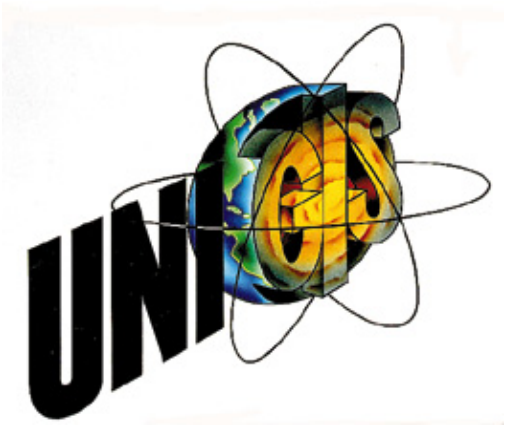

UNIGIS Amsterdam

Master of Science
Research Project and Thesis

Study Guide Part III – MSc
(2008-2009)

vrije Universiteit amsterdam

Educating GIS Professionals Worldwide

This UNIGIS Amsterdam Master of Science Study Guide provides the information needed to successfully carry out an MSc Research Project and write an MSc Thesis at UNIGIS Amsterdam. Every third year student is advised to read this part of the Study Guide carefully and keep it for reference.

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Preface

This is the first complete MSc Study Guide on how to perform an MSc Research Project and how to write an MSc Thesis. This study guide is based on a thesis manual from the Faculty of Economics and Business Administration (Camfferman and Gelderman, 1999[1]) and compiles a pile of separate UNIGIS MSc texts and documents.

The study guide contains guidelines for choosing an MSc subject, how to get a supervisor, writing the MSc thesis itself and doing the necessary research to come to this point. It is meant as a resource for part-time distance-learning students of the UNIGIS Master of Science in GIS.

I would like to express my gratitude to Margaret Jones, former MSc Thesis Co-ordinator of UNIGIS Amsterdam, for having written the most part of this study guide in a first version of an MSc Handbook. Her handbook was the main source for this new study guide.

Amsterdam, December 2008

Jasper Dekkers, MSc Co-ordinator

Disclaimer

Although every care has been taken to ensure that the information given in this MSc Study Guide is correct at the time of publication, UNIGIS cannot accept any liability arising out of possible errors in this MSc Study Guide. Should you find any errors or have questions, remarks, suggestions for improvements of this study guide, please contact the author.

[1] Camfferman, K. and M. Gelderman, *Scriptiehandleiding Doctoraal*, VU Amsterdam, 1999.

Table of Contents

1. Introductory remarks

1.1. About the MSc in GIS

An MSc qualification is an internationally recognised level of achievement. UNIGIS is able to offer you the opportunity to graduate with an MSc in GIS by completing our advanced MSc programme. Rules about how to apply for the UNIGIS MSc can be found in the Education and Examination Regulations.

You have already successfully completed all your compulsory modules and workshops and are now facing the MSc Research and Thesis stage of your training. The MSc in GIS consists of a research thesis prepared by you with the support of experienced supervisors. The MSc provides you with the opportunity to investigate a topic of your choice in some depth. Your supervisors will help you to develop skills in problem definition, research design, project planning and management, data analysis and interpretation and presentation.

Unlike studying modules and doing workshops you now have to make your own timetable, find your own resources and produce the material yourself. The aim of these pages is to assist you in this process, BUT remember - whilst they provide you with the information necessary to get on with the job of producing an MSc thesis, this is still no substitute for discussing your research with your colleagues and supervisors.

The variety of UNIGIS research projects makes it undesirable to impose a strict set of criteria for assessing MSc thesis but students are always assessed on the basis of their ability:

- to demonstrate knowledge and understanding of their topic, including an ability to recognise the value of their research findings to the broader body of knowledge,
- to select and implement research methods and to evaluate their appropriateness,
- to develop skills and apply techniques and to assess their effectiveness.

Because it is only a thesis in part fulfilment of an MSc it is important to realise that you are not necessarily expected to make a substantial or novel contribution to knowledge. The MSc is a training programme and therefore it is important to demonstrate that you *could* make such a contribution and that by learning from your experience you would successfully implement research at the next opportunity. For example, a critical evaluation of your findings might lead to recommendations for further research. Alternatively, you may develop sophisticated skills but the main criterion in this category is the selection (and correct application) of appropriate techniques i.e. effective for the specified task.

One word of caution: The MSc thesis is only in part fulfilment for the MSc, you have already completed all modules and workshops - don't try to make a PhD out of it!!

1.1.1. Criteria for Assessment of the MSc Thesis

As an aid to judging what is required, there is a list of criteria that have been used previously in the assessment of a similar type of thesis. The criteria are structured into three sections. In the first section (criteria 1 - 11) are general matters relating to the problem and the quality of the approach. In the second section (criteria 12 - 17) are matters related more specifically to content. Finally are criteria 18 - 33, about a set of specific issues of the thesis from balance to technical precision in format. It is worth mentioning here that an examiner will consider such a list either explicitly or implicitly,

consciously or sub-consciously, but will have no fixed marking system. The judgement will be on the overall impression. It is impossible to justify fully impression marking or to describe precisely how it works. It is based on discussion and consensus between experienced examiners. It is possible to say that the most important criteria in examiner's minds are those in the first set.

(a) Criteria of a general nature

1. The currency and relevance of the research.
2. The clear identification of an issue or problem to research.
3. The range and appropriateness of source materials with evidence of the use of research papers.
4. Timeliness and accuracy of references.
5. Conceptual and methodological rigour.
6. Critical and analytical justification of standpoints and strategies adopted.
7. Evidence of a concern for professional and individual values and needs.
8. Practical application of the research.
9. Changes resulting from the research.
10. Significance of outcomes in relation to professional role.
11. The evaluation of the research.

(b) Criteria relating to content

12. The overall structure.
13. The appropriateness of the abstract.
14. Referencing in the text and reference list conforming to the Harvard System.
15. The writing style (impersonal).
16. Clarity and accuracy in respect of the use of language, syntax, spelling and punctuation.
17. Observance of accepted norms of scholarly presentation.

