



Consorci de
Biblioteques Universitàries
de Catalunya

**Towards storage and access of electronic theses:
A proposal of its organisation for the
Consortium of Catalan Libraries**

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Short biography:

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0 Executive Summary

The objectives of this report is to conduct a desk study to the state of the art in the digitisation, storage and access to electronic theses in the world and to propose an organisation thereof for the Consortium of Catalan libraries (CBUC). The scope of the study is virtually unlimited with the exception that theses merely available on paper have been kept outside the study. Also the conversion process from theses stored on older medium to newer mediums is not addressed in this report.

The actual and global situation in the world with respect to the digitisation, storage and access to theses can be described as rather poor. Although in Europe there are a few initiatives, the major development in the field is happening in the USA with the establishment of the Networked Digital Library for Theses and Dissertations (NDLTD). In fact, this initiative has set the de-facto standards in the main areas and with the numerous requests of universities to join the NDLTD it seems to get a world spanning support.

The focus of the NDLTD is to make authors responsible for the final preparation of their electronic thesis. It is recognised that this is, at this stage, a step too far for the CBUC. However, it is nonetheless recommended to join the NDLTD as consortium to benefit from the experiences and expertise once the CBUC likes to progress to a more sophisticated service and system.

The proposed model for the CBUC with respect to the organisation of the storage and access to electronic theses is a model that adopts open access to the theses (i.e. standardisation), multiple access points available in the individual universities for end users to approach the theses and to store the theses central at the CBUC. This model has advantages over other models from (a) an economic point of view , - less equipment costs-, and from (b) a technical point of view this model is easier to implement. From an organisation point of view the various addressed models do not vary very much. Efforts need to be undertaken anyway at each site (i.e. consortium member) to set up a local organisation to collect the theses from the author through the faculties and to set up promotion campaigns in order to have the system used.

The fear that copyright law would undermine heavily the progress towards the digitisation, storage and access of electronic theses is in Spain actually a non-issue. In contrary to the rest of the world just a few percent of all produced theses in Spain are really published before. When one likes to also embed these theses in the project, one has the encouragement that the NDLTD project managed to negotiate successfully with publishers to have the theses published electronically.

As an overall conclusion the foreseen project to store and provide access to electronic theses is from an organisation nature rather than from a technical nature. The real efforts are in getting commitment in the university, to find a good collaboration between library, computer centre(for system backup), faculties and authors of theses and to promote the new service so that it is used.

1 Objectives and scope of the study

Although commonly recognised as an important source of scientific information for getting an overview of the state of the art of new research, theses have until now not attracted much attention with respect to their digitisation. While working papers and scientific journals have been digitised and disclosed (or at least are being disclosed) to the general public, the digitisation of theses seems to be in the stage of pioneering.

Reasons for this lack of interest to digitise theses compared to working papers and/or journals are difficult to find. Where the digitisation of working papers and research memoranda and its use look very successful in for instance the area of Economics, and where even projects exist to digitise textbooks and readers, one would think that a thesis would be an easy follow-up target to digitise.

However it looks like that the scaling-up to bigger units of information seems to be the main problem. Looking back at the short history of digitisation a first start was made by the digitisation of a table of contents of a journal, followed by the digitisation of a single article. Together with the advent of better technology whole journals became subject of digitisation however always with the view on individual articles that constitute the journal. Advertisements, editorials etc were not really taken into account. In this respect, a working paper is just considered as an article in progress like a research memorandum is. Typically they do not exceed a certain number of pages or perhaps better, datablocks. Even the commercial publishers do not treat journals like real journals (as smallest unit) but like containers of individual articles, and, not only in the delivery to their customers but also in their electronic datawarehouses. It suggests that the amount of data organised in a form that exceeds this "article level" may cause a serious problem.

This report aims to structure the problems in the area of theses and to find or suggest solutions. The objective of the study is to explore (a) the current state of the art in the digitisation and the current way of storage and providing access to theses and (b) to find models for its organisation in the context of the consortium of Catalan libraries. It should be noted however that this report is not intended to contain an execution plan but rather aims to be a document that contains essential elements to decide what way to go.

Within the scope of this report are the theses that are available both on paper and electronically or merely electronically and from virtually any subject area. The report further addresses the four main areas of investigation for models of storage and access to the theses: techniques, management (organisation), economics and legal aspects.

The scope of this study is limited. Theses, only available on paper, are excluded from the study. The only way to get them electronically is to digitise them with the technology commonly available (i.e. using scan technology) and is considered to be a retrospective operation for which money, human resources and equipment should be available to carry this out. However, their potential problem areas like the management of the various objects (photos, drawings, formulas, etc) are discussed in this report. This report neither addresses

profoundly the conversion from theses from microfilm or any other medium used in the past to a new more advanced medium.

The report is organised as follows: Chapter 2 shows an overview of cutting edge projects and or initiatives in the field, both nationally and internationally. Chapter 3 introduces the field of theses, their nature and characteristics and its conditions towards a digitisation of them in the framework of the Consortium of Catalan Libraries, from a legal, technical and management point of view. Chapter 4 addresses the models for storage and access of electronic theses and suggests variants and optimisations for them. Chapters 5,6,7 describe the organisation with respect to the three main areas of investigation: techniques, management and economics. Finally, some concluding remarks are made in chapter 8.

2 State of the art in the digitisation and access to electronic theses

2.1 International

General trends

It is clear that just a few places exist where research has been or is undertaken to explore the digitisation and access of electronic theses. These places are concentrated in North America and Europe. It is remarkable that, although Europe has a perfect platform for further research in the area of digital library on a large scale, - i.e. the Telematics for Libraries program in Luxembourg-, there is no project dedicated to the subject nor does the eLib program in the UK, considered as one of the more cutting-edge overall programs at the moment in Europe. In the contrary, major developments are taken place in the USA with some expansions of these developments on a much smaller scale in Europe.

Furthermore and as general observation, many initiatives are undertaken by individual universities without further real dissemination of the results. However, of high importance to the subject of this report is the initiative in the USA in which collaboration was sought with more universities.

This chapter provides an overview of the more cutting edge projects in Europe and North America (USA and Canada), which are the pioneering places with respect to Electronic Theses and Dissertations (ETD's) and a special section addresses the initiatives in Spain.

2.1.1 Europe

General trend

The actual situation in Europe can be best described as "poorly developed" with respect to the disclosure of electronic theses and dissertations. There exists a few projects, especially in The Netherlands, Germany and Austria, which have been evolved into real end user' services. The general trend of its organisation seems to be the same at these places. The main differences are found in the presentation of the electronic theses to the end user (i.e. the user interface) and the representation and amount of the bibliographic data that is available. A centralised approach in the storage of dissertations was chosen in Austria only.

The Netherlands

The projects in The Netherlands are limited to those at the Rijksuniversiteit Groningen (RUG) and the Rijksuniversiteit Utrecht (RUU). The RUG has always had the pioneering position in the Netherlands with respect to the digitisation of theses and dissertations, whereas the RUU followed in September 1997.

The situation at RUG is that they have a full-blown service for end users. With about 200 theses electronically available from 1994 onwards they do cover now in total 12 faculties. The situation at RUU is similar, although less theses are available but also covering 12 faculties. The faculties vary from those from the Humanities (Law, Sociology, Philosophy, Arts, Religious Studies, etc) and those from the "hard" Sciences (like Physics & Astronomy, Chemistry, Mathematics & Computer Science, Geology, Medicines, Pharmacy etc).

The theses are available in PDF format with a mixture of real PDF and wrapped PDF. The latter was noted by a lesser view quality on the screen. Thesis from the sciences Physics and Chemistry, typically containing spectra, tables, formulas, photos and drawings, were surprisingly also represented in PDF format with high levels of detail. No theses were found yet in the HTML format (nor in SGML or XML), although authors, wishing to publish their theses can opt for this format.

Access to the theses is free of charge (i.e. open to the world) and normally they were cut in smaller parts to improve the performance of the service. Sometimes even the option to view the total thesis (in Adobe Acrobat Reader) was given but the time to transfer the data becomes unacceptable long. A common division of the thesis was found in chapters and summaries.

The presentation to the public was organised by theses by faculty and a listing, sorted by author, of the available theses. The listing contained a short title representation (author, title and year of publication). A click on a title revealed the various parts (title, chapter, summary, etc) of the theses one can choose to view in PDF format. Additional to the organisation at RUG, RUU produced bibliographic records and recorded them in the main library catalogue with WWW links to the document. Metatags were added to the electronic version to have the theses better indexed at Internet. Furthermore and only at RUU the theses are disclosed on the various WWW-pages of the individual faculties too.

The theses at both RUG and RUU are stored at one document server, although it is not known whether this document server is only serving retrieval requests for theses.

In general students are free to choose whether they want to publish on the Internet or not. If they want to, they have to fill in a participation form (indicating the format and other software that they have used for preparing the thesis). When articles in the theses had been published before, or parts were submitted and accepted for publishing in a journal or when the thesis was already published by a publisher, the student had to collect the permission(s)

of the publisher(s) to publish also on the internet.

The student had to commit him/herself to write the thesis (or convert) in one of a predefined but limited set of formats, including conventional ones like Word Perfect, Word, Postscript and PDF and less conventional ones for thesis and dissertations like HTML and SGML. Furthermore, the student has to take care of the delivery of an identical copy of the electronic and paper version (incl. tables, photos, drawings etc). Electronic copies can be delivered on diskette, and sometimes even by FTP or CD-ROM. Courses are organised to publish on Internet. The library is taken care of the final disclosure of the thesis on Internet, but did not accept any responsibility against any infringement of the copyright.

Germany and Austria

As one of the universities in Germany most in progress with respect to the subject, the Humboldt-Universität in Berlin has launched a project in September 1998 to implement a "digital library" for all official university publications such as thesis and dissertations. They aim at the development of an training environment in which authors can create their own digital publications, on developing a workflow model for submitting electronic thesis to and handle within the university library and on modelling and testing a secure solution for archiving digital publications.

