. Choices**

Choices are simply when you make a decision between several alternatives. These alternatives may, for example, be specific technologies to be compared. There may be thirty different technologies but there is only time to compare three. There are also choices to be made when deciding which research methodology to use. Whatever choice is made needs to be argued for. This is ALWAYS the case. To make a choice you need criteria that will enable you to narrow down the possibilities. These criteria must of course be relevant for the research problem and goal. An example may be as follows:

Your thesis might focus in comparing system development approaches. Since there are many definitions of what a systems development approach you need to state several criteria that will allow you make an initial group. The definition can be taken directly from literature or you own motivated criteria. Once you have what a systems development approach is you choose criteria that will help you perform the actual comparison. These may again come from the literature or you can motivate your own. Examples of such criteria are, based on Java programming, allow for the generation of code from models, produces user documentation etc, etc. These are primary criteria, directly related to the artifact being compared. Primary criteria are always more relevant than secondary and tertiary criteria.

Secondary criteria are those that are indirect. A typical example is when you choose “availability on the web” as a criterion. While it is a criterion, it is of little relevance. Tertiary criteria are those that are ONLY based on personal preferences, beliefs and experiences. Such criteria are, heard from friends, own experience, studied it on a course, have a book about it, etc, etc. If you only use such criteria, the credibility of your work will be low, since it is almost impossible to motivate or argue for these.

#### **2.1.4. Truthfulness**

When conducting research it is not enough that you believe that your result is true. You need to convince the reader that it is so. You need to also consider the possibility that there are alternative “truths” in regards to your research problem, goal, method and result. What a truth is depends on amongst other things, the questions being asked, the method used to collect data and the context in which the answer is sought. All these issues depend on the researcher making choices. Given for example the same research problem different “truthful” results may be found by using different research methods. A typical example is when your research involves evaluation of a system. One research method might involve checking if it has certain functionality. Another approach might focus on the user interface, while a third will deal with user experience. The results may show that the system is “bad” or “good”.

Related to the term “truthfulness” is the term “objectivity”. Ever since the ideas of science originated, the notions of “truth” and “objectivity” have been discussed and argued about. These won’t be discussed in any detail here besides the following distinction, which is relevant in our field.

The idea that a scientist must be objective is embedded in what can be called modern science based on the natural sciences such as physics, chemistry and astronomy. This would appear to be simple, as it’s easy to accept the notion that one can conduct experiments on objects such as stones or planets without bias. Conducting an experiment by dropping a stone to see how fast it travels before it hits the ground can be done identically by anyone given a description of the weight and size of stone, distance from the ground and other parameters are given. From the late 1800s and for some years on there began a move to establish “new” sciences where it was for the first time human behavior that was to be studied, for example; Sociology, psychology etc. etc. Initially, it was believed that the same principles and methods used in the natural sciences could be applied in the social sciences. This was however found by many scientists to be incorrect based, amongst other things on the observation that human thought, behavior, speech, text and actions are too complex and unpredictable. There emerged then new ways of thinking about and conducting scientific research that attempted to take account of this. One conclusion arrived at is that there is no objectivity since everything is based on human thought and choice based on unique individual experiences. Reality was then seen to be determined by those observing this reality. The countering view is that there is always a single “objective” reality independent of who is observing it.

How does this fit in with research in our field? Firstly, you don’t need to make a choice regarding which approach you believe to be correct. The approach is usually implied by choice of research problem and method. The truthfulness of your research and the relevance of the terms “objectivity” and subjectivity are related then to what you are doing research about. Dealing with computers in terms of hardware and software may be in most cases considered a sort of natural science where you can measure for example the speed at which a certain computer completes a certain activity, given that the preconditions are explicitly described.



Objectivity can then be implied since the activity with the computer in the form of an experiment can be repeated by anyone at any time.

On the other hand, if you study for example how certain people react to certain responses from a particular computer under predetermined circumstances, then this can be considered to be subjective truth. A typical approach would involve asking people for their reactions, that is, an interview. It is subjective in that in the research you are choosing the questions and deciding how to analyze the textual response. This subjectivity is NOT considered to lead to knowledge that is less true or less valuable than the knowledge said to be obtained by an “objective” approach.

To summarize this section; Each research problem needs to be solved using a research method that leads to a “true” result. Different methods may lead to different truths. Each method implies a different understanding of the nature of the truth, i.e. subjective or objective. These truths are complementary in that they can be combined to provide a more complete “truth”.

### **2.1.5. Research methodology**

A research methodology is the accepted, documented and traceable way of solving a research problem. It answers the question; How will the research goal be achieved? A correctly carried out research methodology will provide a correct result to a research problem. This does not however guarantee the research problem is relevant, interesting, original, solvable, well formulated or that the correct research methodology is chosen.

As was discussed in the previous subchapter, there may be alternative truths to particular research problems that in turn leads to alternative research methods. There is then rarely only one research method for each research problem. Explicit choices need to be discussed and motivated. To use any research method knowledge about these must be gained by reading relevant literature. It is never sufficient to just state that you are for example conducting an interview, case study or experiment, and then do what you believe to be the right way. Each one of these is well known and well documented as a scientific research method. Hence, when using one of these or any research method you must have sufficient knowledge about your choice.

Once you have chosen the method you need to follow it of course. An alternative is to make changes to the method. In such a case you describe the changes, motivate them and discuss the expected effects of the change on the expected results.

### **2.1.6. Credibility**

Being knowledgeable or having personal experience in a certain domain is in no way sufficient for writing a scientific text. It doesn't matter if you believe that you have a great system, method, model, framework, explanation, description, etc, etc. if you can't convince the reader. You must argue, show and/or prove that what you have arrived at is actually what you claim it is - this is credibility. A reader must have reasons to believe you. Producing results without any traceable method, any literature, motivation or argumentation will mean that your thesis will be at best just ignored.

## **2.2. Reflection**

Perhaps the greatest difference between scientific research, done to discover knowledge and technological research, done to produce artifacts is the necessity of reflecting over the research.

Throughout the past few sub-chapters the idea that a researcher must discuss, argue, motivate, and explain have appeared many times. To summarize, this “reflection” means that it is insufficient just to produce something. You must also reflect upon what you have produced in terms of what, why, when and how. Only then can you claim that you have contributed to the accumulated knowledge in a domain.

## **2.3. What does not constitute a master’s thesis?**

*This subchapter describes the types of theses (or parts of theses) that are not acceptable. The characteristics of such a thesis is given as well as the motivation for not allowing such a thesis.*

### **2.3.1. A company report**

#### **Characteristics**

This report contains only a description of the company and how it should solve a particular problem. Alternatively, only the requirements or description of a particular artifact for the company such as system, model or method is described.

#### **Motivation**

This type of thesis is only a consultancy report, with no reference to previous knowledge. It only deals with the particular company. There is most often no research method, argumentation or choices made between alternatives.

### **2.3.2. Diary notes**

#### **Characteristics**

Here the focus is very much on what the author did as an individual. It is an account of personal activities such as; “I went to the library”, “I talked to some people”, “I searched in Google”, etc, etc.

#### **Motivation**

These are often descriptions of choices made that the author mistakenly believes are research methodology steps. They are however what the author has done as an individual and not a recognized scientific method.

### **2.3.3. A manual**

#### **Characteristics**

These types of thesis consist mainly of instructions for understanding or using an artifact. It may also contain many diagrams of user interfaces or software code.

#### **Motivation**

There is no research, previous knowledge, research problem or research method.

### **2.3.4. A summary of literature**

#### **Characteristics**

The thesis contains only a collection of summaries of other authors. There is almost no own contribution.

#### **Motivation**

While a literature study is always part of research there must always be a substantial own contribution. A summary of literature could be used in many situations, but all of them must result in new knowledge being created.

### 3. Language usage

*There are certain conditions, restrictions and recommendations involved in the use of language when writing a thesis. These have however little to do science itself or research methodology in particular. These have more to do with customs and traditions within particular sciences. Hence recommendations may differ between these. These are additions to the normal conventions of writing in the English (or Swedish language) that must always be adhered to. There are a number of issues of importance to note:*

#### 3.1. Personal involvement

In many disciplines, you are not permitted to use pronouns in discussing your work. Hence words such as "I" and "we" are not allowed as they are seen to imply subjectivity rather than objectivity that is said to be the aim of science. This position is most common in the natural sciences. Instead of pronouns, a passive voice is used. Instead of writing, "I conducted an experiment" you would write, "An experiment was conducted".

There are other disciplines, in particular the social sciences and humanities where the opposite is the case. The use of "I" and "we" are encouraged as science is seen as a process involving the relationship between the researcher and people who are being researched. Objectivity is seen as an incorrect and irrelevant term.

The use of pronouns does not however mean that you may include what might be called "diary notes". This means that it is completely irrelevant to write sentences such as, "I was supposed to have a chat with Roger in his office on Tuesday at 13.00, but he hadn't got back from lunch so I went to get a cup of coffee downstairs."

#### 3.2. Time and place

A thesis is not an assignment and one of the implications of this is the fact is that the audience is international compared to your teacher and your fellow students in the case of an assignment. Hence, you cannot discuss issues and mention things that only your teacher, fellow students or fellow nationals know anything about. Anybody in the whole world should in principle, be able to understand what is written. You cannot for example write, "The study was carried out at DSV". Very few people know what DSV is. This includes the names of people. You cannot mention specific people, firstly because names are irrelevant and also because nobody knows who they are besides perhaps a tiny percentage of the population in the world. Hence, your supervisor's name is completely irrelevant.

Another issue related to names is that it is always important to know the roles of the people who are for example being interviewed, since this has an impact on the validity of the interview data. The roles are then much more important than any names. It may even be the case that the particular people do not wish their names to be made public.

#### 3.3. Choosing particular words

The reader of a thesis should have absolutely no doubts about what each word means. This may seem obvious but some students tend to use every possible synonym for some words so that it becomes unclear if the same term is meant or not.

A commonly used set of terms is for example, organization, company, enterprise and business. To keep the text clear and unambiguous only one of these terms should be used when only one definition is intended. If however, there is a need to differentiate between for example, company and organization then this can be done and then used consistently. Changing between these four nouns in a thesis will ultimately lead the reader to wonder if the same concept is meant or if there is a new meaning intended.

