

ETDs in ProQuest and the Institutional Repository: A Descriptive Study of the Current Workflows Available for Dual Online Submission

Abstract

The following study used primary and secondary data sources to identify and describe the current workflows available for the dual online submission¹ of graduate electronic theses and dissertations (ETDs) into the institutional repository (IR) and the ProQuest system. The main objective of the study is to provide a comprehensive examination of these workflows and to describe their characteristics and capabilities to manage the different aspects and stages of the ETD submittal cycle, from online deposit to publication and distribution. Workflow aspects discussed in this study include: ETD review process, metadata management, publishing options and access restrictions, consent agreements, embargo control, payments and fees, preservation, options to opt-out from ProQuest submission, and turnaround time for the ETDs to display in the systems, among others. Interoperability aspects between ProQuest and the IR systems, in addition to issues encountered with the workflows, are also discussed. Institutions looking for practical decision-making information on ETD workflows and processes could derive much benefit from this study.

Introduction

In the past 12 years, electronic theses and dissertations (ETDs) have become one of the most sought and used information resources in higher education. This is due, in part, to mass digitization efforts, mandatory electronic requirements, and new technologies, which have made ETDs more available than ever before. This fact has not gone unnoticed by institutional decision makers, who want to maximize their access in order to bring more visibility to the institutions' research endeavors. One way to maximize access to these resources is by distributing them in multiple indexed venues with high traffic, such as the institutional repository (IR) and the ProQuest Dissertations and Theses (PQDT) database. This practice of dual submission of ETDs into the IR and PQDT is used by many libraries and has become increasingly popular in the last 10 years (Clement & Rascoe, 2013).

Currently, there are three methods that can be used for the dual online submission of ETDs into the IR and ProQuest's system. These methods consist of submission using the: ETD Administrator tool, File Transfer Protocol (FTP), and harvesting (ProQuest, n.d.-a). The methods can be implemented with a variety of workflows and processes. Some of these workflows are

¹ In the context of this study, online submission refers to a process that requires network connectivity.

very popular, while others are less known, as the literature on ETDs tends to concentrate on the same type of workflow, whereas information on the others is rarely covered. So far, studies on ETD workflows and practices predominantly consist of case studies that describe local institutional implementations, or large-scale studies that provide general trends in aspects of the ETD workflow that are discussed as discrete elements, rather than as components, of the whole workflow cycle (Flynn & Ahrberg, 2020; McMillan, Halbert, & Stark, 2013; Rasuli, Solaimani, & Alipour-Hafezi, 2019).

No study yet has performed a large-scale overview of the different types of workflows available for the dual online submission of ETDs into ProQuest and the IR, nor describe their characteristics and units as integrated parts of the workflow cycle. The following study addresses this gap in the literature by providing a comprehensive examination of these workflows, and by describing their characteristics and capabilities to manage the different aspects of the ETD submittal cycle, from online deposit to publication and distribution. Interoperability aspects between the ProQuest and IR systems, in addition to issues encountered with the workflows, are also discussed.

Literature review

The first attempts at creating online processes for the submission of ETDs into ProQuest and the IR date back to 1997, when ProQuest began accepting ETDs sent via FTP and leading institutions, such as Virginia Tech, began the implementation of IR software (e.g. ETD-db) to be used in the management of ETD workflows (Crowe, 1998; Networked Digital Library of Theses and Dissertations, n.d.). By then, ProQuest was only able to handle online submissions of textual electronic files, while multimedia had to be sent in analog formats (e.g. CD-ROMs, floppy disks) through regular mail (University Microfilms [UMI], 1997). When ETDs were received by ProQuest, they were printed out, microfilmed, and entered in the ProQuest archival database, which by then was called ProQuest Digital Dissertations (PQDD), for online distribution (Crowe, 1998). If ETDs were deposited in ProQuest and the IR, the submission process was done using separate procedures. Full-text access was provided through the IR and was limited through the PQDD database to subscribers only. An option to browse the first 24 pages of the ETDs was also available for free (McCutcheon, 2010). Bibliographic metadata in the form of Machine-readable Cataloging Standard (MARC) records was provided to the institutions, which could be uploaded into the library catalog for additional access.