At present, 11 faculties are joining the effort and there is a link to the Free University in Berlin. They cover both studies in the Humanities, the Technical Sciences, Medicines and Biology. Until now 77 dissertations have been disclosed. Most of the dissertations are available in PDF format. However, more formats may be available of one and the same dissertation (of which 21 in HTML, 17 in Postscript and 18 in SGML)

The presentation to the public of the dissertations is hybrid and lacks standardisation. Every faculty seems to have autonomy in how they like to present them. As an example, the faculty of Medicines presents the dissertations per field and number of available theses per field but at the same level they offer search and browse (author) possibility to all the dissertations of the university. The short title presentation is like the usual one with author, title and publication year field. Additional there is a link to the abstract and the full text. The size of the full text in PDF is given. The full record presentation is poor with only a duplication of the short title presentation including the abstract. There is no entry to the full text at this level.

Electronic documents can be written in Word, WordPerfect, Latex, Postscript, HTML, and PDF. Authors may deliver their manuscript to the Library via email, on diskette or even on CD-ROM.

The Humboldt University is not standing alone in the efforts in Germany. A range of 22 German Universities is currently implementing a service dedicated to the disclosure of thesis and dissertations. Among them are the Deutsche Bibliothek and the Universität Göttingen, one of the leaders in Germany with respect to development of the digital library. However, at present they are setting up websites and content is not yet available. At

Gottingen they have now disclosed 20 dissertations from 1997 onwards.

The Technische Universität Graz has electronic theses and dissertations available mainly in the area of the technical sciences. The disclosure of the theses shows a variant in that even certain studies rather than faculties have got a main entry in the list of 15 "faculties" of which theses are available. The first electronic theses date back from 1990, a sign that retrospective work has been carried out. Also here all the theses are in PDF format, but those until 1997 are scanned and wrapped into PDF and because of that showing less quality.

The theses are presented per faculty per publication year. A further click reveals the list of theses sorted by author only. Besides, the title is presented. One can progress immediately from the short title presentation to the electronic copy by clicking the little document-thumbnail.

Finally, an interesting project in Europe to mention last is ongoing in Austria where the subject is taken from a national level. The Ministry of Science and Traffic supports the development of an Austrian dissertation database (by Forschungszentrum Seibersdorf). They aim to disclose all Austrian dissertations from 1990 onwards. This project is a joint project in which many university libraries are collaborating. The main difference with other projects mentioned before is the storage (or archive) of the dissertations at one place.

2.1.2 North America

General trend

In the USA the general situation is divided into what can be said as three main schools of making dissertations and theses available. One school makes use of commercial services like ProQuest from UMI or Dissertation.com from Academic Dissertation Publishers (ADP) to provide access to theses and dissertations. A second school exists of individual universities or a bi- or trilateral collaboration of universities who are pioneering either in setting up a sole form of submitting theses electronically for their students instead of the usual paper submission (both USA and Canada) or setting up similar but individual services like in Europe. The Networked Digital Library represents the third and most important school, of which its impact is gradually growing to world level, for Theses and Dissertations (NDLTD).

School 1: Commercial services

One of UMI's databases is dedicated to dissertations and theses only, and is called "Dissertation Abstracts". It contains over 100.000 abstracts of dissertations and theses mainly produced in the USA. They can be ordered in paper format or electronic format. The paper copies that UM receive from universities are scanned and made electronically available (most of them in wrapped PDF). However, with time passing by UMI also evolves to become a main storage place for the archiving of electronic copies for the universities.

Universities seem to have integrated access to this UMI database. The University of Michigan at Ann Arbor, commonly recognised as the leader in the development of "the digital library", for instance uses software, Current Research@ (tm) , that allows students and staff to approach this ProQuest database of UMI. Current Research@ filters the visible dissertations in the UMI database to those of the University of Michigan (cost reduction) which have become electronically available from 1996 onwards. The dissertations and theses are not offered free of charge to the world although a small subset, published in the years 1998 and 1999, were. One needs to be student or staff of a registered university to be able to access the database and to download electronic copies.

The short title presentations contain the usual author title and publication year data, but additionally also the size of the file and an option to preview. This is a PDF file containing at maximum 24 pages. The full record reveals additionally an abstract, the digital formats in which the thesis is available and an advisors field. Although more digital formats are told to be available (postscript) the real standard format though is PDF.

ADP's commercial service is organised around the ordering of paper and electronic copies by end users directly. Their approach is to interest authors to publish their theses and dissertations with them. The author receives up to 40% royalties of every sold copy. Prices vary from 40 US\$ for paper copies and 6 US\$ for electronic copies. The latter can be instantly downloaded from their site.

Both services have implemented a professional search engine and search tool to disclose the theses. Searching on the usual fields as one would do in bibliographic database is available.

School 2: Exploring the (solely) electronic submission of theses and make them accessible

Main examples of this school are (a) The University of Virginia Library, - the Electronic Theses and Dissertations (ETD) will be stored in a digital library and made available through the catalogue system as full-text searchable documents-, (b) the TUG group, consisting of the University of Waterloo, University of Guelph and Winfrid Laurier University, - explore all of the issues which would be involved in an ETD being accepted as the sole form of submission by a student -, (c) University of South Florida, (d) University of West Virginia, (e) The University of Montreal and (f) University of Toronto in co-operation with York University. In essence they do not divert from the initiatives in Europe, although the TUG group, trying to set up a form of solely delivery of electronic copies requires the student to make them available according to standards predefined by the project group. This initiative finds a much bigger impact in the next school, the NDLTD.

School 3: the Networked Digital Library for Theses and Dissertations (NDLTD)

Started as a scholarly communication pilot project at the Virginia Tech (VT) Library to "develop and disseminate a standard method for making graduate students' final work available online" the project was expanded to national level when external funds were provided by The South-eastern Universities Research Association, Inc. (SURA), the U.S.

Department of Education's Fund for the Improvement of Post-Secondary Education (FIPSE), Adobe, IBM, Microsoft, and some others. At the time that even universities outside the USA were becoming members of this initiative, the name was changed into the Networked Digital Library for Theses and Dissertations. At the moment there are 54 official members of this group and another 50 potential members have expressed their interest to participate, showing that its world character is expanding rapidly. The following countries, besides the USA, do have representatives in the NDLTD: Australia, Austria, Canada, Germany, India, Singapore, Spain (see section 2.2), South Africa, South Korea, and United Kingdom. Also organisations like UNESCO and the National Library of Portugal have expressed their interest.

The project started as the Virginia Tech Electronic Theses and Dissertations project (<http://scholar.lib.vt.edu/theses>). The main objectives of the project were (a) to implement a system to disclose the electronic thesis and dissertations (ETD's), (b) to produce a set of procedures and to write a set of guidelines as to how to write an electronic theses suitable for publication on the internet, (c) to offer a step-to-step assistance to students to publish their theses electronically, (d) to find a solution for the copyright problem that may appear in publishing a thesis both on paper and electronically, (e) to find access models to electronic theses in correspondence with copyright law and wishes of the authors and last but not least (f) to find commitment from decision-makers in the university/faculty and to create a collaborating platform among faculties, students and library/ computer centres who finally provide the access.

Although no standardisation is really set as to how to present the electronic theses, the basis is nevertheless the same. The system at Virginia Tech (VT) shows electronic dissertations and theses from 1995 onwards. The system through which they can be accessed facilitates the usual applications of a bibliographic system, with professional search and browse tools and search engine as their basis. A short title presentation in general shows the author, title and department of the author. The full record shows additionally an abstract, an URN (Uniform Resource Name: i.e. logical name linking to the URL as physical address), the advisors of the thesis and its availability. The retrieval of theses varies somewhat per thesis as some are only retrievable as full text whereas others can be retrieved by parts (like title page, summary, individual chapters). The theses at VT are stored at one central place.

At the moment experiments are going on to implement a system based on "federated search". This means that with one query multiple databases (read: thesis or dissertation databases of several universities) can be searched for results. The results are then presented per university. Going through the usual steps of short title and record presentation, the returned URNs (with corresponding PDF file) can be directly accessed (as long as access is free of charge). Sometimes the URNs are displayed at a higher level than the full record presentation. It must be noted that the URN appearance is transparent for end users. They will only see a URL notation.

This tendency of "Federated searching multiple databases", is unarguably the future in searching (bibliographic)databases. OCLC has implemented this feature in its SiteSearch

software. Projects in Europe, like the European Decomate II project, show the same tendency (VT's demonstration system at <http://jin.dis.vt.edu>; contact UAB Library for Decomate II demo system)

Besides the technical aspects of setting up a system, VT also recognised the need for user support in writing and preparing the publication of electronic theses and dissertations. To this it has set up a whole system of assistance and support varying from introductory workshops to work with the recommended software as well as email and newlists to communicate electronically with students preparing ETD's. A starting point though is that the student is responsible of the correct delivery of the final ETD, which reduces the work at the library/computer centre to merely check whether all "paper-work" is met, to describe the thesis in the bibliographic system and to provide electronic access to it.

One of the more delicate matters with respect to the publication of ETD's on the Internet is the potential conflict area with copyright material. To this, solutions have been found by having template forms available to require the permission of the publisher of the theses (or articles in the thesis) and/or having restricted access policies set by the library. At present, four main policies exist at VT: (a) unlimited access to the rest of the world, (b) unlimited access to the VT community only, (c) if patent was requested a restriction to the access for one year after which it is released as in case (a) unless written statement was received of another option (b or d) and finally (d) full access at VT only but unlimited access to their corresponding full record data and abstract by the rest of the world.

Document formats that are eligible follow those from the ones discussed above. Furthermore, there is no limitation set to the kind of multi-media objects, which means that merely electronically available ETD's may contain audio and video. The Adobe software (Distiller, Exchange) is able to embed these objects and ultimately integrate them in PDF, diminishing the problem of how to manage these objects in an ETD.

Without any doubt it can be said that the impact of this initiative is huge. Regarding the overwhelming interest of universities in the world to join this initiative one can speak of a project that has set de-facto standards in the digitisation and access to electronic theses and dissertations.

