David Edelman
Member of the Graduate School at the North Carolina State University, USA, specialized in innovative design and development of business applications for both the Graduate School and the University Community. In 2010, served on the International Scientific Advisory Board for ICERI 2010 (International Conference of Education, Research and Innovation) in Madrid, and also, as a session chair, for both ICERI 2010 as well as INTED2010 (International Technology, Education and Development Conference) in Valencia. Presented papers for the e-Learning & Blended Learning, Technology-Enhanced Learning, and E-content Management and Development sessions.

Sviluppo e utilizzo di un sistema elettronico di revisione e archiviazione per tesi universitarie.
Development and Utilization of an Electronic Thesis and Dissertation Submission Review and Storage System for Universities.

La North Carolina State University ha sviluppato un sistema completamente automatizzato per il deposito, la revisione e l'archiviazione digitale delle tesi di laurea e delle dissertazioni, chiamato ETD (Electronic Thesis and Dissertation). Il sistema ETD migliora l'accessibilità e sostanzialmente riduce i tempi richiesti per sottoporre i lavori, se paragonato ai metodi di deposito cartacei, da parte dei gruppi coinvolti nella valutazione e nel processo di approvazione delle tesi / dissertazioni: studenti, membri del comitato di valutazione, diplomati, curatori di tesi, archivisti (per esempio bibliotecari universitari) e ricercatori.

North Carolina State University has developed a fully electronic submission, review and digital storage repository for theses and dissertations, also known as the ETD (electronic thesis and dissertation) system. The ETD system improves access and substantially reduces time required compared to paper-based submission methods for the community of groups involved in the thesis/dissertation approval process: students, thesis/dissertation advisory committee members, graduate schools, thesis/dissertation editors, archivers (for example, university libraries) and researchers.

With the increasing attendance of graduate students at colleges and universities, and the increasing ratio of students to faculty and administrators due to issues such as financial constraints, the traditional method of producing a hard-copy thesis or dissertation and having it approved and stored is difficult and costly to maintain. As a result of these issues, North Carolina State University has developed a fully electronic submission and review system and digital storage repository for theses and dissertations, also known as the ETD (electronic thesis and dissertation) system. The ETD system improves access and reduces time required substantially over paper-based submission methods for the community of major groups involved in the thesis/dissertation approval process: students, thesis/dissertation advisory committee members, graduate schools, thesis/dissertation editors, archivers (for example, university libraries) and researchers. As a result of the improvements shown using the ETD system, paper-based thesis and dissertation submittal has been replaced at North Carolina State University entirely by the ETD system.

For example, for students, practically all interactions of the student with the University in terms of the ETD are online: classes on how to prepare an ETD (although traditional classes are also provided on a monthly basis); an upload process so that the student can prepare the ETD as a Word or PDF document with media file attachments and upload it to the ETD system; and document review and approval of the ETD by the ETD editor and student's advisory committee. In addition, all interactions of the student with the ETD editor and advisory committee members are online and tracked so that interactions can be reviewed at any time. A dashboard display of required checklist items and milestones with their status provides a method for all interested groups to check and verify the student's progress. The student may edit and resubmit the ETD without a formal office meeting or unorganized chain of emails, allowing a substantial reduction in revision time. A storage interface to a DSpace based online reposi-

tory system allows the ETD to be stored and accessed electronically by researchers under restrictions set by the student such as time-based embargoes.

The software follows the PHP/AJAX/MySQL standard for modular application development with support for plugins for components including authentication, metadata population, and repository/catalog object export. For example, the NCSU PeopleSoft plugin populates all metadata from the campus information system, including biographical and demographic data as well as milestones and checklists involved in the thesis and dissertation approval process.

I will present an overview of the nature of archived documents, both traditional and digital, followed by a discussion of the ETD system including the primary system modules and how they were designed to facilitate communication among members of the major University community groups who are involved in the ETD process.. The operation of the system will be illustrated by taking showing the steps encountered by a student and a Thesis Editor to complete the ETD process and how each of the steps represents an improvement over the paper-based method traditionally used. Unique aspects of the ETD system, including security, requests to keep research unavailable to researchers for a fixed amount of time will also be discussed as well as statistics on the usage of the system at North Carolina State University.