By 2001, ProQuest received 3% of the total theses and dissertations submitted that year in electronic format, and over the next year, that number increased to 5%, or 3,000 ETDs (McLean, 2016; ProQuest, 2003). ProQuest referred to the FTP submission method as “the most efficient means of submission” (UMI, 2001), while they were still “limited in the handling of multimedia” formats (Edminster & Moxley, 2002, p. 93). With the number of ETD submissions expected to increase over the next years, and to better handle the complexities of multimedia formats, the company developed in 2003 a “web-based application for the submission, review, and approval of ETDs, in conjunction with the Berkeley Electronic Press (Bepress),” who developed the backend technology (ProQuest, 2003). The new system, called ETD Administrator, allowed students to upload their approved ETDs online, including supplementary multimedia files (Savage, 2004), and forward them to the graduate school for final review. Once accepted, the ETDs were delivered to ProQuest and the university library via FTP in zip packages. The packages contained the full-text files of the ETDs, their associated files, and metadata in

ProQuest Extensible Markup Language (XML) schema. Libraries had the option to upload these files into the local IR, but these copies were “intended for local access or dark storage only.” If the library had plans to distribute the files beyond campus, special arrangements had to be set with ProQuest (2004a). These restrictions probably caused many institutions during this timeframe to only provide campus access through the IR for the returned ETD files. Institutions that sent the ETDs to ProQuest via FTP, instead of the ETD Administrator, however, provided full-text access in the IR beyond campus (McCutcheon, 2010).

In the next couple of years, the implementation of IRs for the management of ETD workflows began to gain momentum throughout the United States. Many used the open-source IR software DSpace, followed by Fedora, ETD-db, and other commercial software (Bailey Jr. et al., 2006). To keep up with the IR trend, ProQuest launched their own IR software in 2004 called Digital Commons, also powered by Bepress (ProQuest, 2004b). Institutions that implemented Digital Commons, and also submitted their ETDs via the ETD Administrator, received feeds of their ETD metadata, which were deposited directly into the IR. These feeds contained a link that redirected users back to the PQDT database for full-text access of the ETDs, but the database was restricted to subscribers and institutional affiliates only (Bergin & Roh, 2016; Hall, Hoover, & Wolverson Jr., 2005).

By 2006, a study from the Association of Research Libraries reported 37 of its members already had an operational IR, with 31 others planning one by 2007 (Bailey Jr. et al., 2006). Though most of these libraries reported uploading their full-text ETDs into the IR and performing most of the workflow tasks in there (Bailey Jr. et al., 2006), many continued to also deposit their ETDs in ProQuest. The same study revealed some institutions were already importing ETD metadata from external systems and mapping it to the IR metadata for ingestion in the IR, with half of them enhancing the metadata supplied by depositors afterwards (Bailey Jr. et al., 2006). This type of workflow was incrementally used over the next couple of years by institutions who used the ETD Administrator and received the ETD files via FTP. The workflow was first documented by Averkamp and Lee in (2009), and soon later, it was implemented by many other institutions throughout the United States with local customizations (Li, Theimer, & Preate, 2014; Mak, 2014; Neds-Fox, 2012).