2.2 Spain

The situation in Spain is like the overall situation in the rest of the world. Not much attention has been spent yet and not much time has been invested in the exploration of the digitisation of theses. Until now many university libraries have either integrated the references to their "paper" theses in their OPACs or have single databases to disclose them.

Although, as the only Spanish University, the Universidad Politécnica de Valencia (UPV) is involved in the NDLTD, there was however no sign at all that UPV had implemented a system for the disclosure of electronic theses. It must be said that all their databases, that are accessible through the Web, were secured against any access made from outside the

campus, except the OPAC. It, at least, means that if they have electronic theses available, then these are disclosed for the university community only.

Remarkable though is the commercial exploitation of theses and dissertations by the University of León. This university provides the possibility to buy theses that are available in electronic format on diskette or CD-ROM (10.000 PTS) from one of the following faculties: Biología, Filosofía, Económicas, Derecho, Veterinaria and I.N.E.F. However, there are just a limited number of theses available and unfortunately theses neither exist online nor is there a possibility to download them in a restricted and secured area.

3 Towards digitisation and full access of electronic theses

3.1 Nature and characteristics of theses

Talking about theses and the digitisation thereof it is important to understand the structure as to know at a later time what divisions can be made in case the theses needs to be cut into subparts, not in the least to optimise performance. As well it shows what data is available for bibliographic references (whether partly used or not). It may even be used later on for a procedure to define the requirements when preparing electronic theses directly. It should be noted that neither this is an overview of a non-prescribing nature nor is it intended to be exhaustive.

A typical thesis (or dissertation) contains, not surprisingly, three main elements

- front matter
- body
- back matter

3.1.1 Front matter

The front matter contains typically the following items. NB: This does not only comprise the title page (or cover)

Title	Full title of the thesis or dissertation.
Author	Name of the author
School/University	Official name of the University
Degree	Degree obtained with the thesis
Department	Official department where degree was obtained
Committee	Names of the members of the committee
Date of Defence	Date of the actual defence in front of the committee
Keywords	A few keywords or short key phrases to assist cataloguers who provide bibliographic access to the document and subject of indexing
Copyright	Copyright statement , if applicable
Abstract	Abstract of the thesis (usually limited to 250-

	350 words)
Grant Information (optional)	Space to acknowledge granting institutions
Dedication (optional)	Space to dedicate the work to people.
Author's Acknowledgements (optional)	Space to acknowledge those that assisted the author in the work.
Table of Contents	Full, includes the chapter and section numbers and their titles and pagenumbers on which each chapter or section begins.
Lists of Multimedia Objects	Full, for each multimedia type (table, graph, diagram, equation, etc.) list the number and title of the object and the page on which it occurs.

These objects constitute a typical thesis/dissertation and usually covers several pages.

3.1.2 Body

The body matter contains the chapters of the ETD. A typical chapter division , although not a standard, is:

- Introduction
- Review of Literature
- Materials and Methods
- Results
- Discussion
- Conclusions
- Summary

However, theses' parts may be divided over several chapters. Sometimes it is difficult to find this division back in a thesis. Obviously, very frequently appearing chapters are (i) introduction, (ii) conclusions and (iii) summary. The others may have been spread across the chapters.

3.1.3 Back Matter

The back matter typically contains:

Bibliography/References	References to work/literature. At present sometimes URLs are included (despite its non-stable character)
Appendices	Any type of information that is worthwhile to keep with the thesis but not of interest to the main text. It may include the source code or output of computer programs as an enumerated appendix.

Curriculum Vitae In general a short autobiographic sketch on your academic and professional experience, positions held, and degrees obtained.

3.1.4 Other Characteristics

Besides the characteristics give in the first three subsections, a thesis is a piece of work that is difficult to classify into one group of documents that have common characteristics.

In general terms a division between theses according to studies can be made based on the types of "media"- objects appearing in theses. Theses in the field of sciences (physics, chemistry but also medicine) contain much more frequent photos, spectra or computer made graphics than those resulting from studies in the Humanities show. However applying this division to the field of science to the parameter "size in pages" it undermines this classification immediately. No general rule could be found as to whether theses resulting from Physics are more voluminous than those from for instance Economy are.

Interesting though is that from a technical point of view, and in the framework of digitisation of theses, the aforementioned division into studies from the humanities and the technical sciences can be made, simply because the theses, that contain many photos, graphics and spectra, just require more storage space than the simple "text-table-figure" theses that appear more frequent as a result of a study in the humanities. Once again, these are just general observations.

3.2 Preconditions towards storage and access

Many times projects to digitise existing paper material had a considerable delay or in the worst case have failed because of the unawareness of preconditions that must be met before such a project can be brought to a successful end. Not only within the limited scope of the project but also by taking into account the various (high) expectations of all parties: the end users, the library, the computer centre and decision makers in the institute, faculty or university. This section addresses the main preconditions from a management, legal and technical point of view. These preconditions are independent of what model of storage and access is going to be implemented.

3.2.1 Management

Although the digitisation of theses looks from the surface a technical project, it is actually not. Techniques are available to do the hard work of digitisation according to the chosen or available technology (incl. (human) resources, time and budget). However, the more important factor for a successful project is the good organisation and communication between all partners. In other words : the management.

3.2.1.1 Getting commitment

An IT project, like the digitisation of theses requires, commitment at all levels. This, if not

yet arranged, start with seeking commitment at decision-makers level that the project is beneficial for the university community. Although the digitisation of "paper-only-theses" may be still under control of the library (for which commitment at library level is sufficient to execute this retrospective work) it is clear that for theses that are going to be written in the future or for theses of which it is known that electronic copies do exist, commitment of other parties is necessary.

Commitment is necessary at certain levels in the university.

(i) *university level* (i.e. decision-makers level; for main or first real IT projects only). For strategic purposes in the longer term it is beneficial for the project to get their commitment as it helps in making progress when main expenses have to be made as to for instance in upgrading the IT infrastructure at university level. In other words IT in the library is not always a case for the library itself.

(ii) *faculty level*: although it can be organised that students are solely responsible for the electronic delivery of theses to the library, it is beneficial when the decision-makers at faculty level know about the existence and do support the project. Deans, professors, advisors, teachers and secretaries of research units may be easy targets to get support from. They are essential in the communication to their students. Furthermore, they must get commitment from their faculty to spend some (marginal) time for the project. Especially secretaries, whose task can be to do routines check-in and -out work before the thesis is delivered to the library.

(iii) *library level*: although it may sound strange it is important to get commitment from the people in the library who are going to do the final work: cataloguing (most of the time it is extra work that involves new non-routine work!), quality control and helpdesk for first aid. The library must indeed be prepared for the first questions arising from users as for instance how to use the system or to be able to solve easy problems with for instance printing.

(iv) *computer centre level*: the computer centre will be most of the times responsible for hardware and network facilities. As the digitisation and providing access to theses is highly depending on these technical matters, and since most of the people in the libraries are not skilled to control these, seeking collaboration with a computer centre is recommended, which implies also to try to obtain their commitment to library IT projects. This may remain at the level of a secured backup for technical problems in the system (both storage as production system) or more profound they even may take the responsibility of the storage and backup of electronic library material.

Without these commitments it will prove to be very difficult to achieve the objectives of the project.

3.2.1.2 Importance of the project and its embedding in the library

It is clear that the library has a main responsibility in the project and they should therefore take the local management of it. It is advisory to think about the organisation of the work in

a structure that is suitable and can be employed easily in the library's way of working. However, a project that is not given a high priority shall have difficulties to achieve its goals. When the library management does already not give a high priority in pursuing the project, then it is not to be expected that the other parties in the project will carry the project. Therefore it is advisory to organise it as a real project (matrix with representatives of all parties) with confirmed starting and finishing dates in order to keep better control over time, budget and resources.

3.2.1.3 Allocation of enough resources

The allocation of enough resources to the project is important for the drive of the project. Nothing is more frustrating of not having enough resources available or to must wait until new resources become available. When the priority of the project is not high enough it would mean in the worst case a delay but often the project is going to get less attention and descends gradually to "just another project". This includes the availability of enough resources on equipment (hardware, software and network).

3.2.1.4 Preserving integrity of the document

Starting point of the disclosure of electronic documents is to maintain and preserve the integrity of the original thesis. The paper and electronic copy must be equal at all times. Depending on the document format it is very easy -for instance a document in HTML format- or very difficult - in case of a document in a format based on bitmaps- to change the electronic copy. Extra care is required when a thesis is merely available in electronic format. A certain warranty that the acquired thesis is the official thesis must be somehow obtained. This means that a submission of an electronic thesis must be pursued through official canals in the institute. And as a consequence this means extra organisational effort for which commitment as mentioned before is required.

3.2.2 Techniques

Standardisation

It obviously is clear that when electronic theses do significantly differ from each other in the formats or in the accompanied bibliographic data the effort on the account of the library and/or computer centre to make them available is huge. They need to convert formats to standard ones or to complete the bibliographic record. It is better to have a set of predefined document formats from which the author can choose. Obviously, this set must be sufficiently broad to adequately serve the needs of the author. The same goes, as explained in chapter 3, for the bibliographic data.

In the case that the electronic copy is acquired from a paper copy, by scanning, this problem does not exist as the library and/or computer centre defines what format will be used.

3.2.3 Legal aspects

The most important aspect in the project and that has the potential to undermine the project

and the availability of a high number of electronic theses is the eligibility to publish theses electronically. Enforced by copyright or, though less restrictive, its registration of (a part of) the results of the work as a patent, the law sets clear restrictions.

3.2.3.1 Copyright

Copyright law still considers an electronic copy of a paper document identical and therefore a reproduction of work. At present it is common practice that with the publication of a work the copyright is also, almost automatically, transferred to the publisher (as one of the requirements for publication) and the author does not really have a choice if (s)he wants the article getting published. In this respect it is good to know that a thesis sometimes is composed of individual articles that have been published before.