DIMENSIONS OF ARCHIVED DOCUMENTS

In order to understand the requirements driving an ETD system, or for that matter, any archiving system, it is necessary to understand the nature, or "dimensions" of an archived document. Traditional (non-digital) archived theses and dissertations can be considered to have four dimensions: contents (material contained within the document including text and graphics), age (time since the document was created), format (usually hard copy) and location (where the primary document and copies are stored). On the other hand, electronic thesis and dissertations have a different set of dimensions which redefine the meaning of the traditional dimensions.

New Dimensions:
Legal: Restrictions on when the thesis or dissertation can be viewed by researchers. For example, holds of up to a year can be placed which prevent the document from being available for research.

Security: Documents are also restricted by the security level of the viewer of the document. Someone with an administrative level would be allowed to update and view multiple versions of a thesis, whereas someone with standard access would only see the version with the most recent effective date. This is useful when a correction needs to be made in a document or the document has aged (see below) and can no longer be read by the most current document viewers. So, instead of having access to multiple versions of a document and trying to figure out which version should be viewed, only the most appropriate version of the file would be shown. Users with the administrative privilege (and also perhaps the thesis author) would still be able to view all of the versions of the document.

History: An ETD's history is shown in communication via email or within an enclosed software system (the ETD system described in this paper, for example) between the ETD author and the ETD editor, members of the author's thesis or dissertation committee, and the Graduate School, as well as milestones and checklists completed then stored in and accessible from University database systems such as PeopleSoft's Student Information System (SIS). An accessible history for an ETD or any archived document is essential in cases, for example, where questions are raised in regards to the document.

The traditional dimension classifications also must be redefined:
Format: Unlike traditional documents, an electronic thesis and dissertation can include many types of files: text/graphics, special inputs for mathematical and scientific display software, audio, and video.

Age: Except for hard copies of test/graphics files, all of the formats require software to view, which may be a problem as the

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etd Electronic Thesis & Dissertation Submission System

Welcome to the Graduate School Thesis and Dissertation Submission System

Before you submit thesis or dissertation files for review you must meet the following criteria:

1. You have successfully passed your defense.
2. You have your signed title page in hand. You must submit the title page along with your review file.

If you do not meet both criteria you should not submit any files for review until you do.

If you do meet the criteria, please underline continue to submit files for your degree in **Biochemistry - PHD**

If you have any questions regarding the submission process, please contact the NCSU Graduate School Thesis Editor

1. ETD Submission System Student Login.

documents get older and have requirements not met by the latest version of the viewing software. The age of the document that now must be considered is not how old the document is, but if it is totally compatible with present viewing software, in other words its "software compatability" age.. For example, we recently had two situations where documents which had been archived a decade ago were viewed recently and were found to be unreadable. It turns out that they both were originally produced in LaTEX and converted into PDF's, and during this process a font was created that was not readable by the latest version of PDF. The problem was solved by utilizing an older PDF version so the document could be read, then stored in a format that could be read by the latest PDF viewer. The new version of the document was saved and is the version that researchers can access, while the original version is only visible by administrative users. Also,

there are new methods, such as PDF/A, which are intended to maintain any archived document as always readable.
Location: There has been a significant change in the meaning of this dimension. Documents were traditionally stored in a few physical locations which required an inter-library loan or travel to a remote library to access. In this way, circulation of the document, and so the dissemination of its knowledge, was circumscribed. Now, having the thesis or dissertation as a virtual document means that its knowledge is essentially available anywhere, within the specified security requirements. This has both positive and negative aspects: the circle of knowledge has been expanded, for both the author's and the researcher's benefit. However, this expanded circle also provides additional opportunity for negative behavior including plagiarism.
Contents: Since archived documents are virtual documents, the contents dimension acqui-

res a new meaning: material contained within the document as viewed by the observer based on the observer's security status and the document's legal status. So, unlike a traditional archived document, which appears the same to all observers, the archived document is a virtual entity that is created at the time of viewing and may vary as a factor of who is viewing the document and when they attempting to view it.