Over the next couple of years, additional methods for the dual online submission of ETDs into ProQuest and the IR became available. In 2010, the Texas Digital Library (TDL) released an open-source tool called Vireo, which addressed “all steps of the ETD process, from online submission to publication in an institutional repository” (TDL, 2010). The system quickly became a popular alternative to the ETD Administrator among higher education institutions in Texas (Larrison, 2014). Some institutions outside the state also adopted the system a few years later (Spradlin & Zulauf, 2014). In 2012, ProQuest introduced two additional methods for the management of ETD workflows due to an increasing demand for alternative options. The first method used the Simple Web-service Offering Repository Deposit (SWORD) protocol to return the ETD files and metadata that were deposited through the ETD Administrator by institutions that used the DSpace IR software (Walker, Collier, & McLean, 2013). This method was created to “accommodate re-occurring requests for direct deposits [of ETDs] into the IRs” (ProQuest, n.d.-b). The second method introduced during this timeframe was the harvesting method, which was originally created to facilitate the submission of ETDs by international institutions and institutions with IR software that did not support the SWORD protocol (ProQuest representative, personal communication, August 16, 2019). In this method, ETDs are deposited first in the IR

and they are later harvested by ProQuest through the IR's Open Archives Initiative (OAI) feed (Borrelli & Harmon, 2019; ProQuest, n.d.-c; Veve, 2020).

Methodology

The following study used the descriptive research design to identify and describe the current workflows available for the dual online submission of graduate ETDs into the IR and ProQuest. Descriptive research is defined as research that “attempts to describe a group of people, phenomenon, or event” (Encyclopedia of Research Design, 2010, p. 1254). It focuses on answering the how, what, when, and where questions, rather than the why. A combination of primary and secondary data sources was used in this study. Data was gathered using mixed methods and was collected throughout the period of two years, from 2019 to the middle of 2021 in three stages.

In the first stage, an exhaustive review of the literature on ETD workflows and processes was performed to initially identify the types of workflows available for the dual online submission of ETDs into ProQuest and the IR. In the context of this study, online submission refers to a process that requires network connectivity. Types of secondary sources consulted during this stage included peer-reviewed publications, conference proceedings, IR's blogs and listservs, and ProQuest's current and archived webpages.

In the second stage of the study, detailed information on the different aspects of the ETD workflows was collected from publicly available institutional documentation on ETD workflows and submission guidelines. This documentation was gathered online from a sample of 62 U.S. institutions who currently submit their ETDs to both ProQuest and the IR using online methods. There are three online methods mentioned in ProQuest's website: submission through the ETD Administrator tool, FTP, or harvesting (ProQuest, n.d.-a). Therefore, institutions included in this study use at least one of these online methods in their workflows. To ensure representation from each type of online method in the sample, a proportionate amount of institutions per method type was selected. These institutions were identified from multiple sources. The ETD Administrator's Participating Institutions website was used to identify institutions that use the ETD Administrator tool (ProQuest, n.d.-d). To identify institutions that use FTP, a mixture of IR's user groups, listservs, online documentation, presentations, and Google searches were used; and to identify the institutions that use harvesting, a list of institutions that use this method was provided to the author(s) by a ProQuest representative.

The sample size of the study was calculated using the Qualtrics' Sample Size Calculator tool (<https://www.qualtrics.com/blog/calculating-sample-size/>) and was determined using a population size of 730 institutions, with a confidence level of 90% and a margin of error of 10%. The population size was approximate and was estimated from the number of institutions in the PQDT database that currently submit their ETDs to this system (as of May 2021) and also host them in the IR. To guarantee representation from each sector of the U.S. population, small, medium, and large size institutions, as well as public and private ones from different regions, were selected in the sample. International institutions and institutions that use the ETD Administrator tool on a trial basis were excluded from the sample.

In the third and final stage of the study, a series of informal unstructured interviews were made to some of the institutions in the sample. This was done to gather more in-depth data about the workflow types and to address questions that could not be answered from the online documentation. An average of three institutions per workflow type were interviewed. Though

approval from the Institutional Review Board was requested at the beginning, it was determined it would not be necessary as the study did not meet the regulatory definition of research with human subjects (45 CFR § 46.102e). Permission to include material in this paper that originated from the interviews was requested from participants. To protect their privacy, information gathered from the interviews was anonymized, paraphrased, and presented in the aggregate. An attempt to have representation from a variety of variables in each workflow type was also made (e.g. different types of IR software, processes used, etc.).