While the discussion here has so far dealt with synonymous nouns, there is a related problem, of the proliferation of verbs, particularly when describing research methods. In such situations, students tend to "overdescribe" what they are doing but don't explain how these verbs will be carried out in practice. Typical words are, study, explore, understand, look at, examine, find, show and prove. Research methodology always involves a systematic way of working which needs to be described in detail. What then for example does the expression "The model was studied" mean? How is a study carried out? Perhaps the most abused word is "analysis". Students write for example, "the data was analyzed leading us to the following conclusions". The important question is how was this analysis carried out. Which analysis method was used and what was the result.

### **3.4. Language and Spelling**

A thesis may be written in English or Swedish. In the case of a thesis in Swedish there may be problems in finding technical terms in Swedish since many domain specific words are only to be found in English or that the Swedish equivalents may be uncommon or unused. There is then a guiding principle to follow; Keep as much of the text as possible in the same language. When there are words where there is a lack of Swedish translation, you should indicate this situation in some way. One way is to have a list of terms. This list could be placed as an appendix. The text in a thesis must of course contain words that are correctly spelt. Use a spelling checker in your text composition program. When you are writing in English and using Microsoft Word use the U.K. or US grammar and spelling checker.

Here is a list of links to relevant dictionaries/lists of IT words:

Swedish computer terminology group: A collection of computer words (Swedish)

<http://www.nada.kth.se/dataterm/>

Språkvårdsportalen: A collection of links about the Swedish language (Swedish)

<http://www.svenskaspraket.nu>

A collection of IT words that are explained (Swedish)

<http://www.pagina.se/itord/>

Computer Sweden's language web (Swedish, password required)

<http://computersweden.idg.se/tjanster/sprakwebb/ord.asp>

STF Engineering education: IT dictionary including abbreviations (English-Swedish)

<http://www.stf.se/4121.pdf>

The Free On-line Dictionary of Computing (English)

<http://wombat.doc.ic.ac.uk/foldoc/contents.html>

English-Swedish-English Dictionary

<http://www.lexikon.nada.kth.se/skolverket/sve-eng.shtml>

Merriam-Webster online dictionary (including words in audio) (English)

<http://www.m-w.com/>

## 4. Thesis Process

*The thesis work begins with an initialization phase. The thesis process is then divided up into 5 stages. You will receive credits for each completed stage when your supervisor determines that you have successfully completed the stage. This chapter contains a description of these stages beginning with an explanation of how to initiate the thesis work.*

### 4.1. Initialization

There are two alternative paths to initiating your thesis work. Each path contains two steps. You can begin by looking for a supervisor and then with their assistance choose a topic/problem or alternatively you can begin thinking about a research problem/topic and then find a relevant supervisor. Choose the path that you prefer.

#### 4.1.1. Finding a supervisor

Writing a thesis of good quality is not intuitive. You will need guidance and assistance from a supervisor. You are responsible to find a supervisor yourself. There are several ways of going about this as follows. You must however keep in mind that the number of supervisors is limited as well the time each supervisor has for supervision. It is possible then that the supervisor who you would prefer is unavailable. In such a situation, ask the supervisor if he/she can recommend someone else or ask the person in charge of master's theses in your unit.

#### Course teacher

You might find a course particularly interesting so that you would like to have the teacher as your supervisor. Ask him/her but keep in mind that it is most often the course teachers who are most requested as supervisors.

#### On DSV's web

You can look at teacher's home pages to read about what particular teachers have as research interests. You can look at research unit home pages to read about which teachers are involved in which projects.

#### Direct communication

You can contact a supervisor directly. It is advisable to book a time in advance by e-mail, rather than just dropping in since teachers have a busy schedule. When you meet the supervisor it is recommended that you already have some idea about what you want to write about, since few supervisors have ready topics.

#### 4.1.2. Finding a research problem/topic

You may also begin by having some idea about what you want to write about or you want find a specific topic yourself. There are several sources of ideas:

- Teachers - Some teachers will supply a list of suggested thesis topics during the course. If this does not happen, ask for topic suggestions.
- Course - A course may contain interesting ideas for writing a thesis.
- Research articles - Most research articles conclude with a discussion of possible future work. This is work that the authors have not done but believe is necessary.
- Research projects - you can read about current DSV projects and either get an idea or perhaps ask to participate by contributing with a thesis in a required area.

Note that all of the above four sources are related to existing knowledge in a field. Having a personal interest or having particular experience is not sufficient to be able to choose a topic. Research, including master's thesis work is always based on the researcher having a sound knowledge of the history and current state of the field in which they are doing research. This is the only way to ensure that the problem that is defined is relevant and the solution is original.

## 4.2. The five stages

*Once you have found a supervisor and decided on a research topic/problem, you begin the first of the five stages of thesis writing.*

The first three stages are organized within your unit. Your unit may have seminars where you present your work to pass the stage. Alternatively, your supervisor will decide when you have passed a stage. Check with your supervisor to find out.

A "Stage" is an administrative step that allows supervisors to allocate credits for each completed stage. In terms of the actual thesis text there are three parts. A "Part" is a logical section of the thesis. The correspondence between Parts, Stages and the credits to be allocated are given here (stages 2 and 3 are combined for KTH students):

Thesis parts	Stages	Credits Allocated by
Part I: Introduction - 1 to 2 chapters	Stage 1: Introduction	Supervisor
Part II: Execution - 3 to 4 chapters	Stage 2: Half thesis done (data collected)	Supervisor
Part III: Conclusion - 1 to 2 chapters	Stage 3: First draft of complete thesis	Supervisor
	Stage 4: Final Seminar	Examiner
	Stage 5: Opposition and active participation	Seminar leader

**Table 1: Thesis parts, stages and credits**

### 4.2.1. Stage one - Introduction

Stage 1 corresponds to Part I of the thesis and *is the complete plan for the thesis*. It describes what the thesis is about, why it is being written and how it will be carried out. This means that this chapter is of a reflective character with a strong argumentative style.

This argumentation should convince the reader that the work is original, necessary, relevant, and correct and carried out in a scientific manner. Hence the introduction must at least contain answers to, and a discussion of the following questions. It will span over one or two chapters. These are however not necessarily headings:

- Is the title representative of the contents of the thesis?
- Is there a list of contents?
- Has the background and context of the thesis been described?
- Is there a discussion of the historical developments in the field?
- Is there a presentation of the current state of the art in the field?
- Has the subject been placed in a larger context?
- Is the problem concisely defined?
- Has the problem been addressed previously?
- If so, what was found then?
- If so, why is your solution better?
- What is the expected result (goal)?
- What are the criteria used to produce the result?
- Why has the thesis been written (purpose)?
- How and why will your result solve your defined problem (purpose)?
- How do you expect the result to be used, in what situations and by whom (purpose)?
- Are there any limitations to the problem, goal, purpose and method?
- How will the goal be arrived at (method)?
- Which research methods are used?
- What is the relationship between theory and empirical data?
- Which research approach is used?
- Why is this research approach used?
- How does the empirical data support theory/theory support empirical data?
- Which empirical data will be collected?
- How will the empirical data be collected?
- How will the empirical data lead to the result?
- What is the disposition of the thesis, logically and chronologically?

When presenting the text of part one for appraisal, it must be complete, that is without empty spaces for missing words or paragraphs and it must cover at least all of the above mentioned issues. Besides the title page and table of contents the text will in most cases initially be between 5-10 pages. For all of the above points a discussion of the issues involved in making choices is necessary.

A typical introductory chapter of the thesis will then have the following structure:

### **Background:**

This entails describing the subject area in general, leading to a specific subject area. The focus should be on the subject area and not a diary account of where you work or what you believe, etc. etc. There are two aspects that must be included in the background. The temporal aspect means that you begin with the history of the field in which you are doing your work. From the historical developments you go on to describe the situation today, i.e. the current state of the art. The other aspect that must be dealt with is that of level of abstraction.

You should move from the general to the specific. Begin by describing the field in general and finish the subchapter with a more detailed description of the problem area.

**Problem:**

The problem will then be derived from the background and describe what is to be addressed in the thesis. A problem need not necessarily be a negative condition. There are several (not mutually exclusive) common types of problems. Each problem statement can usually be restated in terms of any of problem types.

Failure:	Something has been documented as having failed
Need for a solution:	There is an explicit need for providing a solution
Innovation:	You wish to develop a new artifact
Need for improvement:	There is an existing artifact or process that you wish to improve
Need for understanding:	There is a situation or process that occurs that is not understood.

Building a system or any other artifact for a company is not a research problem. Nor is providing a service to a company. This is simply consultancy work, which is neither general nor scientific by itself. It is only when previous knowledge or theories together with scientific research methods are included, can a company-initiated problem be acceptable as the basis of a master's thesis. In short, the company becomes the source of empirical data for the study. The details of company based research will be discussed later in this document.

There are also criteria for problem formulation that need to be addressed so that a decision can be made about the suitability of the problem. These are:

Originality:	Has it been tackled before? Are you going to do it better? Why/how are you doing it better? Is there a new method or new empirical data? Why has it not been done/solved before?
Usefulness:	Who needs the problem solved? Why does it need to be solved? Will solving it actually make a difference? How does the problem manifest itself? Is there are a scenario that can describe the way in which the solution will be useful? Is it still relevant today?
Feasibility:	Can the problem be solved? Can valid conclusions be drawn? Can it be done in the time available? Data collection Can the data be collected in time? Is the necessary data attainable? Do you have access to the data sources?



### **Question**

A question is an alternative to a problem statement. It is a statement (why, when, how, where, what) describing what you want to find out. The criteria for the research question are precisely the same as those for the problem statement.

### **Hypothesis (not obligatory)**

The hypothesis is a guess at a solution to the problem. It is in the form of: If X then Y. X is called the independent variable while Y is called the dependent variable. That is if "something" is done to X, Y will change/improve in specific way. A hypothesis **MUST** be tested by conducting a scientific experiment and a description of how the experiment will be carried out needs to be included in the method discussion. The result of the experiment is based on whether the hypothesis was proven true or falsified. A hypothesis is commonly used when the research is deductive in nature. Details about how to conduct experiments can be found in literature dealing with research methodology. Examples of deductive approaches can be found in the subchapter of this document that deals with thesis types.