DEVELOPMENT OF THE NCSU ETD SYSTEM
At North Carolina State University, the NCSU Libraries, the Graduate School and the Information Technology Division (now the Office of Information Technology), collaborated on a pilot project in 1997 that allowed theses and dissertations to be submitted, approved and accessed electronically. The local effort was part of a larger project sponsored by the Southeastern Universities Research Association (SURA) and prototyped by Virginia Polytechnic Institute and State University (Virginia Tech) to create a

digital thesis and dissertation repository. Starting Fall 2002 the University required electronic submission of all theses and dissertations.[1]

A revision of ETD system software was developed by the NCSU Libraries starting in 2009 to incorporate new technologies and to interact with the Student Information System (SIS) from PeopleSoft. The ETD System allows students to submit their works to the Graduate School as Portable Document Format (PDF), audio and video files. Once the files are electronically reviewed and approved by the Graduate School Thesis Editor, they are transmitted to the Libraries for cataloging. Once cataloged, they are accessible by researchers via the Libraries' Web server.[2]

INTERFACES TO THE ETD SYSTEM

Students prepare for a review with the Graduate School Thesis Editor after completion of their thesis/dissertation defence. The ETD Website (http://etd.ncsu.edu) provides a link to the ETD Submission System. After viewing a secure login page and entering a University-provided user id (known as Unity ID) and password, the student is prompted with a reminder to proceed only if the thesis review criteria are met (fig. 1).

Next, as shown in fig. 2, students read the instructions to upload their two required PDF files for the thesis review. At this point students are able to request either a 90-day or 1-year embargo (request to keep research unavailable to researchers for a fixed amount of time) for patents pending or publication reasons.

Students are directed to the student dashboard main screen once the files are submitted (fig. 3). At this screen, the student is provided with communications from the Thesis Editor as well as information related to the thesis or dissertation. On the left is a section of identifying information including student name, Unity ID, degree, program, plan, committee members, thesis title, required forms and fee and the submission progress checklists. This information is provided as a double check for information accuracy and as a guide to the student during the submission progress to provide notification they are mis-

2. ETD Student File Submission & Embargo Request.

sing a required ETD item. The information is drawn from the Student Information System (SIS) PeopleSoft application.

The communication hub in the middle of the student dashboard serves as the central means of communication between the student and Thesis Editor. This is where the student receives a welcome message from the Thesis Editor, and where the student can view the thesis review submission to verify the two PDF files for the thesis review have been properly submitted. If a student requested an embargo, the embargo can also be viewed here. All messages are archived with date/time stamps for historical purposes. Only the student and Thesis Editor have access to the messages.

Once the Thesis Editor has received the thesis review submission, the editor will review the files and provide the student feedback via a message within the ETD System. The ETD System emails the student to notify them they have a message from the Thesis Editor and directs them to login to the ETD System to read the message. Attached to the thesis review message is the reviewed PDF draft file and a thesis review checklist. The student reviews the corrections and makes the required corrections to their file.

Once all Thesis Editor corrections, committee corrections and other edits are made, the student submits the final error free file to the graduate school for acceptance (fig. 4). It is in this section that the history and legal dimensions of the ETD discussed in the first section are specified and stored.

The Thesis Editor performs a final review to ensure that all of the thesis review corrections have been made. If the corrections have been made and the file is error free, the Thesis Editor accepts the final file and it is then sent to the library to be catalogued.

The Thesis Editor keeps track of the submissions via the active tab of the Thesis Editor (Admin) Dashboard Screen (fig. 5). The security access is similar to that for the student, except that only the Thesis Editor is allowed to access the Dashboard. Each student submission has a row within the dashboard and remains as a row until the final file is accep-

3. ETD Submission Student Dashboard Screen.

4. Student Final Submission.

Embargo Request	Sep 26, 2010	
Thesis Review Submission	Sep 26, 2010	🖉
Welcome Graduate Student	Sep 26, 2010	

Please choose one of the following:

1) Submit Final   2) Send Other Message   3) Request Embargo

Final File Submission

To submit your final file do the following:

1. **Click the Browse button** to select the location of your final file
2. **Click the Attach button**. A popup will inform you the final file will be renamed 'etd.pdf'
3. If your file upload is successful you will see an 'etd.pdf' file in the attachment area with an x beside it.
4. Type any additional information to the Thesis Editor in the text area and **click the Submit button** to finish your final file submission.
5. If your final file submission process was done correctly you should be able to see the Final File Submission message at the top of the message list. It should include a link to your uploaded final file.

Final *(Must be PDF)*

[Browse...] [Attach]

[Submit]   [Clear]

ted. The row indicates the date of the original thesis review submission, the student name, student id, the date of the last message, the message status (read or unread), degree and attachments. One or more students may be sent a message such as a deadline reminder or other important information regarding the submission process and graduation.

Within the Thesis Editor dashboard, submissions are color-coded for status, with red highlighted text rows for final file submissions, black highlighted text rows for questions from students and black standard text for students that have had a thesis review and are in the editing phase before final submission.