(c) Specific criteria

18. The details, accuracy and form of the Table of Contents.
19. The balance of the chapters.
20. The quality and pertinence of the introduction.
21. The relevance of the review of literature.
22. The clarity and appropriateness of the research design.
23. The choice of appropriate methodology.
24. The correct use of the methodology.
25. The appropriate treatment and interpretation of the data.
26. The coherent reporting of the findings of the research.

27. The critical evaluation of the research (conclusion).

28. The details and accuracy of the reference list (on the Harvard System).

29. The correct use of appendices.

30. The correct use and indexing of tables, diagrams, etc.

31. The clarity and accuracy of the presentation including page numbering and typing.

32. The appropriateness of the binding, cover and lettering.

33. The meeting of specified deadline dates initially with the unbound version and, if satisfactory, the bound thesis.

Most of the implications of these criteria for the student are clear. It might by useful, however, to amplify some, which experience shows, are common causes for concern.

1.2. General sources for doing MSc research and writing a thesis

There are numerous general texts on how to successfully complete an MSc project. The texts are very different with regard to the focus of your MSc research project. Four texts that previous students have found useful are:

- Bell, J., 1991. *Doing your research project: A guide for first time researchers in education and social science*. Open University press. This handy book is aimed at the practical problems related to planning, executing and interpreting empirical work in the education and social science fields.
- Benyon, R. J., 1993. *A researcher's companion: Postgraduate study in the biological sciences*. Portland Press. This book deals with the logistics and management issues of research. It is aimed at PhD students but has a wealth of practical advice.
- Mayntz, R., Holm, K. and Huebner, R., 1976. *Introduction to empirical sociology*. Penguin. This is an excellent introduction to the issues which link ideas, theories and techniques in the social sciences.
- Parsons, T. and Knight, P. G., 1995. *How to do your thesis in Geography and related disciplines*. Chapman Hall. London. This text is for newcomers to research and asks all the obvious (but important) questions such as How do I do it? Should I model? And Help, it's all gone horribly wrong. What can I do? If you are doing a `classical' scientific study then this is a useful reference.

And for those who prefer guidance in Dutch:

Opzetten van een onderzoek

- P.J.M. Verschuren, *De probleemstelling voor een onderzoek*. 1992, vierde druk. Aula 134. ISBN 90 2746 2879 (170 pag) Uitgever: Het spectrum BV, Utrecht.
- G. Kuypers, *ABC van een onderzoeksopzet*. 1992, vijfde druk. ISBN 90 6283 580 5 (150 pag) Uitgever: Coutinho, Muiderberg.
- A.H. van der Zwaan, *Organisatie -onderzoek*. 1992, tweede druk? ISBN 90 232 2558 9 (160 pag). Uitgever.: Van Gorcum, Assen.
- D.B. Baarda, M.P.M. de Goede, *Basisboek Methoden en Technieken*. 1996, tweede druk. ISBN 90 207 2589 0 (300 pag). Uitgever.: Stenfort Kroese

- F. Wester. *Strategieën voor kwalitatief onderzoek*. 1995, derde druk. ISBN 90 6283 896 0 (220 pag). Uitgever.: Coutinho, Muiderberg

Schrijven van een scriptie

- P. Nederhoed, *Helder rapporteren. Een handleiding voor het schrijven van rapporten, scripties, nota's en artikelen in wetenschap en techniek*. 1993, vijfde herziene druk. ISBN : 90 31311987 (300 pag) Uitgever: Bohn Stafleu Van Loghum, 1993
- B. Overduin, *Rapporteren. Het schrijven van rapporten, nota's, scripties en artikelen*. 1990, derde druk. Aula 133. ISBN 90 274 2743 7 (300 pag). Uitgeverij: Het Spectrum BV, Utrecht.
- R. Geel, *Hoe zet ik mijn gedachten op papier*. 1991, vijfde druk. ISBN 90 6283 855 3 (160 pag) Uitgever.: Coutinho, Muiderberg

Projecten en projectorganistie

- G. Wijnen, W. Renes, P. Storm, *Projektmatig werken*. 1991, achtste druk. Marka ISBN 90 274 33283 (250 pag). Uitgeverij: Het spectrum BV, Utrecht.

1.3. Managing your own Research

A thesis should be regarded as one form of project that has to be managed. It would be foolish to attempt to be prescriptive about how the thesis project should proceed. Too much depends on the nature of the problem, on the individuals' priorities and on the relation between student and supervisor. There are nevertheless, many points of advice based on experience that are of general nature and which will help individuals to structure and focus a research programme.

1.3.1. Who is the manager?

Broadly speaking there are two ways to run a research project. Either as a predetermined programme structured by the supervisor or to have a student as project manager. Both are extremes and in reality a mix of ways will happen. However, the distinction is important in determining who is making the running and controlling events. Both extremes have their dangers; over-supervision can be restrictive, under-supervision can lead to loss of objectives.

In the situation of part-time, at-a-distance research, over-supervision is unlikely and the problems you will face, as a student is the problem of the sole project manager. You will need to be aware of objectives, milestones, monitoring and corrective measures to a greater extent that the conventional postgraduate students. Your experience in successfully completing the first stages of this course should stand you in good stead. One thing you will have learnt is the importance of keeping in touch with your supervisor in order to get a balanced view of how you are getting on. The difference this time is that you have to provide the material that allows the assessment of progress and you have the first responsibility for maintaining contact.