### **Goal/objective/results**

The goal is what is to be achieved in the thesis based explicitly on the question/problem (and hypothesis). This could be for example, a method, a system, a comparison, a list of guidelines, an explanation etc.

Achievement of the goal must solve the problem/answer the question. The thesis should have only one goal/question/problem. Otherwise, there will be parallel threads of research being proposed without them relating to each other in a transparent way.

### **Purpose**

The purpose is why the goal needs to be fulfilled. It is also how the fulfillment of the goal will solve the problem/answer the question as well as the expected consequences of goal fulfillment in terms of who will benefit from it and in what circumstances this should occur. It is here that you should convince the reader about the benefits of your solution.

Sometimes the terms purpose, goal, objectives and aims are used synonymously. Which particular word you use here is not important. It is more important that you discuss all the issues mentioned above.

### **Method**

Method means *how* one is to achieve the goal that has been presented as well as how the hypothesis is to be tested if there is one. This document will not contain any details about carrying out research methods. Detailed descriptions of research methods can be found in thousands of articles, books and websites. This document will instead contain a very broad overview based on the typical thesis types that are written at the department.

There is amongst researchers no complete agreement on all the details about what constitutes “good” research and “correct” research methods. You may then find that the broad descriptions given here may clash to some extent with description that can be read elsewhere. In such a case, it is the descriptions given here that are applicable to your thesis. One reason for these differences is the unique nature of research methodology in particular scientific fields. Currently there is no commonly agreed upon research methods for our field. We have instead been “borrowing” methods from other disciplines. When we do this, we need to adapt the methods to our field.

When writing a thesis, it's possible to distinguish between research methods at four levels, where each level is related to each other. The description of the levels is just an outline providing the bare minimum. The ways of using these levels is described under the subchapter called, "thesis types". It is not necessary to use these levels as headings. You should rather use them as guidelines that help you structure your research. Following this structure explicitly or implicitly should ensure the credibility of your work.

The levels are:

1) *Logical level*: The relationship between theory and empirical data.

The first issue to be dealt with when beginning the research is whether or not you have an idea or a guess of the solution to your problem. If you have an idea/guess then it is called a hypothesis. A hypothesis is usually in the form of, "If X then Y. X is the independent variable that you manipulate to see how Y, the dependant variable reacts. This way of conducting research is called deduction. This means that you empirically test a hypothesis. An alternative to logical hypothesis is to present an artifact as a hypothesis. You then guess that it meets certain conditions, or successfully meets certain requirements. In the experiment phase, you test if this is the case.

If you cannot guess the solution (present a hypothesis) then you need to begin by collecting empirical data. From the empirical data you draw conclusions based on a methodological and systematic analysis.

These two ways of dealing with theory and empirical data are called deduction and induction. Deduction occurs when you have a hypothesis that is your guess at a solution as previously mentioned while induction is when you want to find out about a certain issue without having an idea about a solution.

The term *theory* then applies not only to "theory of X" but also an expression of the knowledge contribution. With deduction, the hypothesis is the proposed knowledge contribution that will be tested empirically, while with induction it is the analysis of the empirical data that will be so. The term *empirical data* refers to data we collect about the phenomenon being studied by observing or experiencing it.

To summarize:

Deduction: Theory (hypothesis) → Empirical data

Induction: Empirical data → Theory (result)

A third possibility is abduction. This is often used in practice instead of deduction since the formulation of a hypothesis can seldom be done without some prior (minor) empirical study.

Abduction is then: Empirical data → Theory → Empirical data.

Deleted: ¶

2) *Approach level*:

An *approach* is a coherent, systematic way of working to solve a research problem that encompasses one or more data collection methods. Approaches are well described in literature about research methodology. The most common approaches used by master's students at the department are case studies, field studies, surveys and experiments. The choice of approaches is to be made on the basis of which choices are made at the logical level.

3) *Method level*:

A *method* is a systematic way of collecting data. Methods are well described in literature about research methodology. The most common methods used by master's students at the department, are interviews, questionnaires, observation and literature review. The choice of methods is to be made on the basis of which choices are made at the approach level.

#### 4) *Analysis level:*

An *analysis* is a systematic way classifying or categorizing the collected data so that conclusions can be made. The choice of analysis method will depend firstly on the type of data that has been collected. There are two types, quantitative and qualitative data. When you collect quantitative data, you need to conduct a quantitative analysis, otherwise called a statistical analysis. Details of regarding how to conduct statistical analysis can be found in research methodology literature. There are also specific ways of conducting an analysis of qualitative data. There is specialized software for both qualitative and quantitative data analysis.

In the thesis, the method section of Part 1 will usually only contains an overview of the method discussion. This means that the logical level is fully discussed as well as an introduction to the approach level. Reference is then made to where in the thesis the method and analysis discussion is detailed.

#### **Limitations (not obligatory)**

This sub-chapter refers to the discussion of limitations of the previous sections that is, background, problem, question, purpose and method. It allows you to narrow down the scope of your work to a manageable size.

### **4.2.2. Stage two – half thesis**

This stage corresponds to Part II of the thesis and involves the documentation and description of the execution of the plan of the thesis, i.e. Part I –Introduction. The empirical data needs to be collected. The following questions need to be dealt with:

- Has all the empirical data been presented?
- Has the source(s) of empirical data been presented?
- Has the method(s) used to collect empirical data been discussed?
- What has been done with the data that has not been presented?
- Have there been difficulties with data collection?
- Is the data presented in an easy to understand and readable format?
- Does the data actually answer/relate to the research problem/hypothesis/question that was presented in chapter one?
- Has the data been collected correctly and where applicable using a correct sample, in relation to the population-reliability?
- Are the correct techniques used for deriving or calculating the data?
- Have the procedures/methods for these been presented?
- Where theory is presented, are the sources and reasons for the choices made discussed?
- How does the theory that is presented, support the argumentation in the thesis?

There are no typical headings here. It depends on how the research was carried out. If you are conducting empirical research then you will have a chapter that firstly describes what the source of the empirical data is, for example one or more companies.

Following this introduction you describe the details of how the research was conducted. Finally you would probably have a "data" section where you present the data that has been collected, without commenting on it.

A theoretical study will instead contain a detailed literature survey of the phenomena being studied. This begins with an overview of the subject. This is followed by a description of the systematic approach used to search, collect and summarize the literature. The third section is a table or list of the results of the literature survey in the field.

#### **4.2.3. Stage three - first draft**

With stage three, a draft of the completed thesis is presented for the first time. Hence Part III is written. Part III of the thesis is the place for a presentation and reflection about what has been achieved. This part of the thesis then will typically have the following structure:

##### **Result**

Here you present all the data that you have collected. If there is a relatively large amount of data you can put it all in the appendix and have only the most important/interesting/relevant aspects in this sub-chapter.

##### **Analysis**

Here you present a systematic and methodological analysis of the data that was presented in the previous chapter. An analysis is not just your opinion about the data. The particular method of analyze to be used depends on the type of data you have collected since there are specific methods suitable for specific types of data. Whatever method you choose all the data must be analyzed with the most important/interesting/relevant aspects being highlighted. You can't just leave out data that you don't like for whatever reason. If there are unusual results that you don't agree with or understand, discuss these anyway. Some details are provided in the subchapter entitled "thesis types".

##### **Conclusions**

Here you repeat what you promised that you would do in chapter one, that is the thesis goal. It should of course follow on from and be derived from the analysis chapter. There is an overview of the work that has been done, including a discussion of the degree to which you have achieved the goal. Finally, you should discuss the possible impact/implications/consequences that the results have on the part of the real world that is of interest. This discussion is of a more speculative nature.

##### **Reflections/deficiencies/weaknesses**

Discuss how the study was conducted. Did it go according to your plan and expectations? Were there difficulties? Are there certain restrictions or limitations on the usefulness or credibility of the result caused by unexpected occurrences during the work? You should also discuss methodological problems that have, or potentially have had a bearing on the validity and/or reliability of the results.

##### **Future Work**

Are there still issues yet to be addressed? Have new questions appeared that you believe should be pursued further?

### **Finishing the first draft**

An abstract is added to the beginning of the thesis. The abstract is the advertisement for the thesis. It should be self-containing; i.e. one shouldn't need to read the whole thesis to understand the abstract. This means that no abbreviations, names or references are to be used. The abstract is less than one page long and contains three parts but no headings. Part one explains briefly the nature of the problem. Part two explains how the work was done while part three presents the significant findings.

## **4.3. Within the department**

*The following two stages are conducted at the level of the whole department and are followed by all master students at the department at final seminars.*

### **4.3.1. Stage four - final own seminar**

The final seminar is a departmental activity where the thesis is presented verbally and visually by both thesis authors at the department. The supervisor together with the thesis authors decides upon the time and date for the final seminar. You and your supervisor should decide a seminar date at least three weeks in advance. Your supervisor will contact staff responsible for booking seminars. The information needed to book a thesis seminar is: Thesis title, thesis abstract, names of authors, supervisor and examiner. Your supervisor will arrange the seminar room and any required equipment. You have to send a copy of your thesis to the relevant First Class seminar conference at least two weeks before the seminar date. This will give the opponents and active participants the time they need to prepare their work. The seminar is public and you can invite people you think have interest in your thesis.

The presentation should take about 45 minutes. Following the presentation, there will be a short break and then a 45-minute discussion where the active participants and the opponents shall present their opinions and discuss the thesis with the authors. The authors' supervisor is the seminar leader. At the final seminar, the thesis examiner will also comment and discuss the thesis. All comments, criticism, remarks and suggestions that are put forward will be noted by the thesis authors. Changes will be made on the basis of these in consultation with the supervisor. The examiner gives the grading of the thesis at the final seminar. The grading is pass or fail with corrections required. The contributions of the opponents and active participants are also graded with a possible grade of pass or fail. Details of the opposition and active participant are presented in the following subchapter.

After the final seminar, the thesis must be corrected if so required by the active participants, opponents and examiner at the final seminar. Once this is done the thesis can be submitted for print, and the final credits will be received.