Two cases can be distinguished

- (1) theses published or to be published on paper, regardless whether a electronic copy does exist or not
- (2) theses that will only be available in electronic format

Case 1 Paper based theses

In this case the electronic publication of these theses require prior permission of the publisher. Or, if the thesis consists of multiple articles then permission of the publisher(s) for every single article must be obtained. This factor makes it hard to get a voluminous number of theses available as most of the times it is hard to get a publisher agreeing on the publication on the Internet (with or without access limitations). On the other side paper theses are not really in demand which means that an publisher is not really earning money and deals may perhaps be made.

Obviously, prior to a possible paper publication, the university (library) may try to convince the author to publish the thesis solely electronic, avoiding the situation described above.

Case 2 Electronic theses

In this case the author can keep the copyright of the work and it may be published on the Internet without further problems. Note that the author needs to enter a copyright registration otherwise the work is not protected.

3.2.3.2 Patent

In case of a potential patent registration it is clear that no publication can be made in the time that elapses between the official request (including preliminary registration) and the investigation to its uniqueness and eligibility. In practice this will mean that an author is not willing to co-operate in publishing his thesis, neither on paper and nor electronic, but shall wait for the result of the investigation if (s)he doesn't want to jeopardise this registration process.

The above does not mean that the project about the digitisation, storage and access of

paper-theses ends here. Fortunately, the situation in Spain shows that just a small percentage of theses are really published. And, the NDLTD project shows that publishers are willing to co-operate and show that more and more authors see the benefit of solely electronic publication. In fact, Elsevier Science, ACM and IEEE-CS (Chemistry Society) have sent letters, on request, to the NDLTD project stating that access restrictions are not really necessary, meaning that the prior electronic publication of the theses do not really constitute a barrier for articles yet to be published and sent to them.

In those cases that a theses was published before an easy scenario can be employed to try to achieve the electronic publication of these paper theses is to produce template "electronic publication permission" letters publishers need to sign. In case of paper theses of which authors can not be traced any longer the university may be in charge; for cases in which a thesis publication is near, the author can request (as a means of negotiation) the publisher to allow electronic publication. Deals can be made with publishers hesitating to sign as to restrict the access to theses to a limited user community (consortium members only for instance).

Also in the case of patents a similar easy scenario can be thought of to try to have it published: the only thing that really differs is that the publication must be deferred for a certain period. Note that this scenario applies both to the two cases (paper-based theses and electronic theses) as distinguished in the previous copyright subsection.

Conclusion from this section is that the legal aspect is of minor importance in Spain. However, this changes for theses that were published. Quite some effort and time must be spent in obtaining permission from publishers to publish theses electronically. After all, it would be beneficial to set up a good promotional campaign to get authors interested in a solely electronic publication of their theses, avoiding any potential legal problems.

4 Models of the organisation of the access to and storage of theses

4.1 Models of Access and Storage

Several models may be applicable in setting up a system for the storage of and access to electronic theses. The following main dimensions are distinguished:

- networked vs. stand alone solution
- open vs. closed access
- one vs. multiple access points
- central storage location vs. many storage locations

A stand-alone solution is easy to accomplish but does not contribute at all to the objectives of the project and shall therefore not be further addressed in this report.

Note further that more dimensions do exist, but they are of second importance to the dimensions given above. Section 4.2. is dedicated to the discussion of these second-degree

dimensions.

4.1.1 Models of access

4.1.1.1 Networked solution versus stand-alone

A logical division is made in models that pursue a networked solution or a stand-alone system. A networked solution is a solution in which in one way or the other the system is making use of a local - or wide area network (LAN or WAN). A future resistant solution employs a networked model only.

4.1.1.2 Open versus closed access

An open access solution adopts standardised software and protocols to ease and allow communication with equivalent systems (given certain) security and perhaps locally imposed access restrictions). Closed access is access provided by a system that uses proprietary software and protocols, and therefore cut off from communication with other equivalent systems or make it very difficult. A future solution is embedded in an open access solution in which at a later stage access can be provided from and to third parties (i.e. non-consortium members).

4.1.1.3 Single versus multiple access points

In a networked model one still can opt for a model in which there is only one single access point or multiple access points. These access points relates to physical places from where access can be obtained. A single access point model may be applicable if one chooses to set up a system that is only available from within the library (or any other point in the university). This may go when severe access restrictions are required, the network infrastructure is not yet at its capacity to allow the organisation of multiple access points or because of better maintenance and/or control. A future solution adopts the possibility of multiple access points.

4.1.2 Models of storage :

Central storage versus storage at multiple locations

A main division is found in the storage of the theses as one central location (for instance at the CBUC) or to have the theses stored at various locations (for instance at the individual universities). Main advantage of the first scenario is the easy organisation of it. Universities further do not need to invest into real equipment and only need to provide a gateway. Furthermore, technical maintenance is easier at one central place and co-ordination, crucial in the beginning of the project, is much easier. Additional benefit of this model is that one always can proceed to the model of many storage locations. Main, initial, disadvantage will be the organisation of the distribution of the theses to the CBUC and the higher costs for the CBUC itself. It is nonetheless recommended to implement the central location model as it is easy and fast to achieve.

Table 1 shows an overview of possible models given the dimension storage location, model of access and number of access points. Because the model based on closed access is not recommendable at all as it does not contribute to the objectives, its discussion is left out in the remaining part of this report.

Table 1 Possible organisation models of access and storage

ACCESS		STORAGE LOCATION	
<i>Model</i>	<i>Nr of access points at university</i>	<i>Centralised at CBUC</i>	<i>At individual universities</i>
<i>Open</i>	Single	A	C
	Multiple	B	D
<i>Closed</i>	Single	X	X
	Multiple	X	X

Model A: Open access, single access point, central storage

In this model the theses of each university are stored at the deposits of the CBUC. Access by the consortium universities is permitted due to the networked model. A gateway to the world for trusted parties can be implemented. However, the access from a university is restricted to a single location, for instance in the library. Advantages of this model are the easy set-up, control and maintenance, also from a security point of view and its very low costs for the consortium members compared to the other models since equipment costs need to be made at only one place. Disadvantages are found in the unique access point and so the limitation for users to use the theses (incurring waiting queues).

Model B: Open access, multiple access points and central storage

This model resolves the main problems of Model A, keeping the advantages and additionally ensures a maximum use of the electronic theses. In theory the model does not restrict on the number of access points. This can range from two to virtually an unlimited number of access points - depends on the maintainability tools one has at the university- and whether gateways are preferred given authorisation and authentication procedures. In essence the material remains stored at the CBUC. Disadvantage of this model is the (initial) overhead that is created to organise the submission of electronic theses from university to CBUC and the higher dependency of universities for the service at CBUC.

Model C: Open access, single access point and storage at various locations

As model A but with the difference that the material is not stored at one central location but at multiple locations (read: universities). In fact this model pretends to provide gateways from one university to another one to the theses they have stored locally. This model requires more organisation efforts among the university members. All universities are rather autonomous in setting up their own system as long as they comply with the standardisation as agreed upon in the framework of the consortium. Advantage for a single university is the

possibility to have maximum control over the own theses. Disadvantages are the higher costs to store and provide access to the theses (incl. setting up security and access policies mechanisms), the possible slower performance due to a higher dependency on the WAN to retrieve theses from other universities and of course the dependency on other universities for their server availability.

Model D: Open access, multiple access points and storage at various locations

As model C but with multiple access points from within a university to the theses of other universities. Advantages to model C are found in the better service to end-users as they can access from multiple points. Disadvantages to model C are the higher costs to implement better access and security mechanisms and its maintenance thereof.

The models marked with X in Table 1 (based closed access) may be of interest if the consortium decides to implement its own protocols or to divert from standardisation's to suit its own needs. It is clear that this is not recommended.

The key question is now what model would suit the consortium the best. Most probably the best model to start with is model B: open access, multiple access points and centralised storage at CBUC. Costs are rather low, and the implementation is easier than in other models. Universities only need to provide one gateway to the CBUC to find all theses. The disadvantage of the need to have a good organisation of the distribution of theses from universities to the CBUC is only felt in the beginning and can be rather easily dealt with. Furthermore, and in contrast to other models, model B contains the possibility to upgrade to, from a technical and organisational point of view a more difficult, model D. This makes model B even more attractive.

4.2 Second degree storage and access dimensions

As discussed in the previous section, there are more dimensions to consider once a choice for a model is made. These dimensions are not determining a new type of model but determine how to organise the storage of and the access to electronic material. These dimensions are considered to be of a second degree.

In case of storage:

- local or remote storage
- storage on one machine or across several machines
- storage based on university or discipline

In case of access :

- limited or unlimited access

4.2.1 Storage options

4.2.1.1 Local versus remote storage

In a networked model (and even within a model with storage at a central location) one can opt to have the documents stored either local or remote. Local storage means storage at the CBUC (or in the library, computer centre of a university in case of models C and D). Remote storage means in general storage effectuated at other places, but access is provided and guaranteed by the CBUC or university library (computer centre). A future solution is a solution that carefully considers the local- versus remote storage from a management ("how difficult to organise"), technical ("maintainability, performance"), and economic ("costs") point of view. Most probably a future proof solution would be a solution in which some of the material is available from a remote site and some of the material is stored locally. (see section 4.3). In order not to complicate the organisation and implementation from the start it is recommended to implement the local storage variant.

4.2.1.2 Storage at one machine or multiple machines

Distributed storage¹ in this report means storage of the documents across several machines (hardware), sometimes not even located at the own compound. Central storage means storage of material on one machine. A future solution for this dimension is rather difficult to give. Most probably it will be a combination of the two. (see more in next section 4.3). A distributed solution incurs higher costs as a mechanism has to be implemented to locate documents at multiple machines and obviously the maintenance costs thereof. Advantages may occur in a better service performance and a better utilisation of the hardware capacity at a site. To start with it is recommended to store the theses at one machine.