1.3.2. Keeping track of all your work

Of course, it goes without saying that you should expect to work hard. Doing research may sound chic to some but the reality of research is of sustained commitment, hard

work and criticism. It is crucially important in the early stages that you establish a framework or pattern of work both independently and with your supervisor. This framework should include your keeping notes on what you do whether it is reading or empirical investigation or development in technique. You should record failures, blind alleys, and marginally relevant events as well as what you expect to or what actually succeeded. You will have to reconstruct an argument from your notes so they should be clear, full and detailed. Ask yourself whether you can describe today what you were doing in a particular task one year ago? The same situation will face you as you write up your work. ***Our suggestion to you would be to keep a logbook during your research***. This is not something we will ever want to see but in it you can jot down ideas, contacts even good quotations from the literature. It should be a working book a bit like a diary of your project. Do not fall into the trap of thinking that it should be tidy and well organised. If this is your individual character then fine but if not just use the logbook to keep things together and track your thoughts. You will find this book a great source of inspiration when you come to write up your project, no matter how many different colours of ink it is written in.

1.3.3. Develop your writing skills

Also during the early stages of work you should develop your writing skills. Do people find your writing difficult to understand? Did you receive criticism during the previous modules? You need to face the fact that your success does not depend on hard work, intelligent investigation or brilliant ideas. It depends on how these are written up. So, in your work you should establish a habit of writing material that is submitted to your supervisor for critical assessment. A simple technique is to identify and then write for your audience. A rule of thumb is to assume that your audience is intelligent people with reasonable - but not expert - knowledge of your chosen topic.

The final stages of your work will (or should) be concerned with writing up. Two points are worth making at the outset. First, do not expect to write up quickly. Actually writing and then producing a thesis can take a lot longer than you expect. Plan ahead. Secondly, expect to rewrite a considerable proportion of your work. The critical comments of your supervisory team should prompt rewriting as you go along, but during the final stages, when the whole structure of a thesis can be seen and the flow of ideas better appreciated then rewriting is expected. It is worth mentioning that experience shows much merit is achieved by rewriting.

1.3.4. Planning - create milestones

As your work progresses you will need to bring into your project management those elements that are going to maintain the momentum of work. Create milestones for yourself, both in terms of completing work and in terms of writing. Develop a thesis plan as early as possible, though you should recognise that it is likely to change. Produce draft chapters or sections as part of your milestones. Also, develop your use and appreciation of the literature. Incidentally, do not make the mistake of thinking that "the literature" is a job or chapter that is completed as a discrete part of the sequence of writing a thesis. Your use of the literature is something that develops as your work progresses and which should permeate the entire thesis, not merely one section of it.

1.3.5. Time is of the essence

Throughout the thesis your project management will face the common enemy - time. Experience shows that every student faces this problem in one form or another. The important thing is to know what situations use up time and throw your plans off course.

A number of common causes can be recognised and you and your supervisor should be aware of them.

One frequent problem is that starts are slow. Defining your research problem, checking sources, getting permissions and similar jobs can easily take up more time than anticipated. In some ways these delays are unavoidable and you will be reluctant to change topic and incur other, perhaps worse delays. You should try to minimise these delays by identifying how you can go ahead without some elements of your plan in place and by working out the options in the event of different outcomes to your preparations.

Another major cause of delay in work is perfectionism of the student. This is our old friend, the best being the enemy of the good. The research mode of working engenders perfectionism. Learn to recognise the diminishing returns and have the courage to stop work that is not materially advancing your main line of enquiry or argument.

A similar time wasting situation is distraction from the main topic. You can easily find interesting, absorbing and perhaps important topics to investigate, either empirically or through the literature. Do not be sidetracked even if you can see the new issue is perhaps more important than your current one. Your problem is not to solve the world's problems but to demonstrate that you can undertake research and write a thesis.

A further problem is inadequate collation of data. This reveals itself during writing up when the student finds that the results they had interpreted on the basis of their data and observations are not borne out by analysis. They have to go back over data or even collect extra. This is due to a lack of planning in the handling of material.

Finally, you should recognise that the nature of research means that new problems, issues and questions arise. The results of research may throw plans off course in unavoidable ways. You should - and this is a difficult skill to master - try to anticipate possible outcomes of your investigations and you should recognise unforeseen results as they arise, be prepared to respond to them and not turn a blind eye. The important thing is that these problems can be minimised and managed if you have established a good framework for working with your supervisor. Regular contact, writing, criticism and a trusting relationship will provide the surest way to meet and overcome difficulties.

1.4. MSc - Selecting a Research Topic

1.4.1. Proposing a Research Topic

A thesis provides an opportunity for you to investigate a topic of your own choosing. Experience shows, however, that selecting a topic is not a simple and straightforward task - indeed the research experience of many students is that the topic evolves and new research problems emerge as the work progresses. In many cases this is inevitable, indeed welcome, but there are dangers if this evolution of objectives is too radical or too late. It helps enormously if the research topic is well defined at an early stage and leads to a structured programme of work. Ideas for projects may come from numerous sources - your own experience, the Diploma modules, colleagues, journals or previous studies. The list of MSc theses includes projects on:

- AM/FM * GPS * Project design and analysis
- Decision support systems
- Implementing GIS and organisational issues
- Project management

- Development of the GI industry
- Internet mapping
- Remote sensing
- Education and training
- Metadata
- Spatial analysis and modelling
- Environmental analysis
- Open GIS
- Visualization and virtual environments

The source of a particular topic that provides the stimulus for research is, in itself, of less concern than how you develop your interest. The important issues are how that interest is translated into a research problem and how that problem is approached.

1.4.2. Refining a Research Topic

At this point it is useful to consider some of the criteria against which a thesis will be judged. In most examiners' minds there are concerns that relate to:
- the currency and relevance of the research, and
- the research topic as a problem.

We need to examine what these ideas mean. The first is about the academic context of a problem. A research problem must relate to the body of ideas currently under discussion by the academic community or by professionals in a particular sphere of interest. Old problems may be interesting but their solution does not fit into the development of ideas in the same way as the solution of current problems. For example, the raster-vector debate may be absorbing but it does not hold much attention at the research edge these days. By extension, the research problem must be relevant to a body of ideas that is accepted as *bona fide*. The role of Zen Buddhism in GIS might catch the eye but it will be difficult to justify your research to examiners.