### **4.3.2. Stage five- Opposition and active participation**

Each student must be an opponent to another master's thesis and be an active participant for two other theses. This means that the student must find theses of interest amongst those completed theses that are posted for this purpose in the First Class conference system ("MAG Seminarier" conference in the First Class system). The student chooses which thesis he/she wants to be the opponent and active participant for and registers this in the same First Class conference as the thesis itself. It is recommended that the student check this First Class conference at least once a week to ensure that a thesis is found within a field of interest.

Once the thesis is chosen, it should be downloaded from the same First Class conference and read thoroughly.

Both the active participants and the opponent must participate in a constructively critical discussion about the thesis based on a careful reading of the text. Their assignment is to point out shortcomings, weaknesses and good points in the thesis and suggest changes and improvements. The final seminar leader will report the credits for participation at the final seminar for both the opponents and the active participants. Not completing these two assignments satisfactorily according to these instructions will result in the credits not being reported.

Where two students are writing a thesis together they may be opponents or active participants together. The demands however are higher than for a single person opponent or active participant as detailed below under each heading.

### **Opponent**

The opposing student must write an opposition report that is at least 1000 words long. The minimum contents of the opposition report are listed in an appendix to this document. Grammatical, spelling and formatting errors are to be reported separately and are not included in the 1000 words. The opponent shall also provide the thesis authors and the authors' supervisor with the written opposition report at the final seminar. When there is an opponent group (two students together) the report must be of at least 1500 words.

### **Active participant**

The active participant must participate verbally in the discussion at the final seminar. Being active means that you have to have detailed comments, suggestions, criticism and positive comments to the work. It does not mean that all you have to do is ask the author(s) a question or two or discuss a few spelling or grammatical issues. When there is an active participant group (two students together), they must participate individually and not as a group.

## 5. Thesis types

Within the department and its fields of study there are certain “typical” types of theses. The following is an introduction to how to structure each one of these thesis types. These types are however not mutually exclusive but are often combined. These types are also related to the research methods that have been briefly mentioned earlier in this document.

### 5.1. Artifact development

The artifacts may be systems, programs, algorithms, models, methods etc. There may be several reasons for developing an artifact. Each of these requires a study of literature in the field before beginning the research. It may be that you have read that a company or organization, or certain groups need such an artifact, but no such artifact exists. You have perhaps read about many such artifacts but the literature describes them as not fulfilling their purpose/requirements or not performing well for various reasons. Another possibility is that instead of you deducing from the literature that artifact development is needed, it may be explicitly requested in articles in the form of a subchapter called “future research”. Finally, you may get an assignment within a research project or from a company. In this case, the requirements put forward here must be supplemented by those in the section called “company assignment” below.

Whichever one of these you choose you must begin with reading about the artifact, artifact type and any history of its design, development and use. For example, if you wish to develop a conference system then you must begin by reading at least about conference systems. You also need to read about which different types there are, what functionality they have, what different uses they have, if there have been any empirical studies of their use, how they are designed, developed, tested, implemented, maintained, etc. etc. All this will provide you with the background chapter of your thesis. It will allow you to argue for the need for innovation or improvement of the artifact as discussed in the previous chapter, based on current knowledge. Your thesis will then be soundly grounded and relevant.

The alternative that some students pursue is to ignore previous research and current knowledge. In such a thesis, the student just writes for example that they want to build conference system X. Ignoring previous knowledge and the current state means that at least one of the following situations are likely to occur. There may already be a system similar to system X making the thesis not original and hence useless. The problems that system X is supposed to deal with are then not problems anymore since technological or other improvements have made these problems disappear. System X would again then be irrelevant. A third issue may be that there is no organization, social or ethical context. The context of system X’s design, development and usage, can be found reading empirical studies of similar systems’ design, development and usage. By ignoring the context of the use of the potential system, important input in its design, development and usage would be missing resulting in previous mistakes being repeated. The artifact development must be based on a need or requirement has been presented and argued for based on previous experience and current knowledge, both existing in literature.

Even if a thesis is based on developing an artifact, the thesis result must be contained in the thesis as text. That is, if for example you are developing system X, the actual system is not the result but rather the text in the thesis. If you are writing code, then the thesis cannot just contain a lot of code.

In special circumstances, where something particularly innovative is to be presented then a few lines may be appropriate. If several pages are needed then these may be included in the appendix, again though only if something innovative is to be shown.

Instead of the thesis containing just code, a user manual, models or diagrams, the thesis must result in the presentation of the new knowledge that enabled the design or development of the artifact. When for example, you wish to develop system X the result of the thesis is not system X. It may be the development of a new process or way of working for developing systems that results in the development of system X. It may be a comparison of similar systems that lead you to deduce which functionality is most needed or required. It may be the usage of a certain theory, model or framework that enables you to design or develop the artifact. It may be an empirical study of the usage of a current system.

With system X being original should mean that something new has been done and this will be the knowledge contribution in the thesis. An artifact development thesis then will usually contain at least the following structure:

## **Part I**

### *Introduction*

History of the artifact (type), its use, and the identification of potential problems followed by an explicit argumentation concerning what the problem is in terms of a) an improvement to a current system or b) the need for innovation of a new system as mentioned previously.

### *Problem*

Short concise problem definition explaining what is wrong/what needs to be done - that is why the artifact needs to be designed/developed based on current knowledge and the state of the art.

### *Goal*

What is the result to be in the thesis? With artifact development this may be the identification of shortcomings in existing artifacts (hence a comparison, the next thesis type). It may be an innovation in the way of working in developing/designing artifacts. It may be the identification of criteria for identifying successful systems or successful development.

### *Purpose*

Why should the artifact be designed/developed? In what way will the artifact improve the specific situation that was mentioned in the problem description? What are the intended benefits? Who are the intended beneficiaries? How should they use system X?

### *Method*

The research approach here could be implicitly deductive or inductive. Deductively you could present your artifact as an implicit hypothesis. In other words, you claim that the artifact will solve specific problems that you have discussed in the problem description.

For example, if company Y uses system X the production will increase by at least 10%. Following this, an experiment is set up that can empirically prove whether this is true or not. The experiment is carried out and the results are noted. An analysis of the results involves a discussion of why/how the experiment proved or disproved the hypothesis. The data collected would most likely be largely quantitative.



An implicitly inductive approach would begin the idea that a system X is needed. Empirical studies are carried out to find out, what the requirements should be/what functionality should exist/which algorithms are useful/which data is needed/which information should the system produce/which other systems are in use, etc. etc. The result of this type of approach is that the result is the system design. The data collected would most likely be largely qualitative through interviews/case study/ethnographical study/observations/literature study etc.

A third alternative is a combination of both a deductive and inductive approach. In both cases there is an empirical part and a theoretical part where the theory is in the form of a hypothesis — System X solves specific problems.

#### *Limitations*

This would entail narrowing the scope of the previous chapters. For example, while the goal may be the design of System X, it may only be a first version or there may perhaps be only limited uses for it. The purpose may be limited in that the system may only be useful in limited circumstance or for specific types of companies.

#### **Part II**

This part of the thesis should contain the implementation of the research approach and methods described in Part I. In the case of a deductive approach, an artifact design is presented. When an inductive approach is used, the empirical data is presented here.

#### **Part III**

With a deductive approach, Part III will contain a validation of the artifact presented in Part II. This is the evidence/arguments/proof that the artifact is correct/fulfils the requirements/fulfils the research goal/proves the hypothesis true or false. The methods used and the type of data collected for the validation will depend on the approach and methods chosen in Part I. The most common combinations are 1) validation is the result of an experiment where statistical quantitative data is collected, 2) a survey or questionnaire is answered by respondents leading to a statistical analysis or 3) interviews of strategically chosen persons leading to a qualitative analysis.

With an inductive approach, the artifact is presented in Part III following the empirical data in Part II. The artifact is the actual result rather than the validation of the artifact as with the deductive approach. Using an inductive approach for artifact development means that validation or correctness is obtained in the extensive empirical study carried out in Part II.

Finally, Part III includes the authors' reflections concerning what was stated in Part I. This includes a discussion of the knowledge contribution of the thesis as well as reflections concerning the solving of the problem, fulfillment of the goal, feasibility of the purpose. The validity and reliability of approaches and methods discussed in Part I are also discussed.

## **5.2. Artifact comparison**

This type of thesis involves comparing two or more artifacts. It may for example, be so that you want to compare programming languages. For example, you believe that certain object orientation languages are better than others are, and need to be compared. You begin the thesis with discussing object orientation in general and which problems that you have found by reading literature in the field, leading to a discussion of why languages need to be compared.

Following this introduction, choices need to be made on two levels. Each one of must be discussed and motivated on the basis of a literature study. With "literature" does not mean one web site or one course textbook. It involves (for all the types of research) extensive searching and reading so that you can claim with a certain confidence, that you are familiar with the current state of the art in the field.

Firstly, the question is that of what it is that is to be compared. It may, for example be the need to see which languages deal with certain situations in a particular way, which functionalities different languages may or should have or may be general criteria that may or may not be fulfilled. Whatever you choose, you must motivate each characteristic you choose based on the literature in the field.

Comparisons are quite common in our field so that it may be quite simple to find existing characteristics. It's also likely that in some fields such as object-oriented languages there are numerous characteristics that have been used to compare languages. In such a situation you must systematically present all the alternatives, referring to the literature. You must then choose the set of characteristics that you will use in your thesis and motivate your choices - usually in a table or list. An alternative is that you find and use a framework for comparison. Frameworks can be found in the literature. A framework is often an abstract description/model of how artifacts can be described. A third possibility is that of using the characteristics of the artifacts themselves. When comparing O-O languages for example, this would entail listing what all the recorded characteristics of all the chosen languages are. These characteristics may be found in product descriptions or manuals or surveys done by others. From this unsorted list, you make your own categories. Place each characteristic in a category. You cannot however, just make up a list of characteristics yourself without motivation. The characteristics cannot be based on convenience or be vague or irrelevant. The following characteristics for example, are quite useless: good, user friendly, easy to use, important, interesting etc.

The purpose of the thesis is then extended to include the situations in which a comparison is useful, necessary and relevant. All of these points must be motivated and argued for, based on the literature.