Finally, data gathered throughout the study was: 1) transcribed and organized in a table, 2) reviewed and analyzed using the thematic analysis approach to identify patterns and common themes, and lastly, 3) categorized accordingly and presented in the next section.

Findings

From the collected and aggregated data, a total of seven workflows were identified for the dual online submission of ETDs into ProQuest and the IR. For the purposes of this study, these workflows were classified into three main categories:

- ProQuest ETD Administrator workflows (4 workflows)
- FTP workflows (2 workflows)
- Harvesting workflows (1 workflow)

ProQuest ETD Administrator workflows

There are four types of workflows used with the ETD Administrator (ETD Adm) tool. In all of them, students, or graduate school administrators on behalf of students, submit the approved full-text ETDs and supplemental files through this tool. Inside, a template with the students' information and ETD metadata is filled. Publishing options and access restrictions that apply to the ETDs in both the IR and ProQuest are selected, and consent to the ProQuest's and IR's publishing agreements is provided. Any payments due for additional services are also handled inside the system. Afterwards, the ETDs are forwarded to the graduate school, and sometimes to a special review committee (Jenkins, 2020), before they are distributed to ProQuest and the IR, in the case they are delivered to the IR. Once the ETDs arrive at ProQuest, they are reviewed by the ProQuest team before they are displayed in the PQDT database within eight to 10 weeks (ProQuest, n.d.-e).

Workflow 1: ETD Administrator => then ETDs are sent to IR using FTP

How does it work?

This is the most popular workflow utilized by institutions so far. In this workflow, ETDs are delivered to the institution in zip packages via FTP after they have been approved and marked for delivery in the ETD Administrator system. Each zip package contains the full-text ETD in PDF, ProQuest XML metadata, and any supplemental files. Once the zip packages arrive, they are downloaded and the ProQuest metadata is crosswalked into IR metadata for ingestion in the IR. Most of the time, this step is performed by the library, which sometimes enhances the

metadata received with Library of Congress Subject Headings (LCSH) before the ETDs are uploaded in the IR.

Systems requirements

ETD Administrator and FTP server to receive the zip packages.

Are metadata conversions between different schemas/formats necessary?

Yes, because the metadata received by the institution comes in ProQuest XML schema and it has to be crosswalked into IR XML schema before being uploaded in the IR. These crosswalks have to be performed on the institution's side either manually, semi-automatically or automatically, depending on the technology used by the institution. Most institutions perform these crosswalks using stylesheets or locally developed scripts.

Transfer of special characters between systems

Some institutions complained that after they crosswalk the incoming ProQuest XML metadata with stylesheets, they have to perform additional editing to deal with illegal characters that display in the metadata. In addition, many times the incoming metadata also come with non-encoded special characters that have to be fixed before the metadata is uploaded in the IR.

Turnaround time for ETDs to display

After the ETDs have been approved and marked for delivery in the ETD Administrator, institutions can select to have them delivered to ProQuest and the institution simultaneously or at different times (UMI, 2008). Also, they can be delivered incrementally as they become available, or all at once in batch. Most institutions that use this workflow receive the zip packages between three to four times a year. Although receiving an FTP package may take a couple of minutes, publication in the IR will depend on the process followed by the institution to unzip the files and perform the metadata crosswalks, quality control, enhancements, and batch uploads to the IR. This process may take from a couple of weeks to months.

Workflow 2: ETD Administrator => then ETDs are sent to IR using SWORD protocol

How does it work?

In this workflow, ETDs are deposited directly into the IR by using the SWORD protocol after they have been marked for delivery in the ETD Administrator. The ETDs are sent in Metadata Encoding and Transmission Standard (METS) zip packages that contain the full-text ETD in Pdf, ProQuest XML metadata, and any supplemental files. Once the METS packages are received in the IR, they go through a built-in import profile (METS ingester) that contains a stylesheet that automatically crosswalks the incoming ProQuest metadata into the recipient's IR metadata schema for ingestion in the IR. In a few instances, the library holds the public display of the SWORD feeds in the IR to enhance the metadata received and to correct students' typos before the ETDs are publicly displayed in the IR.