Two further comments:
- select a topic that you are genuinely interested in or committed to - it is your MSc and you have to live with the project for almost a year.
- open you mind to as many projects as possible - talking to colleagues is one source of ideas but often the most profitable lines for research come from reading the published literature and in particular academic journals. These are, by definition, full of the results of research and it is worthwhile visiting a local university library or contacting your professional organisation.

At this stage it is useful to ask the question - **what is research?**

The Oxford English Dictionary defines research and development as 'work directed towards the innovation, introduction and improvement of products and processes' in which research is the systematic investigation into and study of materials, sources and ideas in order to establish facts (sic) and reach new conclusions.

At a general level, and at the risk of being repetitive, we can say that the problem has to relate to a body of ideas and the product of research must relate to general ideas. If you were to look into how GIS helped the planning of transport in City A and you showed how it did but you have nothing at all to say which might have relevance to City

B or City C then you will have failed in some way. The problem you devise and the products of your research must both have general and theoretical relevance. Your examiner will need to see clearly how your specific findings are built into a wider body of ideas.

1.4.3. Typical Research Projects

The MSc Programme Board has identified four typical projects that have been completed by UNIGIS students. They are:

Work-related study

Many students undertake projects that are related to their employment but are not an integral part of their normal responsibilities. Your employment provides good access to a rich case study, which is likely to include knowledge of internal procedures and use of data, hardware and/or software. The key to success is to let your research be driven by a research issue/problem NOT the case study - use the case study to investigate your selected topic. Some students have found it difficult not to become embroiled in internal matters and to neglect events that are happening (or have happened) in other organisations - can you identify the context for your work? What are the general lessons to be learnt?

Work-dependent study

In your employment you are responsible for either producing a new product, designing or implementing an information system or reviewing organisational procedures. These projects are very tempting as thesis topics and have formed the basis for some excellent research. You benefit from direct support from your employer (time, equipment, privileged access to senior managers) and there can be considerable satisfaction on completion. The most likely problems are either (i) you have to compromise your study due to organisational procedures and select techniques which are inappropriate for the precise demands of your research or (ii) a failure to undertake a critical evaluation. In the latter situation students have tended to provide a commentary on events with limited analysis and, sometimes, no attempt to compare their findings with those of other studies. A further difficulty can arise if students are less than systematic in their evaluation. It is very rare that there is conclusive evidence that an organisation is totally useless or absolutely perfect - it is more usual to find that some things work well and others don't. Therefore, students must avoid the temptation to 'moan' or 'hype' their findings for the sake of internal politics. Are you prepared to take a critical look at your organisation - and publish your findings without being tempted to put a spin on the results? These projects can be more difficult if at the same time as writing your thesis you are also preparing an internal report.

A more general consideration which applies to all projects but which we can deal with here is the issue of research which 'fails'. A product or system that fails to deliver a favourable outcome can make an excellent MSc project - even though you might not be that popular within your organisation. I estimate that 80-90% of my research has failed in that I was unable to prove the validity of an idea (we will return to this notion of failure when we have a look at the concept of the Null hypothesis). The research benefit is being able to explain why it didn't work out as expected - and to use those findings to generate new ideas or make recommendations for further research.

MSc projects are expected to be completed in a relatively short period of time and you should make sure that you can carve out a niche for your MSc even if the main project is scheduled to run over a much longer time period. For example, produce a prototype or proof of concept rather than a fully operational system.

The ultimate weakness is that your MSc depends on the commitment of your employer. UNIGIS has experience of students in organisations which are restructured or change ownership and other students who found the budget for their project was suddenly withdrawn. These risks need to be considered before you start a work-dependent project.

New field of study

Are you tempted to explore beyond your existing expertise, to investigate something totally different? We have a diverse range of interests within the Course Team and, if necessary, can also call on experts from within our Universities. Every year some students decide they want to develop completely new knowledge or skills and use the MSc as an opportunity to do so. Recent examples include Earth observation by remote sensing, GPS, web-based GIS, GIS education and training.

The usual difficulty faced by these students is the time it takes to get up to speed with new concepts, terminology and technology. Unless early progress is good it may be difficult to make a useful contribution to knowledge by the end of the MSc. Although this is not a critical achievement for the award of MSc it is likely to influence the mark awarded for your efforts.

Classic academic study

These projects develop an idea or explore an issue with which you are already familiar through the Diploma modules or your professional experience. They are often seen as the classic model of research and they have the benefit of having roots firmly established in the current level of knowledge. Indeed, the most likely weaknesses are caused either by students relying on ‘old’ knowledge and not identifying current thinking or when a student attempts to solve an insurmountable problem given the available resources. Solutions tend to be very simple (i) read the literature (and read it again... and again) before defining the research problem, (ii) discuss the project with colleagues and supervisors to identify all issues (or as many as possible) before starting the research, (iii) constrain the scope of the research to a single issue and (iv) don't believe everything you read - research only leads to advancement of knowledge if we are prepared to challenge existing thinking on a subject.

I'm sure that you realise that many of the issues highlighted for a particular project type are equally applicable to other projects. Some of you will also develop research that include elements of more than one project but you should use this simplified list to guide you through the early stages of project selection.

1.4.4. Developing a Research Problem

Within any project there is a need to be sensitive to a clear and precise definition of your research problem. We can clarify what we mean by this. The issue revolves largely around the translation of an idea into a concrete measure. We might, for example, want to investigate how to make GIS more effective in the retail sector. The problem with this project is the vagueness of the term ‘effective’. What do we mean by effective? We cannot measure effectiveness itself, but we can measure some property that we interpret as having something to do with effectiveness. Such a property might be, for the sake of argument, the precision with which potential customers can be identified by using GIS. If this was so, then we can define and measure precision. We can identify improvements in precision and compare different situations with some measure of precision and interpret what these results mean in terms of effectiveness. In other words our study would be dealing with empirical evidence, testable statements and relations to general ideas. We should avoid defining our problem in terms of such

things as 'social goals', ideas of better or worse (which are matters of opinion), and everyday phrases which have no specific, scientific or technical meaning.