Once you have chosen and argued for the characteristics, you need to decide the criterion/criteria for choosing the specific languages that you want to compare. You must begin with a discussion regarding the scope of object-oriented languages. There are so many object-oriented programming languages so that you may you must take a strategic sample from the whole population of O-O languages. The criterion/criteria for choosing which languages that are to be included must be well known/accepted, clear-cut, relevant and again based on a literature study. The criteria cannot be based on convenience. For example, that there are books about particular languages in the library or that you have had personal experience with certain languages. For object-oriented programming languages for example you may perhaps only look at those that have support for multiple class inheritance, those that appear to be most widely used, those that have been recommended in another study or use other such specific criteria.

Once you have chosen what you are going to look at and why, the next question is that of method, that is "how" you will arrive at the result, that is the comparison. Part of this "how" has been answered already in that you have chosen characteristics that are being compared as well as the population of O-O languages from which the comparison is made.

The following step is then to fill in a list (or table), where one heading is the list of programming languages to compare. These are then populated with the characteristic that is being compared. For each combination of language-characteristic in the list, there must be a presentation of whether the characteristic exists or not followed by a discussion concerning the reasons for this, followed by the implications of the situation when a characteristic is missing. This then is the comparison.

Finally, once you have made the comparison you need to discuss the implications of your findings. This will inevitably involve a judgement on the suitability, usefulness or quality of the artifact in some respect. An artifact comparison thesis then will usually contain the following structure. The details have already been gone through earlier in this subchapter.

### **Part I**

The background and history of the artifact type (for example O-O programming). This would include a brief presentation of the current state of the art, artifact use and perhaps differing functionalities. This will lead to a discussion of the need to distinguish between many alternative programming languages. This is then the problem statement. The thesis goal is then to present a comparison of artifacts, for example O-O programming languages. The purpose will most often be to provide some sort of decision making support for organizations that need to choose between O-O languages for a variety of reasons.

The research approach and methods will partially depend on the extent to which you believe that you have an answer to the question of what a comparison will lead to. If already at the outset you believe that programming language X is better than programming language Y then you will be using a deductive approach. You need to perform some sort of experiment or simulation to test whether your hypothesis is true or not. The criteria or rather the variables used in the experiment would be precisely the same ones mentioned earlier, chosen from the literature. The population for the experiment group and control group would have to be chosen in a way that is in line with common practice for conducting experimental research. The research methods used are most likely then to be simulation and/or experimentation. The data obtained will most likely be quantitative with a statistical analysis of the results "proving" whether programming language X is better than programming language Y.

An alternative approach is artifact comparison by induction. Here, you begin without an idea about how for example, any programming languages compare to each other. You must then proceed in the way that was described in the beginning of the subchapter, choosing characteristics to compare as well as a sample of the population as described. The methods used here will most often be based on a literature survey and the data may be qualitative or quantitative.

Qualitative data can be used for both deductive and inductive approaches. One type of research that requires qualitative data is that based on the simple fact idea that artifacts such as programming languages or even models, systems etc. are used by people. Instead of comparing static descriptions, functionality, models or specifications, one could compare attitudes, experiences, reflection or beliefs concerning usage, understanding, beliefs and expectations for any type of artifact. For example, one could compare usage of O-O programming languages. Deductively, you could propose a hypothesis that programming language A is better than programming language B in terms of usage. You would then define, based on a literature study certain characteristics of usage that could be tested for.

Your testing with the use of qualitative data would involve interviews and/or observations of programmers when they are trying to solve the same problem with say the two different programming languages. Inductively, you would conduct interviews and/or observations to find out if there are any differences in usage.

#### **Part II**

Part II would involve presenting the actual comparison as described in Part I. The data should be presented in a systematic, structured way. The different artifacts that are to be compared are listed or put in table form with the existence or otherwise of the characteristic in the list/table. Alternatively the characteristics are listed and the artifacts are placed in the list/table. A summary of the comparison shows which artifacts have which characteristics.

#### **Part III**

This final part includes a review of the work done, the usefulness of the comparison and finally the implications of the result of the comparison in relation to actual use of the artifact as well as current research and knowledge and finally potential future research.

### **5.3. Artifact evaluation**

An evaluation of artifacts is to be carried out similarly to the way the previous type, “artifact comparison” was done. The difference is that while artifact comparison deals essentially with looking at artifacts in relation to each other, an evaluation looks at usually one, and sometimes more artifacts and relates them to values.

Values are assessments in terms determining whether an artifact is “good” or “bad” in some way. An example of evaluation of an artifact is when a user interface is to be evaluated. Even if the result will partially be the actual evaluation resulting in some type of claim that the interface is “good” or “bad”, there is more to it. The line of discussion is similar to that of artifact comparison.

#### **Part I**

If an evaluation of a use interface is to be undertaken, the background subchapter is not about the particular interface or organization that developed or owned it. It is rather the field of interface design and/or interface evaluation. It is the general, scientific that is of primary interest and not the specific interface or organization. Following the background, the problem is not that the particular interface needs to be evaluated. It may be for example, that an evaluation model is to be tested, or that specific interface design recommendations are to be tested. These are quite common and it may be difficult to choose between them.

The goal/objective could then be to compare or evaluate evaluation models or compare or evaluate design recommendations rather than the actual interface. Hence, an artifact evaluation thesis may actually be an artifact comparison thesis. The purpose is then to evaluate for example if a certain list of design recommendations is followed or not. The method in such a case would be an empirical study of the particular user interface. The user interface is then the empirical data used to test the theory (specific design recommendations). In such a way, a general scientific result is obtained from a specific case. The research methods used may be qualitative and/or quantitative.

The qualitative approach might entail for example the derivation of questions from the design guidelines, for interviews with users. Data analysis would also be qualitative.

Alternatively, a quantitative evaluation could be carried by counting the occurrences of the design guidelines' prescribed points of importance as they appear in the user interface. Whichever approach is chosen will be related to the goal/objective, purpose and problem.

#### **Part II**

As usual, Part II involves carrying out whatever has been described in the method section of Part I. Here, the empirical data is gained from the user interface. This data is cross-checked against some theoretical input. Which theoretical input is used depends on the choices made in Part I. It may be, in this example, specific design guidelines or an evaluation model. Another alternative could be a comparison of evaluation models against the same empirical data (user interface). In this type of thesis, the result will be a comparison of evaluation models. A short textual description of the user interface may be included. Screen dumps should only be used very sparsely and only in exceptional situations.

#### **Part III**

As in the previous types, here again is a reflection concerning the work. It includes a review of the work done, the usefulness of the evaluation and finally the implications of the result of the evaluation in relation to actual use of the artifact as well as current research and knowledge and finally potential future research.

### **5.4. Understanding a situation**

This type of thesis is quite different from the previous three types in that it is not directly related to artifacts. Instead, this type of thesis is often more related to sociology, psychology, economics, organizational science, pedagogics, etc. Inspiration for the types of theses can be taken from literature in these fields. Examples of typical thesis topics are; how do organizations implement knowledge management? How do elderly people use the Internet? This type of thesis most often begins with a situation where the researcher is unclear about a certain process/activity. This is usually manifested in the form of a question, why, how, when or what.

#### **Part I**

If we take the example of how elderly people use the Internet, then this may be a typical Part I. The background is again an introduction to the subject area. It needs to be both about Internet and then the elderly. It should include previous studies of elderly and computers and/or Internet.

The problem is usually that there is a lack of knowledge in a certain area or concerning particular phenomena. The purpose needs to be defined in terms of why it is important/relevant/necessary/interesting to "understand the situation". Why is it important to find out how the elderly use the Internet? The goal/objective is to describe a particular situation in terms of a process and its context. Any research approach based on induction could be used. One could for example, do a case study, an ethnographic study or partake in action research. Research methods will most likely be qualitative, such as interviews or observations. Alternatively quantitative methods such as questionnaires could also be used. Qualitative studies will show Internet usage for a particular group of elderly. Quantitative studies will provide a generalized result. Whatever method that is used should be based on previous knowledge or current theories, regarding the use of the Internet in general, specific studies of use, theories about human behavior or theories about the activities, understanding or beliefs of elderly people. The goal/objective is then extended to include the application of one of these, to see how useful they are.

As in the previous thesis types, the actual empirical study (of elder people) will not be the goal of the thesis but rather the way of conducting a comparison or evaluation. This is then general scientific contribution.

#### **Part II**

Again, Part II contains the implementation of the approach and methods presented in Part I. In the case of the elderly and Internet, results showing how the elderly use the Internet will be presented as cross checked against the theories, studies or other characteristics that are compared or evaluated. This is similar to the previous thesis types.

#### **Part III**

As in the previous types, here again is a reflection concerning the work. It includes a review of the work done, the usefulness of the study and finally the implications of the result of the study in relation current research and knowledge and finally potential future research.

### **5.5. Exploring the existence of a phenomena**

This type of thesis deals with finding out how a phenomenon actually manifests itself empirically (in a real situation). Typical verbs here are explore, study or understand. An example of a topic may be, "Exploring Agile Systems Development". The structure of the thesis would be the following:

#### **Part I**

The background follows the usual pattern. A historical overview followed by a presentation of the current state in the field. The inherent problem that writing this type of thesis tries to alleviate is the lack of empirical data showing how certain phenomena actually manifest themselves in reality. Research in our field tends to contain an overflow of suggestions for new artifacts and processes that are intended to solve specific problems. With this type of thesis, you investigate instead how already existing artifact or process actually works or is understood. The goal is then to understand the phenomena in practice. The purpose is to assist those contemplating obtaining or using the phenomena in making relevant decisions based on actual usage.

The method used is that firstly the phenomenon is clearly and explicitly defined. If you are studying "agile systems development", the first step then is a literature review of the definition of the phenomenon. A systematic literature review would present all the definitions that are currently in use. These definitions are presented as a list or table. The definitions are then categorized according to suitable criteria. These may be functionality, usage, level of detail, degree of abstraction or anything else that appears to cover all the definitions. Following this, a decision is made regarding the definition to be used in the thesis. There are several options:

#### **Most common definition**

Use the definition that most of the sources use after listing these.

#### **Synthesis of definitions**

Combine all the definitions into one definition that will be a sort of most common definition.