Systems requirements

ETD Administrator and IR software that supports the SWORD protocol to receive direct deposits from ProQuest. Examples of these software are: Esploro, DSpace, Fedora, Eprints, Figshare and their derivatives, such as Islandora and Samvera/Hydra (both based on Fedora),

DSpace Express and Open Repository (which are customized versions of DSpace hosted and maintained by the Atmire service provider), and ScholarWorks (based on Samvera). As of 2021, ContentDM (Phipps, 2019) and Digital Commons (Bepress representative, personal communication, April 21, 2020) do not support the SWORD protocol.

Are metadata conversions between different schemas/formats necessary?

Yes, because the metadata received by the institutions comes in ProQuest XML schema and has to be crosswalked into IR XML schema before ingestion in the IR. Even though these crosswalks have to be performed on the institution's side, they are done automatically by a stylesheet in the IR system, which has to be mapped and configured by the institution to receive the metadata ingests. Although these crosswalks are automatic, many times the metadata received has to be edited afterwards as some special characters do not transfer well into the IR system.

Transfer of special characters between systems

In some instances, special characters in the abstracts or titles do not transfer correctly into the IR and display as Hypertext Markup Language (HTML) tags instead. To fix these problems, some institutions run cleanup jobs to the metadata received and reimport it to the IR. These problems, however, are not seen in IRs that are hosted and maintained by service providers such as DSpace Express and the Open Repository.

Turnaround time for ETDs to display

After the ETDs have been marked for delivery in the ETD Administrator, they are gradually deposited in the IR overnight.

Workflow 3: ETD Administrator => then metadata feeds are sent to IR

How does it work?

In this workflow, Digital Commons customers under a legacy agreement receive metadata-only feeds deposited in their IR accounts for the ETDs they submit through the ETD Administrator. This legacy agreement was established in 2007 between Bepress and ProQuest, after Bepress took over the rights of Digital Commons (Bepress representative, personal communication, November 13, 2019). Prior to July 2007, these feeds were deposited automatically by ProQuest into the participating Digital Commons' accounts, but now these metadata feeds are sent in spreadsheets to Bepress, who then uses a script to process and upload the metadata into the back end of the participating Digital Commons' accounts (Bepress representative, personal communication, November 13, 2019). The metadata in these feeds contain the ETDs' authors, titles, abstracts, and uniform resource locators (URLs) that link out to the full-text version of the ETDs in the PQDT database. Only institutional affiliates and/or subscribers to the PQDT database can access the full-text version of the ETDs via these feeds, which usually display as a "campus only" or "restricted access" series in the IR. In addition to the metadata feeds, some institutions also receive the full-text version of the ETDs via FTP, which they sometimes upload into the IR as separate series from the metadata-only series, creating a duplication of series in the IR which can sometimes be confusing to users.

Systems requirements

Only Digital Commons customers that installed their Digital Commons IRs between 2004-2007, under a legacy agreement between Bepress and ProQuest, who previously hosted the IR until 2007.

Are metadata conversions between different schemas/formats necessary?

No, because the metadata in the spreadsheets is sent in textual format (not XML).

Transfer of special characters between systems

In some instances, subscripts, superscripts, and some special characters in the metadata feeds do not transfer well into Digital Commons because they are not formatted for HTML display. To fix these issues, some institutions have to contact ProQuest as this cannot be fixed on the institutions' side.

Turnaround time to display in IR

After the ETDs have been marked for delivery in the ETD Administrator, they are processed by ProQuest. Afterwards, spreadsheets with the ETDs' metadata are sent to Bepress around the 15th of each month. Bepress processes this metadata on the 19th and publicly displays it in the Digital Commons' accounts a few days later (Bepress representative, personal communication, March 12, 2021).