After final files have been accepted, the Released tab may be used to display all released ETDs that are available in the Library catalog for public viewing while the Withheld tab displays papers with an embargo. Students

have the option of having their ETD withheld if they have patents pending or for certain publications. When a file is withheld, only the Thesis Editor is able to view the ETD. The ETD is automatically released by the ETD System on the date the student selected, either 90-days from date of acceptance or 1-year from date of acceptance. Once the file is released, it is catalogued by the library.

RESEARCHER ACCESS INTERFACE
As a requirement of graduation from the state's publicly funded universities, ETDs are required to be available publicly. To review the ETDs, a search can be performed using parameters such as key word, title, or author name at http://www.lib.ncsu.edu/guides/etds/known-ncsu.html . The Library's search tool provides a list including a link to the title, date and authors which allows the

researcher to open both the abstract and the thesis or dissertation online.

TECHNICAL INFRASTRUCTURE
The technical infrastructure of the NCSU ETD System is divided into two separate, independent applications. The first is the ETD submission application, which handles the submission of ETDs and any interactions between the student and the graduate school. The second is the digital repository, which handles the search, retrieval, and archival tasks.

The ETD submission application is built on the standard Apache/PHP/MySQL web development stack. Heavy use is made of the Zend Framework's reusable and object-oriented code toolkit including its Model-View-Control (MVC) development framework. An MVC design allows the application code to be divided into separate data, control, and

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etd Electronic Thesis & Dissertation Submission System

Active | Released | Withheld   Settings

Showing 1 to 81 of 81 entries

Search:

Selected	Thesis Review	Name	Student Id	Last Msg	Msg Status	Degree Type	Attachments
☐	Jul 9, 2010	████	███	Sep 22, 2010	Read	PHD	0
☐	Jul 13, 2010	████	███	Sep 22, 2010	Read	MS	0
☐	Jul 17, 2010	████	███	Sep 22, 2010	Read	PHD	0
☐	Jul 20, 2010	████	███	Sep 22, 2010	Read	PHD	0
☐	Jul 23, 2010	████	███	Sep 22, 2010	Read	PHD	0
☐	Jul 26, 2010	████	███	Sep 22, 2010	Read	MS	0
☐	Jul 27, 2010	████	███	Sep 22, 2010	Read	PHD	0
☐	Jul 28, 2010	████	███	Sep 22, 2010	Read	PHD	0
☐	Jul 29, 2010	████	███	Sep 22, 2010	Read	PHD	0
☐	Jul 29, 2010	████	███	Sep 24, 2010	Unread	MS	1
☐	Jul 30, 2010	████	███	Sep 22, 2010	Read	MS	0
☐	Jul 30, 2010	████	███	Sep 22, 2010	Read	PHD	0

5. Thesis Editor Dashboard Screen.

display layers that minimize coding errors. Javascript, specifically JQuery, and AJAX are used to streamline the user experience and provide a more polished interface.[3]

The digital repository application is a customized DSpace 1.6 installation. DSpace is coded in Java and runs under the Tomcat application server using PostgreSQL as its database. Development of the DSpace platform is ongoing through the Duraspace umbrella organization. DSpace also provides tools to check the integrity of the stored ETDs for archival purposes, allows easy maintenance of the ETD metadata coming for the Student Information System, and supports many dissemination protocols like the Open Archive Initiative (OAI) to allow the widest possible access for the final ETDs.[4]

USAGE STATISTICS OF THE ETD SYSTEM (SPRING-FALL 2010)
a) Total number of students processed: 291
b) Total number of messages: 2,793
1) From students: 1,068
2) From the Thesis Editor: 1,725
c) Total numbers of files uploaded: 1,464

REFERENCES

[1] NCSU Graduate School Electronic Thesis & Dissertation (ETD) Guide: http://www.ncsu.edu/grad/etd/docs/etd-guide.PDF

[2] NCSU Graduate School Electronic Thesis & Dissertation Website: http://www.ncsu.edu/grad/etd/

[3] NCSU Libraries ETD Database: http://www.lib.ncsu.edu/guides/etds/known-ncsu.html

[4] "Development and operation of a fully electronic Thesis and dissertation submission and review system with digital repository at North Carolina State University", Edelman, Cutchins, Earl and McEachern. ICERI2010 Conference, Madrid, Spain. November 2010.

[5] Sustainability of Digital Formats: http://www.digital-preservation.gov/formats/fdd/fdd000125.shtml