#### **Most recent definition**

The assumption here is that the latest definition sums up the previous definition and/or it takes account of the latest developments in the field and is hence the most relevant.

### **Stipulative definition**

If you believe that none of the definitions is appropriate then you can make your own. You need to argue why none of the existing definitions are suitable.

Whatever definition you choose you must motivate your decisions.

The following step is to develop a "template" for examining the existence of the definition in an empirical study. This template is the method of data collection. It may be interview questions, an observation protocol or a list of criteria to be checked against a model, program code or any other artifact. This template must be derived clearly and explicitly from the definition that you formulated in the previous section. The final step is to carry out the method so that you can check how the phenomenon manifests itself in reality. To summarize the procedure is:

Phenomenon→Definition→Template→Method→ Empirical Study→Phenomenon

Part II is where the method of Part I is carried out reported and discussed. In addition there may also be a discussion of how any empirical study of the phenomenon is discussed, so that it can be compared with your empirical study.

Part III should contain the general Part III contents that have been previously discussed. The conclusion will include a discussion of differences between your empirical study of the phenomena and the other ones that you have described in Part II.

## **5.6. Company assignment**

You cannot write a consultancy report as your thesis. That is, if for example the company wants you to develop a system, then this in itself is insufficient to be a thesis, even if the thesis work may include this as a part. If you are going to do something for a company then the company assignment will always provide you with the empirical data to test/evaluate/compare/understand a general theory/method/model/set of guidelines etc. Hence the purpose of research is not to solve the particular problems of a company but to produce knowledge that can and should be relevant for groups of companies, organizations, individuals or the society in general.

In practice, a company-based assignment will then be an example of one of the thesis types previously mentioned. A company wants you to develop a system. You can write then an artifact development type of thesis according to the instructions provided earlier. In such a situation the input from the company is limited to perhaps indirectly contributing to the determination of the criteria for the artifact. If for example, the company is a part of a particular branch or is of particular size or can be determined to be of certain type or restricted by certain conditions, then these may be included in the criteria that are to be used in the determining the requirements for the artifact.

It is important to keep in mind that it is the development of the artifact on the basis of criteria determined from theories, previous research and current knowledge that makes the result generic and scientific. It will not be so if you only provide the company with a completed system

An example may be:

Company X wants you to develop a new conference system B.

There are three main topics in such a thesis. Topic one is the artifact type. Topic two is the set of characteristics/criteria/properties of the artifact. Topic three is the new artifact. The three topics are discussed in terms of the three parts of the thesis as follows:

### **Part I**

The background includes the history and current state of knowledge regarding conference systems. The problem is discussed in terms of the lack of conference systems that are based on the most suitable/important/necessary characteristics/criteria/properties. The goal is NOT the specific goal of developing a conference system but rather the scientific goal of determining which characteristics/criteria/properties are suitable/important/necessary for developing a conference system. The purpose is based on a discussion of the need for the characteristics/criteria/properties and how these will be used in practice. The research method can be based on induction or deduction. Inductively, you may begin by searching the literature for the characteristics/criteria/properties that should be applicable for developing a conference system.

You then apply these when developing a conference system. Alternatively a deductive approach would entail you proposing (guessing) a set suitable characteristics/criteria/properties that you think may be suitable. The final step would then be to test if applying these characteristics/criteria/properties leads to a conference system being suitable (where the term suitable is operationalized) based on the implementation of the conference system.

### **Part II**

The characteristics/criteria/properties are applied in the development of the conference system. The organization for which the conference is built is described here for the first time in terms of the empirical setting for the development of the conference system. That is to implement the conference system that tests/shows the suitability of characteristics/criteria/properties. This part also contains the results of the implementation. There is a description of the design/architecture/functionality of the conference system with the focus on the new characteristics/criteria/properties. It may also be necessary or useful to use the conference system after an implementation in an empirical study to describe the practical implications of applying the characteristics/criteria/properties.

### **Part III**

As in the previous types, here again is a reflection concerning the work. It includes a review of the work done, the usefulness of the study and finally the implications of the result of the study in relation current research and knowledge and finally potential future research.



## 6. Use of literature

*A key part of doing research is the ability to search for, find and correctly use relevant literature. In this chapter, there will be an overview of the main issues that are involved.*

### 6.1. Reasons for using literature

There are several reasons for including information gained from literature. Whatever the reason, you must begin your thesis work with a literature study. In any situation you can use literature to gain support for your claims. You should however also be aware of and read literature that does not support your claims. You need then to show that you have taken these into account when making your claims. You need to argue against those claims that are made against yours. Doing this improves greatly the validity of your work. Not including information from literature that does not support your claims is does not only reduce the validity of you work but is also misleading and hence unethical. You should not give the impression that your claims are undisputed. When there are differing opinions, results or methods in the literature, you should discuss these differences in a systematic way. Make a table or list of who wrote what and why and discuss the implications to what you are discussing.

It is important that you make it absolutely clear what you are writing and when you are basing something on literature. Whether you cite or refer, there are standard practices that must be followed. It's not enough to just to include what other people wrote. It's your ability to use the literature to explicitly support your arguments that is important and NOT your ability to "copy and paste". You must discuss the significance and relevance of what you have referred to. In other words, why are you citing or referring to the specific text and how does it relate to the particular claim or argument that you have precisely made?

#### **Differentiate from own work**

You must always clearly differentiate your text and the text that others have written.

#### **Support for arguments**

As mentioned earlier in this document you must get support for your claims from literature. You cannot just make claims about situations or circumstances without the claim being based on literature. The only exception is when the claim is based on knowledge that is so well known anyway. Some students write for example, "many organizations have such a problem", or "few organizations have dealt with this issue". You cannot just guess these things. There are several possible alternatives. You can try to find out exactly how many organizations have the particular problem by looking for surveys in the area. You can conduct a survey yourself. Finally, you can avoid this problem altogether by not estimating a value such as, many, few, some or all.

### 6.2. Using literature in the three parts

*Besides using literature to support your arguments in general you should use it to support all parts of thesis according to the following:*

### **Part I**

You must use it to find out about and describe the history of the field and the current state in the field in the background chapter. By doing so you show that you are aware of what is known in the field. This means that it is more likely that your thesis is relevant and original. Even if you believe that your problem is unique, it is always a subset of a larger field or problem that you need to discuss. The key is to place your research in the context of what else is known in the field. In the goal chapter, you can discuss the existence of studies that have similar goals. In this way, you can argue how your study is original and "better". In the method section, you can use research methodology literature to explain the choices of methods that you made. You can also include a discussion of the actual use of methods in other research as they are explained in empirical studies. The purpose can be discussed in terms of the purpose of similar studies and literature that describes the needs and requirements for the research problem to be solved.

### **Part II**

This part will typically include the use of literature to find the criteria that were discussed in the section called "Thesis types". It will also include literature to describe the empirical data and perhaps the companies that are being studied.

### **Part III**

In this part there is typically not much use for literature, given that the focus is on your own reflection and understanding of the work that you have done in Part II.

## **6.3. Referring and citing**

Once you have searched for and found the literature that is relevant for you to use when writing your thesis, you need to *refer* and *cite* in the correct way. Whichever way you use, you cannot just copy and paste text into your thesis. Pasting in other people's work and not citing or referring is a misrepresentation of your work, i.e. Cheating. This form of dishonest conduct is discussed later on in this document.

### **6.3.1. Citing**

Citing is the process of copying precisely the original author's words and using quotation marks and a reference the original author to explicitly show that it is a reference. This should be done very sparingly, perhaps 1-2 sentences in a chapter at the most. Citing is useful when you find 1-2 sentences in the literature that are so well written or are so crucial that you want to reproduce the precise wording. If you however, cite too much and/or too often, this will lower the validity of your work as it will contain too much of other people's work and too little of your own work.

### **6.3.2. Referring**

Referring is the process of discussing the work of others in your thesis. When you refer, you discuss literature that you have read, in your own words. You discuss it in relationship to your own work and not just summarize it. There is no recommendation regarding how much you should refer, but rather a balance should be found. If you refer too much, your text will probably contain too little of your thoughts, research and results and hence only be a summary of others' work rather than a thesis. If you refer to little, then your text will probably be of little relevance and originality since it has not been related to other current and previous knowledge.

## 6.4. Reference style

*Make sure that all the references that you use in the text are also listed in the reference list at the end of the thesis and that all the references listed in the reference list are in the text of the thesis. You should also use one of the common reference styles. The most common styles are Chicago, APA and Harvard. Almost all of the following text concerning references has been taken from Monash University, School of Information Management & Systems, Style Guide, March 1998. This is based on the Harvard style.*

### 6.4.1. In-text references

Use the author-date format to cite references in text. For example: as Smith (1990) points out, a recent study (Smith, 1990) shows....

For two-author citations, spell out both authors on all occurrences.

For multiple-author citations (up to five authors) name all authors the first time, then use et al., so the first time it is Smith, Jones, Pearson and Sherwin (1990), but the second time it is Smith et al., with a period after "al" but no italics.

The first time an "et al." reference is used in a paragraph, give the year, thereafter (if the citation is repeated in the paragraph) omit the year.

For six or more authors, use et al. the first time and give the full citation in the reference list.

Include page reference after the year, outside quotes but inside the comma, for example: The author stated, "The effect disappeared within minutes" (Lopez, 1993, p. 311), but she did not say which effect. Another example would be: Lopez found that "the effect disappeared within minutes" (p. 311).

If two or more multiple-author references which shorten to the same "et al." form, making it ambiguous, give as many author names as necessary to make them distinct, before et al. For example: (Smith, Jones, et al., 1991) to distinguish it from (Smith, Burke, et al., 1991).

Join names in a multiple-author citation with and (in text) or an ampersand (&) in reference lists and parenthetical comments. For example: As Smith and Sarason (1992) point out, the same argument was made by in an earlier study (George & Swen, 1990).

If a group is readily identified by its initials, spell it out only the first time. For example, "As reported in a government study (Department of Education, Employment, Training and Youth Affairs [DEETYA], 1996), blah blah..." and thereafter, "The previously cited study (DEETYA, 1996) found that...."

If the author is unknown or unspecified, use the first few words of the reference list entry (usually the title), for example: ("Study Finds," 1992).