4.2.1.3 Theses stored by university or by discipline

Especially in the framework of a consortium of libraries like the CBUC, it is of interest to think about the organisation of the theses. Storage based on university location means that the first disclosure level to the theses is through "University". Storage based on discipline includes a model in which field of sciences are the first levels of disclosure. The advantage of the discipline model is that end users know immediately that they do not need to search for more theses in this field than through this entrance. Disadvantage is that this model requires a much more thorough initial organisation of their disclosure as in general common rules as how to organise fields and subfields of science in faculty units at universities do not exist. (e.g. sub-specialisation of for instance Applied Computer Science within the Faculty of Economics)

This disadvantage does not occur in the location-model in which the theses are organised by university. Disadvantage of this model is that end users do not get a complete overview of the theses in the field.

It is considered that from an economic point of view costs are more or less equal. Practice shows, but this is also given in by a lack of consortium way of organisation, that the model

¹ . NB: It must be noted that sometimes distributed storage is referred to as storage at multiple universities or providers. From a computer science point of view that definition is incorrect and is not adopted here. Here distributed storage means storage of material across several machines.

“theses stored by university” is preferred over the discipline-model. Additionally, within a location model one can build in, but not necessary, a discipline model as it can be the other way around: a location model within a discipline model.

In case an extra effort can be made, it is recommended to offer the end users both ways of disclosing the theses. This can be easily achieved by providing a different *view* on the same basic bibliographic data as long as detailed data about location (university) and discipline (or discipline) is present for every thesis.

4.2.2 Access option: Limited versus unlimited access

To the extreme there are two options in providing access to theses: on one hand the unlimited access to the world and on the other hand limited access to a predefined user group. A choice for the direction in which a solution is to be found depends on copyright aspects and the level of security the consortium wishes to implement. The copyright aspect is important since authors may face copyright conflicts with the publisher of the thesis. A publisher may prohibit a further publication of the thesis on the Internet. The security aspect comes along when a university wants to have more control in the access to theses.

Obviously it is recommendable to aim at unlimited access to the material and to only compromise against full accessibility when patent or copyright problems require this.

4.3 Model Optimisation

The models presented above just show the main lines of Sections 4.1. and 4.2 already imply that choices can and actually must be made.

Additional to these models one can think of optimisations to these models which are worthy to explore. These optimisations consists of better storage strategies based on the demand effectuated by end users to the theses and consequently better performance to end users. It is common practice that, like with journal articles, there is a high demand in about 20% of the available material whereas 80% is rarely consulted.

Starting point is that theses in high demand must be served quickly whereas theses in low demand can be served a bit slower to the end users. The acceptance of the system by end users will be perceived as good, incurring the return of users to the system. From a technical point of view the theses in high demand can be stored at a fast machine. A thesis that is not or rarely consulted may be stored at a different slower machine.

Another optimisation of an equal degree would be the publication year of a thesis. If it is practice that new theses are more likely to be consulted than older ones, then these new theses may be (initially) stored at a fast machine. However, more research should be carried out as to how end users evaluate the year of publication of a thesis to the importance of their research.

However, note that first quantitative data need to be collected before a decision in these

aspects can be made. Nonetheless, it is worthwhile to consider these optimisations to provide a better service to the end users.

Part II A proposal to the organisation of storage and access

This part describes a proposal how to organise the storage of and access to theses. Starting point is to join and use existing standardisation and not to invent the wheel again. To this the initiative of the NDLTD is of such a world impact that ignoring this would lead to isolation in the field. Besides and fortunately, other projects as described in chapter 2 comply with a great extend to the standards used in the NDLTD initiative.

This part contains the three main aspects: technical (chapter 5) , management (chapter 6) and economical aspects (chapter 7). The legislative aspect, or in particular how to deal with copyright and patents as a result of the work, was addressed in chapter 3.2.

This next chapters aim to give lines of thought, guidelines, requirements and suggestions thereof rather than an execution plan whereas all is based on model B: a combination of central storage, open access and multiple access points. As second degree storage and access dimensions it is recommended to start with storage on only one machine ("central storage") and to choose a location model instead of a discipline model. Furthermore, it is considered well known how and where to catalogue the bibliographic data or how to provide gateways to a storage location.

5 The technical aspects

This section contains an overview of important technical aspects that has to be taken care of when setting up a system for the storage, disclosure and access to electronic theses. Note that standardisation goes as a red thread through this chapter.

Three categories are distinguished

- classical library issues
- issues in the organisation of storage, archiving and retrieval of theses
- equipment requirements to make it work

5.1 Architecture

The architecture of the final system is simple. From an end user's point a separate thesis database may exist, but actually it is only a different view on the union catalogue. The following figure shows the idea.

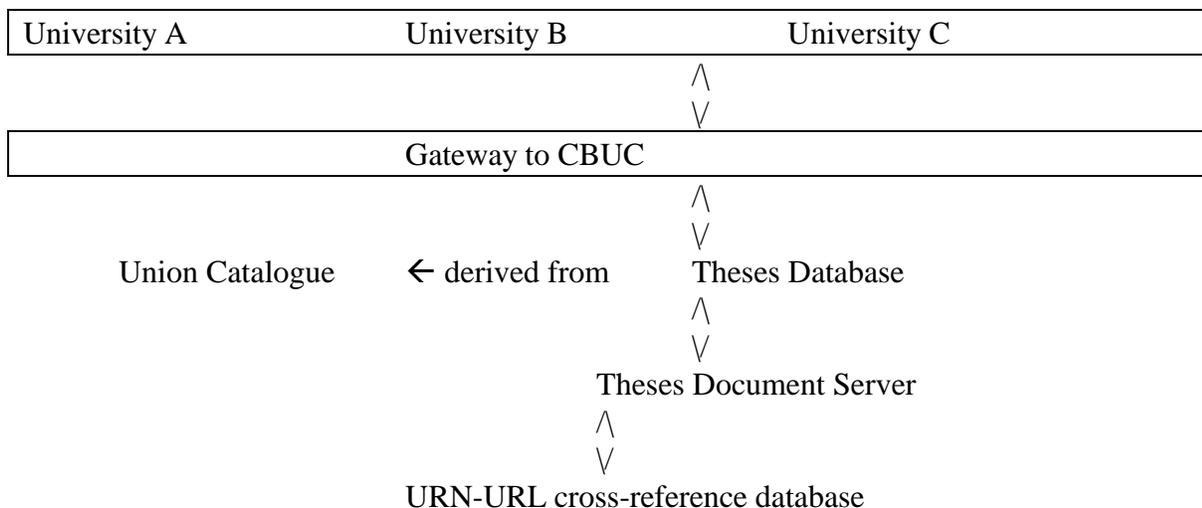


Figure 1: System Architecture

Universities A, B and C do have their gateways to the CBUC. The CBUC offers, besides the Union Catalogue, also a Theses Database. This Theses Database is merely derived from the union catalogue as all records are described in this union catalogue. By selecting all these records a new view is composed. The end user will perceive this database as a separate database whereas in fact it is just another view. Adding new thesis records to the union catalogue and an automated view update mechanism ensures the actuality of the thesis database. The records in the theses database link to the theses document server.

Electronic theses are stored and served by the Thesis Document Server. This document server ensures that the URN is translated into an URL, when a record download request was received.

5.2 Setting up a document server

Document servers are in general easy to set up. The more important step is to find a good document directory structure. The document server actually stores the document in an ordinary file system and will find the various components of a document when a download is requested.

The following directory structure is proposed

- 1st dir level <URN>
- 2nd dir level <thesis structure> where <thesis structure> is one of the following elements
 - <thesis front matter>
 - <thesis body>
 - <thesis back matter>
- 3rd dir level <text and other multi media files that constitute the thesis part structure>

NB: The abstract file is assumed to be part of the bibliographic record in this proposal.

5.3 Library issues

5.3.1 Bibliographic record information and metadata

A standardisation about what bibliographic data will be stored in the bibliographic databases of the participants is recommended. To this chapter 3, section 1, shows a typical data structure. It is recommended to present at least the following data to the end user: author, title, publication year, abstract and additionally the size of the file and formats in which they are available. The latter two are important for the decision of end users whether to retrieve (download) a thesis and in what format. In any case, starting point is to have the *same* bibliographic data available for *all* theses, rather than having a diverse set of poor and rich described theses. Agreements on cataloguing policies must be reached.

As a future proof solution and achieving a maximum benefit of the disclosure of electronic theses on the Internet, consideration should be given to follow the initiative of the Dublin Core group. Metadata tags are included in the electronic document, accessible by Internet indexing machines like AltaVista, Lycos, HotBot etc. This provides better search possibilities and reveals better hits when searching on the Internet only. Appendix B contains a general, indicative outline of the metadata that may be introduced in electronic copies of a thesis following the Dublin Core initiative and its match to USMARC as a standard in bibliographic descriptions. It should be noted that the Dublin Core metadata tag convention is in development and, obviously, that this is not a requirement to start with.

5.3.2 Gateway to the union catalogue

Members of the consortium only need to provide a gateway to the union catalogue, where the theses are described and links to the electronic document are preserved. The fact that electronic documents are attached to bibliographic records does not change the nature of the gateway. No extra measures need to be taken to allow the retrieval of electronic documents.

5.4 Storage, archiving and retrieval issues of electronic theses

5.4.1 Storage issues

Electronic theses are stored in a nowadays-standard way. A document server, if not already available, may need to be set up and links (pointers) between the bibliographic record and the electronic document have to be added. To this the use of Uniform Resource Names (URNs) is recommended.

(a) Uniform Resource Names

It is recommended to use the URN in the bibliographic data instead of the conventional URL. An URN is just a logical name (pointer) to the location address (URL) of where the document can be found. Advantage of the use of URNs is the maintainability of both the library catalogue and the document server(s). Electronic documents may change from one to another machine, however instead of changing the URL in the bibliographic data, the cross-reference database URN-URL needs to be updated only. OCLC Dublin Ohio (USA) has set up for this purpose a so-called PURL (Permanent URL) server, which is just a predecessor of the URN. This advantage increases when more material becomes available. Obviously, its disadvantage is to set up and maintain such a cross-reference database.