Workflow 4: ETD Administrator & IR separate submission

How does it work?

In this workflow the graduate school, or students, submit approved ETDs and supplemental files into the IR and ProQuest in separate processes. Most institutions in this study deposit the ETDs first in the IR, and after final review from the graduate school, the ones selected for deposit in ProQuest are uploaded in the ETD Administrator. A metadata template with information on the student and the ETD is filled in both places. Publishing options, access restrictions, and publishing agreements that apply to the ETDs hosted in ProQuest are managed inside the ETD Administrator's settings. The restrictions and publishing agreements that apply to the ETDs in the IR are handled outside the ETD Administrator, through paperwork that is submitted to the graduate school. Many of the institutions that use this workflow forward the ETDs to the library for metadata enhancements and final review, before they are posted in the IR.

Systems requirements

ETD Administrator and any IR software.

Are metadata conversions between different schemas/formats necessary?

No conversions are necessary, as the IR and ETD Administrator systems do not communicate with each other, so no metadata is transferred between them.

Transfer of special characters between systems

Does not apply in this workflow as no data is transferred between the systems.

Turnaround time for ETDs to display

In the IR, ETDs can display as soon as they are uploaded and approved by the graduate school, and in some cases, after they are cataloged by the library. Because this process will not depend on receiving anything from ProQuest, the ETDs may be available faster than with the other ETD Administrator methods.

Other characteristics of the ETD Administrator workflows

Embargo control

Table 1. Embargo control in ETD Administrator workflows

Embargo	ETD Adm + IR submitted separately	ETD Adm => IR using SWORD	ETD Adm => IR using FTP	ETD Adm => IR metadata feeds only
Control settings	Embargo restrictions for ETDs in ProQuest are controlled either in the: a) paperwork that is sent to the graduate school or b) inside the ETD Administrator’s “ <i>ProQuest Publishing Options</i> ” section. Embargo in the IR is controlled in the IR’s settings and paperwork that is sent to the graduate school.	Embargo restrictions that apply to ETDs in both IR and ProQuest are controlled in 2 separate sections of the ETD Adm’s settings: 1) <i>ProQuest Publishing Options</i> : controls embargo in ProQuest. Offers 4 embargo length options: 6 months, 1 year, 2 year, or until a specified date set by student (in accordance with institution’s policy) 2) <i>IR Publishing Options-IR delayed release options</i> : controls embargo in IR. Offers up to 5 embargo length options (ProQuest, 2013) customizable by the institutions. This section is optional and can be removed if desired.		
Content release	Embargoed ETDs are deposited in the IR and the ETD Administrator.	Full-text embargoed ETDs and metadata are sent to institutions with the rest of the other ETDs, for except the ones applying for patents, which are not delivered until the restrictions end.		
Content display	While on embargo, only metadata of the ETDs is displayed in the IR and PQDT. Full text is automatically available in both places upon embargo expiration.	In PQDT, only metadata of the embargoed ETDs will display. In the IR, the full-text of embargoed ETDs may sometimes display.	In PQDT, only metadata of the embargoed ETDs will display. In the IR, the content displayed will depend on the institution. Most display the metadata while others do not display anything until the embargo expires.	Only metadata of the embargoed ETDs will display in PQDT and the IR.
Reported issues	If submission to ProQuest is done by stud, they may select a diff embargo date from the one selected in the IR.	Some institutions reported getting the full-text embargoed ETDs deposited in the IR, which institutions have to manually remove afterwards.		None reported
		Sometimes students: 1) indicate different embargo periods in the ProQuest and IR publishing options, 2) select to embargo their ETDs in the IR through the ETD Administrator without previous approval from the graduate school, 3) select to embargo their ETDs in one place and not in the other 4) can get confused by having two publishing sections in the ETD Administrator.		