The early stage of research is a time when you should consider most carefully the terms of reference, scope and deliverables (e.g. a theory, procedure or product) of your project. The decisions you make at this early stage of your work will control ALL your subsequent work. It can be extremely difficult and complex to try to retrieve a viable justification for research once the work has been carried out. My advice is to discuss your ideas with someone who understands your field - a colleague or your supervisor are obvious candidates.

1.5. The role of the Supervisor

You should expect to receive support from your supervisor in two ways. First, and most important, is in selecting and analysing a research problem. The second way is ensuring that you make good progress and that you comply with University regulations.

It is not possible to give much concrete advice on the first type of support, either to the student or to the supervisor. Both have a responsibility for establishing and maintaining a *modus operandi*.

Two points are worth making about the academic relationship. First, try to establish good personal relations. It is not possible to work together as supervisor and student if there is animosity or lack of trust. Secondly, make contact frequently and discuss written work. Do not make the mistake (and it is a serious mistake) of thinking you can develop ideas alone. Working in isolation is usually disastrous. As in any other project there is a need for a structured programme with a system of monitoring.

Responsibilities of supervisors and students generally come into sharp focus only when things go wrong and together they have to identify what are the causes of a problem. A student can expect a supervisor to give guidance about the nature of research and the standard expected. This is often most effective when it is part of the assessment of the student's own work. There is also a responsibility for giving advice on literature and the issue of plagiarism. Students should be made aware of current developments and the timeliness of problems. Part of this responsibility is, where appropriate, to make arrangements for meeting other experts, for attending seminars and for presenting results of work.

Supervisors have responsibilities for ensuring that the student produces a thesis. This involves requesting chapters to read and criticise, monitoring the progress of thesis production and advising on presentation. In addition supervisors have a responsibility for ensuring that administrative matters relating to submission and examination are dealt with efficiently and effectively. Where students are setting up or using computer files with data on individuals, the supervisor should advise on the requirements of the local data protection laws and whether the students work is covered by the university registration with a data protection agency.

1.5.1. Agreement between MSc student and supervisor

If desirable, the role of the supervisor and the responsibilities of the MSc student can be formalized in a kind of contract, stating the agreements they make. A standard form for this is:

On the part of the Supervisor

I undertake:

- To have regular contact with you either in person or by email to discuss your work, according to a time-schedule agreed at the beginning between the two of us.
- To keep you informed about long periods of absence which might affect our contact and communication.
- To return work to you within four weeks of the day it is received under normal circumstances.
- To give regular feedback on your progress and to make suggestions and discuss ideas for future work.
- To take appropriate measures to ensure that the thesis is truly original and is not subject to plagiarism.

As the student

I undertake:

- To draft a workplan and time schedule for the completion of his/her thesis and keep the UNIGIS office and the Supervisor informed of any changes.
- To have regular contact with the Supervisor to discuss work in progress according to the time schedule in the workplan.
- To prepare an agenda in advance, and make a summary afterwards, of the issues discussed at the supervision meeting and send a copy to the Supervisor, to be kept as a formal record of the meeting.
- To keep the UNIGIS office and the Supervisor informed about periods of absence which might affect our meetings and communication, and about other factors such as change of address.
- To deliver work to the Supervisor at the time agreed in the workplan.
- To process feedback from the supervisor and work on ideas and suggestions that have been jointly agreed.
- To agree a timetable within which work will be undertaken over an academic year.
- To ask for help with academic and personal concerns.
- To ask for guidance about research methods and training.
- To identify hindrances to academic progress, to discuss them in supervision and agree on an action plan to minimise or overcome the difficulties.
- To provide feedback on the experience of supervision.
- To ensure that the MSc thesis is truly original and not based on a compilation of the work of others, and to make certain that all information used is correctly referenced.

Date and place, *Date and place,*

Signature Supervisor *Signature MSc student*

1.5.2. Supervision of MSc students living outside the Netherlands

Most of the material in this Study guide will apply to you, but it will not be easy for you to come into the office in Amsterdam to discuss the progress of your work. It is possible that we will appoint an extra supervisor; someone in your own country who can give you some support during the course of your work. Usually this will be someone from your local UNIGIS site who is familiar with your work.

You will still have a supervisor in Amsterdam, and you will need to keep both supervisors informed of your progress. It will be necessary to come to Amsterdam at least for the final examination, but this will be arranged at a time convenient for you.

1.6. Language and writing

First, the choice of language: it is normal that you submit your thesis in English, but in exceptional cases it is acceptable to write it in Dutch. The following comments about writing clear and plain English however, apply equally well if you are writing in Dutch.

The purpose of language is to transmit ideas. The hallmark of good writing is clarity and organisation. To write well you must have your ideas organised. This means you must have some strategic overview of what you want to write and the ability to produce ordered sequences of statements. The necessary logic of your argument must unfold as one reads successive sentences and paragraphs.

Writing should be structured not only at the strategic level, but also at the 'tactical' level. That is, our sentences and phrasing must be clear and logical. Construct sentences around single ideas.

Avoid sub-clauses, detailed qualification of points and complex strings or argument. Break complex things down into simple ones. In all that you write try to use what Gowers calls "plain English" (Gowers, 1986). Plain English means avoiding pomposity, vagueness, tautology, clichés, jargon (where inappropriate) and 'adorned' words where plain, simple words and phrases will do. Plain English is a question of the choice of the correct word as well as of structuring word sequences.

In scientific writing (try to avoid the term 'academic') you should try to use the third person. It is the natural style of disinterested, impartial and critical writing. It helps you to avoid the use of opinion as fact and to structure arguments.

You should get into the habit, or improve the habit, of going over what you write in order to improve your use of English. Remove unnecessary or misleading words and phrases. Everyone has his or her favourites. For example, 'very', 'obviously' and 'basically'. The first rarely adds emphasis. The second is used invariably when something is far from obvious. The third has no meaning in most usage. Probably you have your own list. Try to extend it and refine it by consulting texts on writing English, such as:

Gowers, E., 1986, *The Complete Plain Words*., London: Pelican

Wood, F.T, Flavell, R.H. & Flavel L.M., 1987, *Current English Usage*, London: MacMillan.