An example of an easy and effective organisation of the linking of theses to a bibliographic record could like as follows:

(1) Expand the bibliographic record with an URN field: a typical bibliographic data record looks like

Author: <author>
 Title: <title>
 Publication Year: <publication year>
 Abstract : <abstract>
 etc.....
 URN: UPC/physics/1999/thesis23
 (i.e. thesis number 23 in year 1999 in the field of Physics produced at the UPC)

(2) Submit electronic thesis with URN to storage location

The appointed URN accompanies the electronic document to the CBUC where the URL will be appointed and the record URN-URL is added to the cross-reference database

Cross reference database at CBUC	
URN	URL

UPC/physics/1999/thesis23

<http://theses1.cbuc.es/theses/upc/physics/1999/thesis23>

In case the document (thesis23) is going to be moved to another machine (e.g. theses2.cbuc.es) then this only incurs a change in the URL column of the particular record in the cross reference table whereas the union catalogue remains unaffected.

URN

URL

UPC/physics/1999/thesis23

<http://theses2.cbuc.es/theses/upc/physics/1999/thesis23>

(3) Retrieval of records with attached electronic thesis

When a record (or set of records) from the union catalogue is demanded by an end user, the corresponding URN is first, with the use of the cross reference database URN-URL at CBUC, translated in an URL prior to the return of the bibliographic data to the end user. This URL (hidden under the button “show document”) together with the corresponding bibliographic data is then returned to the end user.

This requires an extra program to detect whether a bibliographic record contains an attached electronic thesis and the translation of the URN information into an URL. This is easy to accomplish.

Obviously, the organisation of an URN can include any number of subfields as desired. And, universities must be made responsible for the appointment of unique URNs to the theses they describe in the union catalogue.

(b) PDF as document format

It is recommended to store the thesis in one format, obviously to save storage space. The preferred document format is PDF (Portable Document Format). It is the de-facto document format and, besides its preservation against violation of the integrity of the document, it also can include links to other PDF documents, to HTML documents and even links to audio- and video files (future theses). Furthermore Adobe Acrobat files can be indexed and searched by keywords.

Of more importance for the storage of new or theses that already exist in electronic format is that PDF can embed multi media objects like photos, spectra and computer graphics. This resolves the problem of how to store these multi media objects.

Theses only available on paper can be scanned (bitmap) and wrapped into PDF. It should be noted that its quality would be less, especially in case photos, spectra, or computer graphics are included. This is caused by the fact that text requires a different scanning resolution than these multi-media objects require.

5.4.2 Archiving issue

The aim will include maintaining the accessibility of the thesis not only today but also in the future. One should think about the format in which the present theses will be stored..

Archiving electronic theses and preservation for future access is an issue that is currently profoundly being investigated by research bodies in the field. Archiving electronic documents in formats that are of proprietary nature (like PDF) in general do contain a higher risk for its future accessibility. TIFF, as an example of non-proprietary software, may be less risky in this aspect, but its main disadvantage of being a bitmap format, with less quality and a format that can not compete with the facilities PDF offers as described above, does not really contribute to use it as an archiving format.

SGML may prove to become a good alternative in the future. SGML is said to embed tags used in wordprocessors and desktop publishing software (like PageMaker). Secondly, on end users' request an SGML document can be automatically converted (on the fly) into HTML. With the further development of XML, as extension to HTML, SGML seems to get a new impulse as document format for archiving purposes.

Fortunately, the short history in the evolution of document formats shows that when a new format is appearing at the market with de-facto standard possibilities, converters from previous to new de-facto standards appear.

In whatever format the theses is going to be archived, one should make sure that the document can be converted to a presentation format (see retrieval issues) and one should pursue as few archiving formats as possible. The NDLTD archives the theses in PDF, not in the least because of commitments of the Adobe company to support PDF for “ a considerable time”. It seems logical to follow their decision.

5.4.3 Retrieval issues

Electronic theses in general are large in size. To better serve the end user and to avoid long download times, it is recommended to cut the theses in several parts. An end user can download them then one by one. However, the end user should always have the choice to download the full thesis at once if (s)he wants (a warning could be given that this may require considerable time). The above doesn't mean that both the individual parts and the full text need to be stored. A webserver request, issued by the end user, to download the full thesis can be organised as a document server request to compose the theses from their individual parts. A typical division of a thesis is given in chapter 3.

Sometimes it may be considered as an extra service to the end user to present more than one document format where a user can choose from (although not recommended). However if desired and to save duplicated storage, it is recommended to convert on-the-fly from the stored format to the desired format. It must be noted this may take time and reduces the perceived performance of the system. In practice documents are presented in PDF format with sometimes an equivalent in HTML (sometimes limited to the abstract only) or Postscript. Multi media objects are presented in JPEG (moving images) , GIF and TIFF (still images) formats.

A PDF viewer (i.e. Acrobat reader) need to be available at every PC from where access can

be obtained (university organisation issue). This means that in a multiple access point model, PC's need to be equipped with such a viewer. Obviously, viewers may be launched from a network drive (or LAN in general). It must be kept in mind though that Netscape Communicator (tm) or Internet Explorer(tm) as webinterface, requires the installation of viewer(s) as plug-in software. This is not a task that novice end users can easily do themselves but rather requires explanation and/or assistance from a professional helpdesk. Obviously this counts for every viewer when multiple document formats are offered.

5.5 Equipment, disk space and software

5.5.1 Software

In fact not much software is necessary. From an end user point of view, the only software that is necessary before they can use the service is 'document viewing' software for every document format that is going to be offered (Adobe Acrobat viewer for PDF, Ghostview for Postscript, etc).

Additionally, to serve the goal of embedding multi media objects in a PDF file the end user or library/computer staff needs to have (access to) additional software to do this. Note that this incurs a main problem area because none of the following two cases is really a good situation to start with.

- case a: the end user is responsible for a correctly prepared thesis
- case b: the library/computer centre finalises the thesis

In case (a) the end user needs the software to do so. (S)He either has it at his/her local PC or has access to the software (Adobe Exchange and Adobe Distiller) Note that this requires a lot of attention and training of the end user first. In case b, library/computer staff is trained to do this final work. Given the few number of theses in the beginning of the project it is beneficial to have library/computer staff responsible for those theses that require this embedding of multi media objects. One even can organise it in the framework of the consortium in such a way that one university will take care of this. In a later stage workshops can be organised to transfer the knowledge and experiences built up, with possible extension to end user level.

5.5.2 Disk space

It is difficult to predict the total amount of disk space required. First of all an average size of a thesis varies with the number of photos, pictures, computer graphics, etc. included. The more multi media objects in the theses the larger its size. Secondly, it depends on how many postgraduate students yearly get their degree awarded and thirdly it will depend on how many publishers want to co-operate in disclosing the theses electronically. Finally it depends on how many faculties will be included in the digitisation and access to theses.

Nonetheless, at present a range in size of a thesis at Virginia Tech varies from 750 Kb to 7 Mb per file in PDF format. Furthermore, they have now about 1400 theses available from

1994 onwards. The Humboldt Universitat zu Berlin for instance has now 77 theses available, released since 1997, covering 12 disciplines.

Given the experience at Virginia Tech of 5Mb as average size of a thesis, 12 disciplines per university, at most 20 postgraduate students per discipline per year, and no problems with copyright, the following figures per university are indicators only. NB: Multiply these figures with the number of universities in the CBUC.²

Table 2 Estimated disk space required per university per year

<i>Year</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>
<i>Nr of theses per dis. per y.</i>	<i>10</i>	<i>20</i>	<i>20</i>	<i>20</i>
<i>Total nr of theses</i>	<i>120</i>	<i>240</i>	<i>240</i>	<i>240</i>
<i>Disk space required</i>	<i>600 Mb</i>	<i>1.2 Gb</i>	<i>1.2 Gb</i>	<i>1.2 Gb</i>
<i>Aggregated disk space</i>	<i>0.6 Gb</i>	<i>1.8 Gb</i>	<i>3.0 Gb</i>	<i>4.2 Gb</i>

Additional grow in 2001 because of the appearance of more theses directly and only written in electronic format.

Universities may want to capitalise on a few fields of science only, reducing the required disk space considerably. But also, the total amount of disk space should also take backups into account. Furthermore it is important to note that the requirement for disk space increments every year, giving more importance to scalability. It is recommended to have a system that can add new drives when necessary. Fortunately from an economic point of view, disk space is not really that expensive.

5.5.3 Hardware

Should a new machine need to be acquired for the storage and of theses and the service thereof to end users, it is recommended to have a DEC Alpha 1000 A, SUN Ultrasparc or equivalent machine, preferably containing RAID disk system (extensible storage space!). From a memory point of view it should contain at least as much that it can handle the numerous retrieval requests per day. It should be noted that when the same machine is also used to index the theses more memory means better service. As operating system it is recommended to use a modern version of UNIX.

As an indication the server at Virginia Tech used 128 Mb memory and was a Sun Netra Server with 200 MHz Ultrasparc processor with several gigabytes of disk space allocated for the operating system and tools.

5.5.4 Network

Sufficient bandwidth should be available between university and CBUC. Should a

² Figures may vary per university. Possible retrospective conversion work and drop outs due to non cooperation by publishers are not taken into account.

university like to offer its end users access from outside the university (e.g. from home through the university) an isolation from the local network traffic of the university, that is serving other workstations and PC's at the university, is highly recommended. Note that a model with open access but a single access point (model A) requires the same as model B.

5.5.5 Web server

A webserver serves and passes on the requests made by end users to the document server, where the theses are stored. A web server should be robust enough and easy to configure. No extra requirements for the distribution of electronic documents are necessary. The Netscape Enterprise server or Apache webserver are suitable for this task.

5.6 Security & Access control

A general model of security and access control in the case of the storage of the theses at CBUC can be easily organised. Given the fact that a multiple point access model applies (model B) it is recommended to have the authorisation and authentication check performed by the university from where the access is demanded. This means that a university can do the IP address check and check on username/password. If both checks are successful then the end user has access to the electronic theses too under the access policy of the consortium. The access to the union catalogue is provided through the gateway. The CBUC only needs to check whether the requester, on behalf of the individual end user, is a trusted party (i.e. a consortium member).