Access restrictions in the IR

Some institutions provide students with the option to apply access restrictions to all or part of their ETDs in the IR, as well as the audience. When allowed by the institution, these restrictions can be controlled in the “IR access options” section of the ETD Administrator. These options are customizable (ProQuest, 2013) and can range from full-text access, abstract only, or campus access only. Institutions that do not wish to provide IR access restrictions to their students, can select not to display this section in the ETD Administrator. If the ETDs are submitted separately to the IR and the ETD Administrator, the access restrictions in the IR are controlled outside the ETD Administrator, through the IR’s settings.

Option to opt-out from ProQuest submission

Workflows that submit ETDs through the ETD Administrator tool, for except the ones that submit separately to ProQuest and the IR, do not provide the option to opt-out from ProQuest submission. Moreover, access restrictions cannot be applied to the visibility of the ETDs hosted in ProQuest, for except the embargoed ones, as there are no settings in the ETD Administrator to control that. While that is the case for most institutions, a few prestigious ones that submit their entire ETDs through the ETD Administrator only display the abstracts of the ETDs in the PQDT database, not the full-text. That is probably controlled through a separate arrangement set with the company and not through the ETD Administrator tool.

ORCID ID provision

Open Researcher and Contributor identifiers (ORCID IDs) are persistent alphanumeric codes that can be used to uniquely identify authors and scholars. The ETD Administrator tool has a feature in the submission template that institutions can turn-on to require ORCID IDs from students or to make them optional.

Controlled vocabulary options

Only terms from the ProQuest controlled vocabulary list and keywords can be provided in the ETD Administrator’s workflows.

FTP workflows

There are two types of workflows that use FTP to submit ETDs to ProQuest.

Workflow 5: IR or homegrown submission tools send FTPs to ProQuest

How does it work?

In this workflow, students submit their ETDs and supplemental files through the IR or a homegrown submission tool, which then forwards the ETDs to the IR. The ETD advisors’ review is usually performed before the ETDs are submitted in these tools, but sometimes it is done inside the system. In these tools, students fill a template with their information and ETD metadata, select access restrictions that will apply to their ETDs in the IR (if allowed by the institution), and provide consent to the IR’s publishing agreement. Then the ETDs are forwarded to the graduate school for final review, and sometimes to the library for metadata, before they are publicly displayed in the IR. Afterwards, the ETDs, supplemental files, and ProQuest XML metadata are exported to ProQuest in zip packages, either through an FTP feature that is

integrated in the submission tools or through a separate FTP software. The publishing options, restrictions, and publishing agreements that apply to the ETDs in ProQuest, in addition to any payments due, are usually handled through paperwork and online payments that are submitted to the graduate school, which then forwards them electronically to ProQuest. Some institutions, however, prefer not to handle the ProQuest paperwork and payments themselves and rather use a “light” version of the ETD Administrator to manage these items.

Systems requirements

Any IR software and FTP software to send the ETDs.

Are metadata conversions between different schemas/formats necessary?

Yes, because the metadata has to be crosswalked on the institution’s side from IR XML metadata, or text, to ProQuest XML metadata before it is exported to ProQuest. Only a few submission tools can generate the ProQuest XML files automatically, while others cannot and have to perform the metadata conversions manually or semi-automatically. One institution, however, reported not sending the ProQuest XML metadata due to previous issues encountered with the zip packages sent, and rather use the ETD Administrator light version to send the ETD metadata.

Transfer of special characters between systems

The systems investigated in this section are compliant with the Unicode Transformation Format 8-bit (UTF-8), which ensures special characters are preserved in the metadata that is transferred between systems. However, one institution reported they occasionally get errors in the metadata students enter in the submission forms when they copy-and-paste text from sources that are not UTF-8 compliant, which is something the institution has no automatic way to correct.

Turnaround time for ETDs to display

After the ETDs are received by ProQuest, they display in the PQDT database within six to 10 weeks (ProQuest, 2018). In the IR, they can display as soon as they are approved and uploaded in the system, but if they are forwarded to the library for cataloging and enhancement, the process may take longer, from a couple of weeks to months.