When writing, try to produce whole first drafts of chapters for re-writing and for criticism by your supervisor or by others. It helps the reviewer if whole chapters (at least) are considered at once, since so many elements of judgement rely on being able to relate different parts of the structure and on appreciating major sections of your argument.

1.7. Size and Layout of the Thesis

It is virtually impossible to make a definitive statement on the ideal size of an MSc thesis. The ideal length is that in which the subject can be treated with sufficient depth. It is practically out of the question that more than 150 pages of main text are needed to reach this goal. In general, 50 to 100 pages suffice. When lots of tables, graphs and maps are included in the main text, more pages are needed of course.

With regard to layout of the thesis, the following guidelines are applicable:

- The thesis should be typed, with 1.5 lines spacing, on white A4 size paper using one side of the paper only with margins of width at least 2.5cm.
- Use a clear font e.g. Arial, Helvetica, size 10.
- All pages should be numbered consecutively.
- Drawings, maps or other material should be included within the main body of the text.

Large maps, etc. may be included in folded form in the back of the thesis.

- All graphics should be numbered consecutively.
- Computer disks containing data sets or run time demonstrations may be included in appropriate pockets attached to the inside back cover. References to your own WWW site are also acceptable.

1.8. Examination Procedures

Your thesis will be independently assessed by Professor Scholten and your supervisor, before examination by external examiners.

Where appropriate, the examiners may require that a candidate provides a demonstration of any software, database, or application that has been developed as part of the research.

After submission of your thesis, you will be expected to make a presentation about your work in front of the examiners.

The exact procedure is as follows:

1.8.1. Delivery of your MSc thesis and finalizing your MSc

Step one: examination by your supervisor and the chairman of the Examination Board

When your thesis is finalized, submit **2 copies** (soft bound, just sufficient for reading by others) to the Unigis office. These will be examined by your supervisor and by Professor Scholten. You may receive feedback at this stage suggesting that you make some alterations.

- **If you are asked to make some changes** to the version submitted, after making the changes submit **2 more copies (**soft bound) for examination by the external examiners.
- If nothing is to be changed, then the original copies will be passed on to the external examiners.

Step two: examination by external examiners
The next step is thus two external examiners reviewing your thesis. Two things can happen:

- Your work is approved. In this case the examiners inform your supervisor and the Examination Board of their approval.
- You are asked to make some final changes. After making the changes, **resubmit two copies** to your supervisor. He will give them to the external examiners for re-examination. Theoretically, this procedure can repeat itself until the examiners are satisfied.

Step three: deliver the final copies
When you have heard that your work has been accepted, we will ask you to produce **3 more copies** (1 for the university and 2 for our own Unigis archive); and we would like **one electronic copy** (word- or pdf-format) to be placed in our MSc archive on our website. When confidential research and/or data is included in the MSc Thesis, the student has the right to refuse publication of this digital copy on the UNIGIS website.

See for more information on thesis regulations Article 20 of the Classes and examination regulations.

1.8.2. Public defence of the Thesis

The public defence of the MSc Thesis will normally take place before the final examination. The date and location of this session will be settled with you. Often, UNIGIS events are selected for this defence. The setup is as follows:
- 10 minutes presentation by the candidate
- 5 minutes discussion

At least two UNIGIS staff members are present at the public defence of the candidate. They will assess the defence and inform the supervisor and MSc Thesis co-ordinator of the outcome.

1.8.3. Examination at the VU

The final defence of the MSc thesis will take place at the VU in a closed session with the Examination Board. The Examination Board will consist of at least 2 professors.

Bring along your **passport** and your BSc/MSc **diploma** from college/university, and transcript of your Unigis modules and workshops

The university's exam forms must be filled in with your data and all course fees must have been fully paid up at this stage.

When all formal procedural things have been checked and found to be all right, the exam will take place. The exam will last for 45 minutes and is setup as follows:
- 15 minutes presentation by the candidate
- 15 minutes discussion by the Examination Board
- 15 minutes evaluation

1.8.4. The Decision

On the basis of their assessment of your thesis, the examiners may decide upon one of the following outcomes:
- If your thesis and presentation satisfy the examiners, you will normally be awarded the degree of Master of Science in Geographical Information Systems.

- If your thesis is not quite up to standard, you may be asked to make good minor blemishes of presentation or fact and to return the corrected thesis within three months for reassessment by the examiners. You will be then be awarded the degree of Master of Science in Geographical Information Systems, subject to the amendments requested by the examiners having been made.

- Where your thesis has in the opinion of the external examiners irretrievably fallen below the expected standard, a failure will be recorded. Students whose MSc thesis fails will retain their eligibility for the award of a Postgraduate Diploma.

When the Examination Board decides you have fulfilled all the requirements of the MSc curriculum, the Master's degree will be presented to you at the end of the examination at the VU or at another occasion, preferably a UNIGIS event. You will sign for its receipt in the Unigis MSc Student Book.

1.9. After the MSc

When you have successfully completed your MSc, you will have reached the end of the formal Unigis study programme. However, most people feel that they want to keep in touch with the new friends and contacts they have made over the study period. We now offer a way to do this through the Unigis Alumni Association; you will become a member automatically for the first year after you finish the MSc. There will be a website, accessible from the Unigis site, and at least one meeting per year for Unigis alumni. Information about other Unigis activities will be provided and a member list will be maintained.

2. Structure of the Thesis

2.1. General

On the cover of the thesis, at least the full title of the thesis (main- and sub-title if applicable), the author's name (first and last name), the year of graduation (i.e. "2006") and the words "M.Sc. Dissertation" should be included.

Students can choose for themselves whether they want to present their thesis with a solid cover or not. Also, they are free in adding (an) image(s) to the cover.