If citing multiple works by the same author at the same time, arrange dates in order. In general, use letters after years to distinguish multiple publications by the same author in the same year. For example: Several studies (Johnson, 1988, 1990a, 1990b, 1995) showed the same thing.

For old works cite the translation or the original and modern copyright dates if both are known, for example: (Aristotle, trans. 1931) or (Darwin, 1859/1996).

Always give page numbers for quotations, for example: (Cheek & Buss, 1981, p. 332) or (Shimamura, 1989, chap. 3, p. 5).

For email and other "unrecoverable data" use personal communication, for example: (V.G. Nguyen, personal communication, September 28, 1993). These do not appear in the reference list.

#### **6.4.2. Reference lists**

There is to be only one reference list containing all the references. The headings provided below are only for the purpose of differentiating differences in styles within the reference list based on the different types of references.

For book and paper titles, capitalize the first word of the title, and subtitle, and any proper name. Take careful note of punctuation in references.

Use prefixes in alphabetizing names if commonly part of the surname (De Vries).

Do not use "von" in alphabetizing (Helmholtz, H. L. F. von).

Treat Mc and Mac literally; Mac comes before Mc.

Disregard apostrophes and capitals in alphabetizing; D'Arcy comes after Daagwood.

Single-author citations precede multiple-author citations (Smith, 1990 then Smith et al., 1990).

Alphabetize corporate authors by first significant word. Do not use abbreviations in corporate names.

#### **6.4.3. Reference types-format**

##### **Book**

Martin, J. (1991). *Rapid application development*. Englewood Cliffs, NJ: Prentice-Hall.

##### **Book, new edition**

Avison, D. E., & Fitzgerald, G. (1995). *Information systems development: Methodologies, techniques and tools* (2nd ed.). Maidenhead, UK: McGraw-Hill.

##### **Old work**

Darwin, C. (1996). *The origin of species*. Oxford, UK: Oxford University Press. (Original work published 1859) (note: In text use the parenthetical citation (Darwin, 1859/1996).)

##### **Edited book**

Bennett, J. L. (Ed.). (1983). *Building decision support systems*. Reading, MA: Addison-Wesley.

**Published proceedings**

Shanks, G. G., & Arnott, D. R. (Eds.). (1994). *Proceedings of the Fifth Australasian Conference on Information Systems* (2 vols.). Melbourne, Australia: Monash University/ Australian Computer Society.

**Published proceedings, unknown editor**

*Proceedings of the Third International Conference on Decision Support Systems*. (1995). Hong Kong: International Society for Decision Support Systems.

**Journal article, one author**

Niehaus, R. J. (1995). The evolution of strategy and structure of a human resource planning DSS application. *Decision Support Systems*, 14, 187-204.

**Journal article, multiple authors**

Suvachittanont, W., Arnott, D. R., & O'Donnell, P.A. (1994). Adaptive design in executive information systems development: A manufacturing case study. *Journal of Decision Systems*, 3 (4), 277-299.

**Article or chapter in an edited book**

Keen, P. G. W., & Gambino, T. J. (1983). Building a decision support system: The mythical man-month revisited. In J. L. Bennett (Ed.), *Building decision support systems* (pp. 133 - 172). Reading, MA: Addison-Wesley.

**Article or chapter in an edited book, multiple editors**

Courbon, J-C. (1996). User-centered DSS design and implementation. In P. Humphreys, L. Bannon, A. McCosh, P. Milglaiese & J-C. Pomerol (Eds.), *Implementing systems for supporting management decisions: Concepts, methods and experiences* (pp. 108-122). London: Chapman and Hall.

**Article in published proceedings**

Paranagama, P., Burstein, F. V., & Arnott, D. R. (1995). User characteristics as a basis for decision support systems design. In *Proceedings of the Third International Conference on Decision Support Systems* (pp. 322-339). Hong Kong: International Society for Decision Support Systems.

**Technical report**

Arnott, D. R., Gilbert, A., & O'Donnell, P.A. (1994). *Preliminary data from a survey of senior executive use of computing in Australia* (Tech. Rep. No. 1/94). Melbourne, Australia: Monash University, School of Information Management & Systems.

**Working paper**

Arnott, D. R., & O'Donnell, P.A. (1993). *The product lifecycle: Lessons for business process re-engineering from decision support systems* (Working Paper No. 12/93). Melbourne, Australia: Monash University, School of Information Management & Systems.

**Magazine article**

Smyth, H. (1995, December). Is Microsoft off target? *PC World*, 50-52.

**Pamphlet**

Australian Computer Society. (1992). Code of ethics. (4th ed.) [Brochure]. Sydney, Australia: Author. (note: "Author" is used as above in all references when author and publisher are identical.)

**Anonymous or unknown author (common in newspapers)**

The information superhighway turns left. (1995, July 13). *The Age*, p. 5. (note: in text, use a short title for citation: ("Information Superhighway," 1995).)

**Commercial computer software**

Mac OS (Version 7.5.1) [Computer Software]. (1996). Cupertino, CA: Apple Computer Inc. (note: in text, use a short title for citation: ("Mac OS," 1996).) (note: common software (e.g., Microsoft Word) does not need a reference entry.)

**Non-commercial computer software**

O'Donnell, P.A. (1996). IEdit (Version 1.0) [Computer Software]. Melbourne, Australia: Monash University, School of Information Management & Systems.

**FTP**

O'Donnell, P.A. (1996). IEdit: An influence diagram editor. [On-line]. Retrieved January 25, 1996 at URL: <ftp://ftp.sims.monash.edu.au/pub/users/podonnell/idedit.hqx>.

**World Wide Web page**

School of Information Management & Systems Home Page. (1998). [On-line]. Accessed on January 25, 1998 at URL: <http://www.sims.monash.edu.au>.

**World Wide Web journal paper:**

Klein, H. K., & Hirschheim, R. (1996). The rationality of value choices in information systems development. *Foundations of Information Systems*, September. Retrieved January 25, 1996 at URL: <http://www.cba.uh.edu/~parks/fis/kantpap.htm>

**Other**

When providing details about the publisher give the city and state for American publications, and the city and country for non-American publications. The following cities are the locations of the major publishing houses and do not have to be identified by state or country: Baltimore, Boston, Chicago, Los Angeles, New York, Philadelphia, San Francisco, Amsterdam, Jerusalem, London, Milan, Moscow, Paris, Rome, Stockholm, Tokyo, Vienna.

**6.4.4. Appendices**

Appendices are not compulsory but if you choose to have them the following conditions apply: The appendices are to be placed at the end of the thesis. They usually contain raw data. This includes, interview text, software code, statistical data, questionnaires, protocols etc. However these are only to be included selectively. Discuss this with your supervisor if in doubt.

The appendices must be referred in the text of the thesis. For example, "...the results are presented in detail in Appendix 1." The appendices are not included in the numbering of the headings but are included in the table of contents. They are to be numbered from Appendix 1, Appendix 2 etc.

## 6.5. Literature searches

This subchapter contains essential practical information about searching for literature at the department. (*Fredrik J. Björck, 2004-09-23*)

### 6.5.1. The need to do literature searches

If you want to write a high quality master's thesis, you will have to look for previous work in the subject area of your thesis. This is essential for all theses – something that must be done.

If you do not search for previous work, you will have a much more difficult starting point for your own project. With the help of previously published literature, you will quickly get a good picture on what the important questions are in the subject area, and also find out what others have already done before you. Therefore, a good search in the literary databases will enable you to build on previous work, and as a consequence help science take a small (or large) step forward.

### 6.5.2. How to get access

There are many different methods to gain access to the literary databases. Most of the databases require a subscription, and these are paid by the university. As a student you can access the databases from the departments computers (in the computer halls), and in the KTH Forum library (situated at the Forum main entrance). In addition, you can access many databases from your own home with an Internet connection. The following factors may affect what databases you can access:

- From where you try to access;
  - Department computers
  - Library computers
  - Home
- Where you are registered as a student
  - Stockholm University (SU)
  - Royal Institute of Technology (KTH)
- Which access control technique is used
  - Automatic login based on IP-number
  - Domain name (e.g. dsv.su.se)
  - Access through login to proxy server
  - Access by university internet service provider

What you can access from where and using which method changes all the time, due to new subscription agreements and technical access solutions. If you need access to a database, and find that you can not get access the way you want, please visit the Forum library – from there, you will get instant access to most databases in case it did not work from other places. Also, librarians in the Forum library will be able to consult with you on how you may gain access to a certain database from home. Now, we have covered to potential access problems you may or may not face – let us go over to the access opportunities.

At the database pages (addresses below) from the KTH and SU university library, you will find information in both Swedish and English on how you may access each database.

From the university, you will most of the time get instant access based on your IP number. From home, you will have to use either your KTH library card with PIN code (for KTH registered students. If you do not have a PIN, or if your card has expired, please see the librarian to get this fixed), or a web proxy account. This is free for all SU registered students. Information about how to get this is on <http://www.it.su.se/tjanster/externuppkoppl/proxy.html>, but you may need to go to the main SU campus to get a student computer account. SU students may also use the university itself as an Internet service provider. Then IP number will then be recognized, and no proxy login will be required.

### **6.5.3. Where to find the databases**

To get access to the databases, point your web browser to:

Stockholm University, English: <http://www.sub.su.se/english/database.asp>  
Stockholm University, Swedish: <http://www.sub.su.se/sok/databaser/databas.asp>  
Royal Institute of Technology, English: <http://www.lib.kth.se/kthbeng/indexes.html>  
Royal Institute of Technology, Swedish: <http://www.lib.kth.se/indexes.html>

These databases search across journals and other sources – in most cases hundreds of different sources. Why not “google-it” instead, you might ask. Well, these sources are most of the time peer-reviewed – this means that there is some degree of certainty that what is written there is correct (within an order of magnitude). However, a good Google search is always a good complement to any literary search.