In this way, no additional IP address administration at CBUC need to be made. Although IP address check mechanisms are common practice at a single university, a similar organisation for a consortium results in an extra overhead when all IP addresses of all potential access points need to be administrated and maintained centrally.

Although copyright law does not apply to the majority of the theses, one should take an extra measure when the thesis is protected by copyright law. Consideration must be given whether one wants to have the permission checks at the time of accessing the union catalogue or at the time of the retrieval of a thesis.

If the copyright law does not apply, then the retrieval of electronic theses goes straightforward by applying the normal security level for accessing the union catalogue. If there are theses in the database and under copyright protection, then one of the two options as mentioned above must be applied: either the checks at time of accessing the union catalogue or at time of downloading the thesis. Advantage of the first option (at time of access to the union catalogue) is that the end user needs to identify him only once whereas the disadvantage is that access to the union catalogue in itself requires identification. The advantage of the second option (identification at retrieval time) is that the union catalogue remains free of an initial identification process, but every time a thesis (under copyright protection) needs to be retrieved, the end user needs to identify him.

In general one likes to aim at unlimited and free access to the theses. However, sometimes

the publisher restricts the access or an author does not want to have the thesis published on the Internet given certain conditions. In such a case, levels of access need to be defined by the consortium or the publishers impose restrictions. The following two cases may appear:

- a thesis is only viewable by the end users of the university where the thesis was produced
- a thesis is only viewable for the end users of the members of the consortium

Both cases require extra “thesis access information”, that can be stored in the bibliographic data record or in the URN-URL cross-reference database. When the bibliographic data record is demanded this access information is read and an extra check, at CBUC, is made whether the requester (i.e. university) demands a thesis from that university. If both data do not match, then only the bibliographic information is returned without the URL. If they do match then all bibliographic data, incl. the URL, is returned. A similar scenario applies in the case of restricted access to consortium members only (i.e. restricted access to the world).

6 The organisational aspects

The digitisation, storage and providing access to electronic theses can typically be divided into two scenarios as how the theses are managed by whom and to what level. The NDLTD project for instance requires students to do all the thesis preparation work while the NDLTD provides facilities to assist end users in preparing them. However, this situation can only be achieved when a big organisation had been set up before to manage this. It is not the aim of the CBUC to achieve the same at this stage. It rather aims at setting up an organisation in which end users typically co-operate along the lines set out by the library and communicated through the faculty. Nonetheless the library (in co-operation with computer centre) takes main responsibility in the preparations of the thesis, the distribution of the material to the CBUC, and in providing access to them by implementing gateways.

A logical and gradual evolution of this proposed model of organisation would be a model that employs an organisation according to the NDLTD model in which the main effort to prepare the electronic thesis shifts from the library to the end user, but with having sufficient facilities available to assist them in doing so.

The consequence of the above is that experience need to be acquired as to how to convert theses to standard formats, how to include links to possible multi media objects (photos, spectra, etc) and to set up procedures and guidelines for end users to prepare their theses so that the library is capable to process them. Obviously, the above doesn't count for the digitisation of theses that are only available from paper sources since the end user is not involved in that process.

But this is in itself not enough. Attention should also be paid to setting up helpdesks for end users and authors preparing their theses along the lines prescribed and helpdesks to assist end users in using the theses database. Furthermore, training facilities may need to be

installed and promotion plans need to be defined due to experiences in the field that a new digital service will only be used nowadays if the advantages of the new service are clear to end users.

6.1 Organisational Procedures

Procedures need to be set up for a number of situations in which the co-operation of the end user, author and faculty is needed. These procedures include the media on what the thesis is to be delivered to the library, where to deliver it, what formats is eligible, etc. The following shows an outline of the main procedures and is intended to be tentative.

Step 1 Prescribing what software and formats are eligible

The first step is an important step to ease the work later on in the process. By prescribing the eligible software that can be used for writing and the preparation of the thesis, what document formats are eligible for the submission of electronic theses to the library, it makes the converting process to the PDF document format much easier and, more important, keeps it under control.

The following list of formats is only an indication. It was used by the Scholarly Communication Project at Virginia Tech and its successor in the NDLTD project. It is not only a list of wordprocessor formats but also contains formats commonly used for multi media objects.

The consortium must eventually decide what is eligible for their purposes based on the experience what these formats with respect to the conversion process.

Document formats

- Wordprocessor with facility to export to Postscript (afterwards Adobe Distiller can be used to convert the ps file to PDF, by opening the PDF file(s) with Adobe Exchange one can add links)
- ASCII
- SGML
- HTML
- TeX and LaTeX
- PDF

Images

- PDF (.pdf) use Type I PostScript fonts
- JPEG (.jpg)
- CompuServe GIF (.gif)
- TIFF following version 6.0 or later, including CCITT G4 (.tif)
- CGM Computer Graphics Metafile (.cgm)
- PhotoCD

Video

- MPEG (i.e., MPEG-1, MPEG-2) (.mpg)
- QuickTime - Apple (.mov)
- Audio Video Interleaved - Microsoft (.avi)

Audio

- MPEG-2
- CD-DA
- CD-ROM/XA (A or B or C)
- AIF (.aif)
- SND (.snd)
- WAV (.wav)
- MIDI (with timing information) (.midi)

Special

- Spreadsheet - Excel (.xcl)
- AutoCAD (.dxf)

Step 2 Collecting the electronic thesis from the end user

Case A: the library staff is responsible for the final composition of the electronic thesis

What to submit ?

End users need to submit their thesis broken down in a predefined structure (for instance, abstract, toc, introduction, chapters, references, summary, etc) and a directory for multi media objects (if any) and links to the place where the objects need to be inserted together with a description of what (prescribed) software was used to create the multi media objects (readme file)

What media is eligible for submission ?

Common eligible media for the submission of the delivery of electronic theses to the library include diskette, CD-ROM and email. Obviously one and another depends on the size of the thesis.

Case B: the end user is responsible for the final composition of the thesis

The thesis is submitted to the library given the same eligible media as under case A, including a readme file about what software was used and prescribed bibliographic data (incl. abstract).

Step 3 Library procedures

The provided bibliographic data is checked on completeness by library staff and an URN will be appointed. The thesis will be described in the union catalogue. Furthermore, in case A of Step 1 the thesis will be composed given the available data by using the software (Distiller and Exchange). When the thesis will also be published on paper the final version is printed by the library (for instance on account of the author) in order to preserve identical

electronic and paper copies.

Step 4 Submission of collected electronic thesis to the CBUC

Once the thesis are collected the bibliographic information is stored in the union catalogue, an URN has been appointed. Once the electronic thesis is finalised (adding multi media objects) by library staff/computer staff and the electronic thesis can be submitted to the CBUC. Based on agreement, the same eligible media as mentioned above can be employed.

Step 5 Storage of thesis at CBUC

The CBUC receives the electronic thesis and appoints an URL and stores it in the URN-URL cross-reference database. Any additional access restriction information is also stored. The CBUC updates the theses database and the thesis can be accessed.

6.2 Setting up helpdesks

It is recommendable to organise a helpdesk for end users (authors). In a normal situation this shall be integrated with the already existing library service to the end user.

One type of helpdesk should employ the assistance in the preparation of an electronic thesis according to the procedures defined by the library. Another type of helpdesk is a counter (or telephone number, email address) where end users can ask questions about how to access the theses database system.

(i) Helpdesk thesis preparation

It is recommended to establish a helpdesk that can answer all kind of questions related to the preparation of electronic theses for the submission thereof to the library. Procedures may not always be that clear or may not always cover all the situations that can occur.

(ii) Helpdesk theses system use

Questions may be distinguished into typical first hour questions, questions of a more technical matter and questions from library staff to computer centre staff about the system and its control.

First hour questions must be easily met by library staff. Questions in this class are typical questions on how the system works, how end users can print, or that end users can not enter the system. In general the role of the librarians is to diagnose the question, to provide answers or to refer them to a specialised helpdesk.

This special helpdesk will receive the more difficult and technical questions. It serves as a main backup for librarians helping end users. Examples of typical questions in this class are "the viewer does not launch", "the system is down", and "end user X can not get access".

A last level of helpdesk can be organised to serve as a technical helpdesk on the control and maintenance of the system. This helpdesk, typically organised in a computer centre environment serves as backup to a library helpdesk only. Typical questions are for instance

" systems performance is very slow", "system is out of service"

6.3 Training facilities

Although a user-friendly user interface should prevent end users to have questions, be prepared that end users need to get accustomed to the new service (and system). This especially counts when a new way of access is introduced. Facilities like special organised training sessions can be organised to echo the end users call for more assistance. This does not only count for end users but also for library staff. Obviously, they need to know from their profession how the system works.

Alternative ways to help end users is to have factsheets available and to have a webpage with frequently asked questions.

NB: it is recommended to integrate access to electronic theses similar to already existing ways of access as it reduces the learning effort end users need to go through to get along with the system.

6.4 Promotion Plan

A last item to address in this section is the preparation of a promotion plan. It is not longer the case that end users start automatically using a new system when it becomes available. At present there are too many alternative ways to get information where most of the times the source of the information (e.g. own university) is not really important. Instead, new systems need to prove their additional value, their benefits over other ways of getting the same information. End users in general are rather conservative in their behaviour. Once they are convinced of the benefits and the additional value to them they will stay using it. This requires active promotion by the library to promote and to "sell" the service. Library newsletters, posters, posting emails in local newsgroups, contributions to the scholarly newspaper, factsheets, information at prominent places on the Library Webpages and direct communication with both professors and postgraduate students are means to promote the service. It may be an idea top start also preparing a special Electronic Thesis project webpage with the latest news on the project as part of the overall library project webpages and have the URLs communicated.

It is recommended to measure the effects of the campaign so that follow-up promotion is better embedded and better equilibrated with the needs and lack of information the end user may have. Follow up promotion is necessary to achieve that the service is indeed going to be used. A typical new promotion campaign is after three or six months.