2.2. Title page

The first right-hand page in the thesis is the title page. In addition to the title, the candidate's *full* name (the name on your birth certificate or baptismal name) and the date of submission, the following should appear on the title page:

For a thesis written in Dutch

Titel

Subtitel

MSc Scriptie

Volledige naam student

ingediend ter verkrijging van de graad van

Master of Science in Geografische Informatie Systemen (UNIGIS)

Faculteit der Aard- en Levenswetenschappen

Vrije Universiteit Amsterdam

Maand Jaar (e.g. Mei 2006)

For a thesis written in English:

Main Title

subtitle

DISSERTATION

Student's full name

submitted in part fulfilment of the requirements for the degree of
Master of Science in Geographical Information Systems (UNIGIS)
Faculty of Earth and Life Sciences
Vrije Universiteit Amsterdam
The Netherlands
Month Year (i.e. May 2006)

You should also include the UNIGIS **logo** on the title page *or* disclaimer page.

2.3. Abstract

Each thesis requires an abstract. This should be no more than one side of A4, to be placed on the first right-hand page after the title page.

Do not dismiss this brief section as something trivial or easy. It is neither. Always the first and often the only part of your work read by a non-expert, or even by a busy expert, is the abstract. Writing good abstracts is especially difficult. It is in essence the art of précis. You will not be able to express in 300-500 words all your ideas, results and conclusions. Therefore, you must distil and generalise.

Remember that the abstract stands as a statement of your research. It is not a summary or conclusion. ***It contains the essence of your research, including the main elements of your argument and findings***. It is not a commentary on your work

so do not start with phrases such as 'this study is about ...' or use phrases such as 'data were analysed ...'.

Perhaps the best way to develop your abstract writing style is to review a selection of the abstracts before you begin. Most scientific journals and conference proceedings will carry an abstract and so by looking at journals such as the International Journal of GIS you will be able to develop an appreciation of what is required.

Once you have a feel for the structure and content of an abstract the only way to improve is by practice. Prepare short abstracts at regular stages in your research and, before submitting the final thesis, distribute the abstract to friends and colleagues. They should be able to understand the essence of your research.

If you write your thesis in Dutch, it is required to include an English Abstract of approximately 300-500 words on the next right-hand page behind your Dutch Abstract.

2.4. Table of Contents

The next item in the thesis is the Table of Contents (TOC), to be started at the first right-hand page after the abstract. Sometimes, people prefer showing the chapter titles in **bold** and inserting white lines between the end of a chapter and the start of another one. This is fine. The most important thing of the TOC is that a reader can get a quick overview of the contents and structure of your thesis.

2.4.1. Contents and Structure

You can look upon the contents section as a map of the thesis and as a statement of its overall logic. The structure needs careful planning. You should have a reason, which is apparent to the reader, for putting one chapter, or section, after another. Although you might wish to borrow some ideas from the following list you should not simply copy a bland structure;

- Introduction
- Literature Review
- Study Area
- Research Methodology
- Research Methods
- Results
- Analysis
- Discussion
- Conclusion.

A common approach for writing a thesis is to divide your thesis in parts. For instance first you have the introduction, then you start with Part 1 – Theory. This part includes some theoretical chapter with a literature review, some discussion on methodology et cetera. The next part is Part 2 – Practice or Case studies, in which you apply your chosen research method to a selected problem. Often, between these chapter there is a chapter positioned linking theory to practice. In fact this chapter describes the set-up of your case studies according to the theoretical descriptions of the method you use. When you visualize this approach, you can think of the thesis' structure as a kind of

hourglass with the linking chapter exactly in the middle. It often helps to draw a diagram or table of how your chapters are linked to each other. You will get a good overview of the structure of your thesis. In the end, you can include this framework in you Introduction chapter as well, so the reader can also see the structure at once.

Try to think up your own chapter headings and express the reasons for their choice. In other words build your own design into your thesis. Learn to use headings and subheadings and to use a numbering system. Do not take this too far and produce Section 4.1.1.1.4b. Too many divisions in contents may obliterate the logic in design. Be consistent in structuring contents. In general, three levels of headings (i.e. 1. Chapter title, 1.1 Paragraph title and 1.1.1 Sub-paragraph title) are included in the TOC, including page numbers for these headings.

2.4.2. Lists of Figures and Tables

Sometimes students include lists of figures and tables behind the TOC. This is not compulsory, but when you use a lot of figures and/or tables, it is advised.

2.5. Disclaimer

The next section behind the TOC (and possibly the lists of figures and tables) is the signed disclaimer, to be put on the first right-hand page again. You should include the UNIGIS logo on the title page *or* disclaimer page. This declaration states that the thesis is the candidates own work and has not previously been published or submitted in candidature for any other degree or diploma. It should be formulated as follows:

For a thesis written in Dutch:

De in de deze scriptie gepresenteerde resultaten zijn gebaseerd op mijn eigen onderzoek aan de Faculteit der Aard- en Levenswetenschappen van de Vrije Universiteit Amsterdam.

Alle bijstand die is verkregen zowel van individuele personen als organisaties is vermeld. Daarnaast zijn alle gebruikte gepubliceerde en ongepubliceerde bronnen opgenomen in de literatuurlijst.

Deze scriptie is niet eerder gebruikt voor het verkrijgen van een graad aan een instituut.

Getekend:

Plaats, datum,

(Handtekening)

Naam student

For a thesis written in English:

The results presented in this thesis are based on my own research at the Faculty of Earth and Life Sciences of the Vrije Universiteit Amsterdam.

All assistance received from other individuals and organisations has been acknowledged and full reference is made to all published and unpublished sources.

This thesis has not been submitted previously for a degree at any institution.

Signed:

Place, Date,

(Signature)

Name student

2.6. Acknowledgements

After the Disclaimer, on the next right-hand page, you can write your acknowledgements. Of course this is a personal section and no strict rules are given for this part. We would however like to point out that it is good custom to thank companies or institutes here who have provided you with the necessary (geographical) data for your research in case you use any. Also, if you have had a grant or scholarship, it is good custom to thank the provider of your funding in this section.

Work based projects must include full acknowledgement of any relationship between the research presented in the thesis and other projects undertaken by or within that organisation. The acknowledgement should include a clear statement of the contribution made by colleagues and that made by the author. The examiners may request independent confirmation of the information supplied.