### **6.5.4. Search for an academic journal**

You may also search for a special journal, and find the right database for that journal:

Royal Institute of Technology, Journals full text, English  
<http://www.lib.kth.se/kthbeng/full.html>

Royal Institute of Technology, Journals full text, Swedish  
<http://www.lib.kth.se/full.html>

Stockholm University, Journals full text, English  
<http://www.sub.su.se/sok/etid/nyaetskr/eTidskrifter.asp>

Stockholm University, Journals full text, Swedish  
<http://www.sub.su.se/sok/etid/nyaetskr/etidskrifter.asp>

### **6.5.5. Structuring a search**

If you start out searching without having a good idea of what concepts to use for your search, then you will probably waste your time. Before even starting the computer, sit down and think – may be with the help of your supervisor – a few concepts that taken together would yield an interesting catch for you. Most databases accept Boolean operators, such as “AND”, “OR”. How about (“information security” OR “IT security” AND management). The choice is yours. If you find it difficult to get a grip on the concepts to use in your search, you may want to try to Google for a few documents and sites – as a “pre-search” for better search terms.

## **6.6. Research ethics and misconduct**

*Conducting research entails agreeing upon certain ethical principles, departmental regulations as well as national and international laws.*



*By writing your thesis you agree not to engage in research misconduct as defined below in that they violate the above mentioned. Any infringements will lead to disciplinary action.*

The following guidelines are based on ethical guidelines for research at Monash University, Faculty of Business and Economics and our "Code of honour and regulations covering examination of all courses at the IT University". The local DSV regulations are available at:

<http://www.dsv.su.se/eng/utbildning/code-of-honour.html> (English)

<http://www.dsv.su.se/utbildning/hederskodex.html> (Swedish)

The IT university regulations are available here:

<http://www.it-univ.se/artikel/757/056012/en> (English)

<http://www.it-univ.se/artikel/757/001019/se> (Swedish)

Serious research misconduct is defined by the following criteria:

- Conduct that is deemed by the department to cause damage to the department's standing and reputation in the academic and/or community in general;
- Conduct that is harmful to others;
- Conduct that displays a persistent, flagrant and willful disregard of the rules and guidelines laid down for the carrying on of research within DSV and Sweden.

### **6.6.1. Types of research misconduct**

The following is a specific list of types of misconduct

- Fabrication of data in claiming results where none have been obtained.
- Falsification of data by changing the collected data to fit your purpose.
- Plagiarism, that is copying another text without the appropriate referencing. This implies that you have written the text when you have not.
- Involving people as your research subjects without safeguarding their right to privacy, confidentiality and anonymity.
- Other practices that deviate from those commonly accepted within the relevant research community for proposing, conducting or reporting research.

Beyond these points, any activity that is illegal based on local, national or international law will result in immediate disciplinary action and will be reported to the relevant authorities.

### **6.6.2. Plagiarism**

Probably the most common type of research misconduct is that of plagiarism. This is when you copy text written by someone else and claim it is your own. In practice, this is done in two ways. One is when you copy text and omit any reference. If there is no reference, you are implying that you are the author. The second way is when you copy text but refer to it as a reference and not a citation which it actually is. This is also plagiarism in that when you refer rather than cite you are also claiming that you wrote the text which again is not the case.

To avoid be accused of plagiarism, its not enough just to add a reference to a paragraph or page that you have completely copied. If you are going to use literature then the first option is always to discuss the references in you're own words including the relevance and importance to you claims.

An alternative is to quote exactly the words used by the original author with a suitable notation that it is a quote. This should only be done for a few sentences at the most in a thesis. The third alternative of copying paragraphs and pages are of course not allowed since a thesis is your own work and not a test to see if can “copy and paste” as mentioned earlier in this document.

#### **6.6.3. Honest errors**

Misconduct does not include honest errors or honest differences in opinion arising out of interpretation of data. In case of doubt you should discuss the matter with your supervisor.

#### **6.6.4. Disclosure and use of information**

If students have received a thesis assignment from a company or they approach a company there are special ethical considerations that must be considered. In all cases, the students and the company should complete a written agreement that defines which information the students are allowed to disclose and use in the thesis.

## 7. Thesis format

*This chapter provides recommendations for the format of the thesis. Besides following these, you also need to ensure the correctness of the language that you use. Hence, it is important that you a) check the spelling with your word processor's spelling checker and b) check the grammar using word processor's grammar checker. Sentences, paragraphs, tables and figures should not break over pages.*

The thesis text cannot contain large amounts of software code, screen dumps of user interfaces, user manuals, protocols or software specifications. In case some small sections of these are vital for the thesis, the supervisor may allow a limited amount in an appendix with appropriate citations in the text.

### 7.1. Choosing a word processor

There are no formal demands for the choice of word processor for writing your thesis. Hence you can choose a WYSIWYG tool such as Microsoft Word if you wish or any other text editor. The final result will however always have to be in the PDF file format.

An alternative to using Microsoft Word as a word processor is to use LaTeX. LaTeX is a program that easily creates well-formatted documents with a professional appearance. LaTeX has for many years been a standard within academia for writing articles and theses. Unlike WYSIWYG-tools (What You See Is What You Get), such as Microsoft Word, you place formatting code in certain places in the text. LaTeX then creates for example, a PDF file with a layout version.

LaTeX has powerful support for the most common activities when writing a long text, such as cross-referencing, referencing, bibliographical databases, footnotes, table of contents, list of tables etc. The LaTeX program has inbuilt typography rules and complains if the document breaks these rules.

DSV has a LaTeX-web with introduction texts, templates, the checking of spelling and links to both English and Swedish documents dealing with LaTeX. If you are writing the thesis with someone else then LaTeX can integrate with a version management system that can exist on DSV's computers so that the thesis can be automatically backed up.

LaTeX also has a commentary function that allows you to hide text that you don't want to discard, but don't want to include in the printed version. There is also an LaTeX template that automatically creates a format that is suitable for a master's thesis.

LaTeX is free and almost every operating system has a LaTeX distribution that is easy to download and work with at home. There are specific LaTeX editors, that show the text distribution, offer assistance with formatting codes etc. All these are available on DSV's LaTeX-web [<http://www.dsv.su.se/datorer/latex>].

## 7.2. Page format

A4 page format

12 points font size

Times New Roman font

Straight margins

1.5 line spacing

Page number at bottom, middle of page. Page numbering starts at the first page of chapter one. The pages preceding this are to be numbered in Roman style, that is abstract, table of contents, (acknowledgements and) (table of figures).

## 7.3. Thesis structure

This section specifies the structure of the contents of the thesis.

### **Title page**

The following text must appear on the title page and must be centered:

Thesis title

Authors

Department of Computer and Systems Sciences

Stockholm University / Royal Institute of Technology

(Final seminar-) month, year

Footnote: This thesis corresponds to 20 weeks of full-time work for each of the authors.

### **Abstract**

Heading 12 points Arial

Text 11 points, Times New Roman

The abstract should be able to be read alone. It should be self containing, that is containing no references, abbreviations, or anything else that forces the reader to read the thesis to understand what is meant. It should entice the reader to the whole thesis. It must not be more than one page long. It includes 1) short descriptions of the problem, 2) the method used to solve the problem and 3) a summary of the main results.

### **Table of contents**

Heading 12 points Arial

Text 11 points, Times New Roman, Italics.

Contains three levels of headings

### **Headings**

Only three levels of numbered headings are to be used. The specifications for the format of the headings are in this section.

#### **Level one**

20 points

Arial

Bold style

18 points before

12 points after

Numbered

**Level two**

16 points

Arial

Bold style

12 points before

6 points after

Numbered level 2

**Level three**

12 points

Arial

Bold style

6 points before

0 points after

Numbered level 3

**7.4. Figures and tables**

Figures and tables numbered continuously but separately.

For example, Figure 1, Figure 2, Table 1, Table 2.

Figure/table number and text under figure/table, 11 points, Arial.

To ensure that the figures/tables are readable, print them out and have look at them.

Do not use colors since the thesis is printed in black and white only.

Use the same format, font and style for all figures.

Use the same format, font and style for all tables.

**7.5. Abbreviations**

Explain what each abbreviation means, the first time it occurs. If an abbreviation is commonly used as a word, it does not require explanation.

**7.6. Quotes**

Quotes are precise copies of small portions of text. Quotes are to be used sparingly, when a central point is to be presented.

Times New Roman

11 points

6 points before

6 points after

3 points indent before

3 points indent after

## 8. Opposition

*This chapter includes instructions for completing an opposition report.*

As mentioned earlier each student must be an opponent to one other thesis at a final seminar. It is the student's responsibility to find, choose and sign up for these seminars that are to be found in a specific First Class conference. Each individual student who is an opponent must complete the following opposition report for each thesis. This report must be sent to the thesis advisor prior to the final seminar and the thesis authors at the final seminar. The report must be of at least 1000 words.

\*\*\*\*\*

Opposition report

Written by:

Opposition to:

Date:

### **PART I - Introduction**

1. Does the title reflect the contents of the thesis?
2. Does the list of contents show all the parts of the thesis?
3. Does the background/introduction explain the context of the thesis?
4. Is the problem explained in the context of the subject area and the state of the art?
5. Are the goals and purpose of the thesis well explained?
6. Are the criteria for goal fulfillment described?
7. Is there a research method used and is it explained sufficiently?
8. Are the potential benefits, originality, relevance and usefulness explained?

### **PART II - Data**

9. Has all the data that has been collected been presented?
10. Is the collected empirical data presented in a comprehensible way?
11. Is there a systematic analysis of the empirical data?
12. Is the method for data analysis systematic and scientific?
13. Have conclusions been drawn based on the analysis of all the data?
14. Have any difficulties/discrepancies in data collection/analysis been discussed?

### **PART III - Conclusions**

15. Is there a presentation and discussion of the results?
16. Is there a discussion of the consequences of the results?
17. Is there a discussion regarding the degree to which the thesis goal has been achieved?
18. Is there a discussion of alternative ways that the thesis could have approached by?
19. Is there a discussion of the difficulties encountered while writing the thesis?
20. Is there a presentation potential further work that could be pursued?

#### **PART IV - Other**

21. Are all the references in the reference list used in the text?
22. Does the referencing following the prescribed format?
23. Does the thesis follow the format prescribed
24. Is the language/grammar/spelling sufficient?
25. Is the terminology used explained to a sufficient degree?
26. What is particularly good about the thesis?
27. What was particularly bad about the thesis?
28. Other comments.