7 The economical aspects

The organisation of the storage and access to electronic theses including the organisational efforts that need to be done to support end users and authors in the preparation of the thesis and the promotional campaigns, incurs various costs from various types. This section

addresses the main cost categories and its main costs. The following cost categories are identified:

- labour costs
- equipment costs
- consumables
- other costs

7.1 Labour costs

Labour costs constitute the biggest costs. Costs are made both at CBUC and at the individual universities.

One “Full Time Equivalent (FTE)”, as mentioned below, is equal to one person who is for 100% dedicated to the project. All figures below last for the duration of the project only.

For the CBUC this would involve:

- 0.25 FTE category Project Co-ordinator to manage the streamlining of the submission of electronic thesis from university to the CBUC for all consortium members
- 0.33 FTE category Systems Manager with responsibility over the theses document server and cross reference database, its security and access control and its well performance.

For every individual university this would involve:

- 0.33 FTE category Local Project Manager to manage the project locally, watch the progress, setting up facilities, and maintaining relations with the co-ordinator at CBUC
- 3 FTEs category Library Staff responsible for
 - streamlining the submission of theses from author to library through faculty channels
 - cataloguing tasks to describe theses in the union catalogue
 - promotion campaigns and follow up campaigns, quantitative and qualitative user feedback studies (1 FTE)
 - organising training facilities and helpdesks (1 FTE)
- 1 FTE category Computer Staff responsible for
 - gateway implementation
 - authentication and authorisation procedures and user database maintenance
 - main backup support library system and maintaining relations with computer staff at CBUC

In general it is difficult to estimate what the exact costs are. Evidently, some of the tasks as described above can be merged together and appointed to one and the same person. If this is an option, depends on the local situation of each individual university.

Structured costs that continue after the project finishes involve costs for the maintenance of the system, personnel at helpdesks and the labour costs involved in making the electronic

theses ready for disclosure.

7.2 Equipment costs

Equipment costs are easier to estimate in the proposed model. The costs are mainly constituted by the purchase of a DEC Alpha 1000, SUN or equivalent machine with RAID system at CBUC. With ever decreasing costs for disk space this is not any longer a real concern.

For reference purposes a DEC 1000 A with raid system costs about 5.250.000 PTS. Disk space of 5Gb costs about 21.000 PTS. Exact list prices of machine and disk space are best solicited with the vendor of these products.

7.3 License costs

License costs are the costs of the acquisition of licenses of software to be used. Fortunately both Adobe Distiller (convert text files to PDF) and Exchange (adding multi media objects in PDF files) can be acquired free of costs (www.adobe.com). Both products must be downloaded per university. Both products do however have license restrictions as sorted out in Appendix B.

Adobe Distiller and Exchange are downloadable from the Adobe website and exist for several platforms, like Windows and Unix. (see references for exact URL)

7.4 Consumables

The category Consumables constitute promotional costs, tools for the training of library staff and end users. One should think of material costs (to produce leaflets, posters, newsletters, factsheets, short end user manuals etc) and printing/binding costs, reproduction costs etc.

The total of these costs depends on the policy per university about what effort one likes to spend in these activities.

8 Global Planning

Although depending on the allocated resources to the project, the working culture and co-operation at the participating universities, a general and global planning for the project can look like as follows.

Month	Activities
1	<ul style="list-style-type: none"> organise the faculties at each university and get commitment

	<ul style="list-style-type: none"> • write procedures to instruct library staff and authors and to deliver documents to CBUC • buy equipment and install machine (CBUC) • agree on catalogue issues
2	<ul style="list-style-type: none"> • instruct library and computer centre staff at each university (procedures and software to use) • set up document server at CBUC and theses-database
3	<ul style="list-style-type: none"> • start preparing first electronic copies of theses at every university to get experience • start writing promotion plan per university • implement gateways at each university to document server at CBUC (if not yet available)
4	<ul style="list-style-type: none"> • distribute theses to CBUC • test procedures at university and test delivery procedures
5	<ul style="list-style-type: none"> • do robustness and performance test of total system • start promotion campaign
6	<ul style="list-style-type: none"> • improve system based on tests • make service available to end users

9 Concluding remarks

This report addressed the main steps in setting up an organisation for the storage and access to electronic theses from four principal aspects: techniques, organisation, law and economics.

It is clear that starting such a project is not without major organisational consequences. Most of the work needs to be spent in setting up a good organisation. Once one has taken care of these organisational aspects then the others are relatively simple to achieve. This, by the way, does not mean that one needs to wait for the completion of the organisation. Preparations can start in other areas as well, however a word of warning is given not to accelerate in the area of techniques as long as no satisfactory solution is found in the organisation.

Main objective of the project should be to establish a service that provides access to theses that have been digitised and, not in the least, that will be used. This objective implies user acceptance of the system. To this, four main goals must be met. If one of these goals is not met satisfactorily, then the end user is not going to return to the system and the project ends in a failure from an economic point of view.

The four goals to meet:

(i) *Satisfactory performance of the final service*

The system may not be perceived slow by end users. End users in general do not

understand why the system can be slow. They only get an impression of a bad performing system. Even if there are very legitimate reasons for delays, then end users will keep a negative impression. A service is only useful (and successful) when end users are returning to the system.

(ii) Sufficient critical mass of material available

The system should contain sufficient critical mass of material. A system that just contains a few theses is not an invitation to end-users to use the system. To increase this critical mass a system of simultaneously searching multiple databases shall prove to be very effective to meet this goal, combining forces among universities. In fact the end user will not really realise that some of the theses are not physically present at the own site, creating indeed a virtual library.

(iii) User-friendly interface but with training facilities

The system should reveal a user-friendly interface. Nothing is more frustrated to open the door not knowing how to proceed. And although the aim of having a very user-friendly interface, there remains a need for additional training facilities for end users. End users find themselves in a jungle of interfaces, new software, all with their own peculiarities. Only when they know how to use the system the best, they will find the information they want without losing too much time.

(iv) Promotion of the new service

It is not longer the case that if a university library offers a new service, end users automatically start using and start appreciating it. In a world in which it becomes easier and easier to find information following alternative ways, there is a new task for the library to promote the service and get a certain "return on investment". And moreover, promotion at times of introduction sounds reasonable, but also here, following the idea of "after-sales", it is important to remain in contact with the end users.

The de-facto standard in the digitisation of theses and dissertations is set by the NDLTD project and its predecessor project carried out at Virginia Tech. It is recommended to join this network which seems to rapidly expand its number of members (see next chapter "web references"). Especially with the experiments that are conducted at the moment in setting up systems to search simultaneously multiple databases (i.e. universities), - as long as open access is guaranteed to the databases of the members-, this initiative may prove to evolve into a world spanning networked digital library for electronic theses and dissertations. Not joining this group will most probably result in isolation in this field.

In fact, membership of the NDLTD is said to include their help and assistance: from defining procedures, setting up an organisation (as globally described in chapter 5), to further assistance in technical matters and the setting up of Webpages to finally disclose the theses. Membership can be requested as a consortium, individual university and sometimes even by individual schools within a university.

Should the consortium join the NDLTD an extension to search the theses databases of the other members is just a matter of time. The CBUC could implement a gateway to the NDLTD, so that the number of databases indeed expands rapidly.

A better way of searching those many databases is already visible for in the near future with the advent of federal search techniques. This is at present being employed as experiments in the NDLTD and the European Decomate II project (with CBUC member University Autònoma de Barcelona as participant). It will allow end users to search with one query all available theses in a certain field, eliminating repetitive searches in various databases at different sites. Starting point and first requirement is an open access model with preferably multiple access points, which the proposed model (model B) indeed constitutes.

Copyright and patent registration may be the one and only real barrier in making theses and dissertations electronically available. However, this problem does not really occur in Spain. There are only a few cases in which a thesis was published before. In those cases and when one likes to do the effort, then attempts to contact publisher and to request their co-operation in Internet publication can be pursued. At the same time postgraduate students can be convinced of the benefits to publish only electronically. Initiatives may be taken to start elaborating a new organisation procedure to graduate in a new legal form by means of electronic publication rather than on paper only.

Now that technology becomes more and more sophisticated, - already resulting in for instance adding audio, video and dynamic links to theses- , this must lead to a breakthrough in the recognition and common acceptance of the electronic publication of a thesis having an equal status as their paper-published counterparts.

10 Web references

Academic Dissertation Publishers (USA)

<http://disseratation.com>

Adobe Company

General: <http://www.adobe.com>

Destiller

For WINDOWS

<http://www.adobe.com/supportservice/custsupport/LIBRARY/acdwin.htm>

For UNIX

<http://www.adobe.com/supportservice/custsupport/LIBRARY/acdunix.htm>

Exchange

For WINDOWS

<http://www.adobe.com/supportservice/custsupport/LIBRARY/acewin.htm>

For UNIX

<http://www.adobe.com/supportservice/custsupport/LIBRARY/aceunix.htm>

Other downloadable files

<http://www.adobe.com/supportservice/custsupport/download.html>

Humboldt Universitat Berlin (Germany)

<http://dochost.rz.hu-berlin.de>

Networked Digital Library for Theses and Dissertations (USA)

- Information about NDLTD at <http://www.ndltd.org>
- Demonstration system at <http://www.theses.org>

Rijksuniversiteit Groningen (The Netherlands)

<http://www.rug.nl>

Rijksuniversiteit Utrecht (The Netherlands)

<http://www.ruu.nl>

UMI (USA) Dissertations online

<http://www.umi.com>

UMI ProQuest (USA)

<http://wwwlib.umi.com>

Virginia Tech (USA)

Scholarly Communication Project

<http://scholar.lib.vt.edu/theses>

11 Appendices

Appendix A Members of NDLTD

(I) 54 Official Members

48 Member Universities

Air University, Maxwell AFB, Alabama (USA)

Chungnam National University, Dept of Computer Science (South Korea)

City University, London (UK)

Clemson University (USA)

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