2.7. Literature review

Some thesis-subjects are developed from experience at work, which often puts theory and results of earlier comparable research in the background. But for most subjects, there is a vast body of theory available and multiple earlier research attempts can be found in literature. Therefore, in most cases, a thesis will start with one or more chapters discussing theory and research related to the subject. These literature discussions are very dependent on the subject, thus can be very different, but still some general guidelines can be given:

- In scientific literature, quite often articles can be found that solely discuss and compare research results from other articles with regard to a certain research subject. If a certain research subject exists in the field of research you are aiming at, probably your supervisor will point this out to you. But even when your supervisor does not point this out, it can be useful to look for this type of articles, so you can get an idea of how a literature review can be set up.
- The literature review is always submissive to the answering of the main research question of the thesis. This means that the connection to the literature you discuss

and the thesis subject must always be explicitly stated. Not everything that laterally has to do with the thesis subject is relevant. And a thesis is to short to contain all relevant literature. This means that not everything that you have read for your thesis will be used in your thesis in the end.

- When building a literature overview while reading, a useful suggestion is to order the literature according to theme. Try to clarify to the reader what the relation between literature is and whether the overview you give is complete or not. Indicate whether there are certain basic articles everybody in the field refers to. If different movements or schools can be found in theory, you will address these off course.
- Literature reviews often can be included in a table in which in a very concise manner differences can be pointed out to the reader. Mostly, the left column of such tables consists of a reference to the articles included (i.e. Stillwell and Scholten, 1999), while the other columns contains mutual characteristics of the studies researched. Sometimes, in the right-most column characteristics or variables of studies can be mentioned that are not found in the other studies mentioned in the table.

2.8. Research methodology

Although you have probably briefly described in the first introductory chapter already what research method you want to use in your thesis, it often is necessary to include some paragraphs or even a separate chapter on the methodology selected. Because the range of your conclusions depends for a large part on the research method selected, it is important for the reader to exactly understand what you have done and why. In principle, a reader should be able to replicate your research with the description of the applied method in this part of your thesis.

2.9. Results

In this section of the thesis, normally there are no surprises for the reader, since the description of your research results in general follows the earlier description of the research methodology. What can be surprising of course is when the results themselves are unexpected. It is very good to describe this, but is not right to start some new alternative analyses here as a result of these unexpected outcomes. In the Discussion section however there is room for exploratory alternative analyses.

2.10. Discussion

A separate section ‘Discussion’ is very useful to inform the reader of the exact meaning of the results of your research. Sometimes the results speak for themselves and a separate section like this is not very necessary, but in most cases some explanation of the results is desirable. Every researcher knows his/her limitations and you show your expertise by pointing out the limitations of your research and the range of your conclusions.

This section also can be used for further explorations. Sometimes you can describe which literature support your findings and which do not support it. Or you can do extra analyses to further investigate a particular outcome of your research. Another

investigation that can be included here is a sensitivity analysis of your outcomes when you change some settings in the analysis.

Finally, certainly when you thesis has a practical or work-related background, you will want to elaborate on the practical implications of your research outcomes. You can do this very well in a separate paragraph in this section.

2.11. Summary and Conclusions

It is very important that the conclusions connect directly to the introduction chapter containing the main research question. This chapter should contain no surprises, no new elements.

It is desirable to explicitly repeat the main research question and sub questions should there be any. You can then answer them. In the conclusions you always point out the limitations of your research. These can arise from the definition of your study or for example data limitations.

Finally, you can also use this chapter to make some recommendations for further research by others in the (near) future.

2.12. Appendices

Appendices should be used to place material that, although used and referred to in the text, is best placed, for reasons of volume or distraction, in another place. Appendices are used for a variety of material, such as raw data, details of analytical algorithms and methods and nonessential background information. Appendices should be referred to in the text but not in a manner that requires the reader to refer to them in order to continue to follow the logic of arguments.

2.13. Other thesis components

You should be aware of the need for and value of using tables and diagrams. Remember in dealing with data you have three options: Describing the data, using graphical presentation (including maps) or using tables. Which one you use should depend on what you want to do. Of course, data presented in graphical or tabular form without accompanying text is useless in a thesis. The point is that certain jobs are better done in the non-text form.

You should give some thoughts to your numbering system for tables and diagrams (figures). It goes without saying the system should be consistent. It is often useful to have a system with chapter numbers prefixing table and diagram numbers. Where there are many references this helps to refer to them and to find them.

2.13.1. Tables

Tables are less suited to showing large data volumes. Of course you can make very large tables but even experienced readers soon tire of inspecting columns of numbers. Tables are excellent as a means of transmitting the true values of data at only a moderately high density. They should be used where knowledge of exact values is necessary for the discussion.

Tables of raw data, presented as evidence of empirical work are often put as appendices, not for inspection during reading of the text but as an archive to be used in cross-examination or reworking by researchers using your material at a later date.

Do not put data in appendices, either in tabular or diagrammatic form, when they are used as part of the flow of an argument. To help that flow you should break up the text in suitable places with your tables and diagrams. It is irritating for a reader to have to hunt for data referred to in the text. Also the variation in layout produced by tables and diagrams can give a more pleasing appearance to a page.

2.13.2. Diagrams and images

Diagrams are more useful for presenting large volumes of data and for developing different ways of 'seeing' data. The map, histogram, graph, pie chart are devices that, through different design techniques, can be made to show enormous amounts of data in different ways. Each method will produce a different visual impact.

2.13.3. Geographical maps

It is very useful and recommended to include some geographical maps in your thesis. After all, you are submitting your work for a Master's degree in GIS! The rules for displaying geographical maps on paper should by now be well-known to you. The main points to think of: select the right scale to show your map in; include legend, compass and scale bar; use the colour scheme in such a way that the map items you want to highlight are in fact the items which jump out at the reader; and of course, if you use black and white maps, do not forget to think about what your colours will look like in greyscale or black-and-white.