Workflow 6: Consortia tools send FTPs to ProQuest

How does it work?

In this workflow, students submit their approved ETDs and supplemental files through a consortia ETD submission tool. The tools investigated in this section are Vireo 4.0, originally created in 2010, and the Ohio Library and Information Network (OhioLink) ETD Center’s tool, created in 2001. In both tools, a template with the students’ information and ETD metadata is filled. Access restrictions and publishing agreements that apply to the ETDs in both ProQuest and the IR are also managed inside these tools. After submission, the ETDs are forwarded to the individual graduate schools for final review before they are sent to ProQuest via an FTP export feature that is integrated to these tools. To export the ETDs to the IR, Vireo uses the SWORD protocol for direct deposits. The OhioLink’s tool does not export the ETDs to the individual IRs, but to the OhioLink’s ETD Center, which serves as the consortia ETD repository for 35 Ohio

institutions. Although this tool does not export the ETDs to the individual IRs, it provides ETD metadata in MARC format which institutions can harvest from the ETD Center’s OAI feed and upload into their individual IRs (Flynn, 2020). The metadata contains URLs that link out to the ETD Center for full-text access of the ETDs. None of these systems handle payments, and for that reason, any payments due to the institutions have to be managed through the graduate school’s electronic payment system. Some institutions also use the ETD Administrator light version to order and pay for additional services requested from ProQuest.

Systems requirements

For Vireo, IR software that supports the SWORD protocol to directly deposit the ETDs into the IR. For the OhioLink’s tool, no technological requirements are necessary, besides being an OhioLink institutional member.

Are metadata conversions between different schemas/formats necessary?

Yes. In the case of Vireo, the ETD metadata students enter in the submission form has to be transformed into ProQuest XML metadata before it is exported to ProQuest, and to METS DSpace Sip format for export to the IR (Larrison, 2019). This process, however, is done automatically by Vireo and no human intervention is necessary. In the case of the OhioLink’s tool, no metadata conversions are necessary for the metadata that is sent to ProQuest, as it is delivered in spreadsheets, or for the metadata that is sent to the OhioLink ETD Center’s repository, which is transferred from the OhioLink’s tool (OhioLink representative, personal communication, November 15, 2019). However, if metadata from the OhioLink’s ETD Center is uploaded into the IR, it needs to be transformed from MARC to IR metadata before ingestion.

Transfer of special characters between systems

Vireo 4.0 is UTF-8 compliant, which ensures there are no issues in the transferring of special characters between systems. In the case of the OhioLink’s tool, special characters in the metadata have to be encoded in HTML to transfer correctly into other systems.

Turnaround time for ETDs to display

In Vireo, as soon as the ETDs are approved and published in the system, they are sent directly to ProQuest (via FTP) and to the IR (via SWORD deposit). The FTPs arrive in minutes and the SWORD deposits are received immediately after been submitted. In the OhioLink’s tool, the ETDs are posted in the ETD Center as soon as they are approved in the system, but they are sent to ProQuest only twice a month, on the 1st and 15th (OhioLink representative, personal communication, November 15, 2019). After the ETDs are received by ProQuest, they display in the PQDT database within six to eight weeks.

Other characteristics of the FTP workflows

Embargo control

Table 2. Embargo control in FTP workflows

Embargo	OhioLink’s tool	Vireo tool	IR or homegrown submission tools
Control settings	IR and ProQuest embargo requests are controlled inside the tools’ settings. Some institutions require additional paperwork to be submitted to		IR embargo is controlled inside the IR’s settings and the paperwork that is submitted to the graduate school.

	the graduate school. Embargo length options in these systems are customizable by the institutions.	ProQuest embargo is controlled either: a) in the Publishing Agreement that is sent to ProQuest by the graduate school or b) in the “ <i>ProQuest Publishing Options</i> ” section of the ETD Administrator light version.
	1 section in tool controls embargo for both ProQuest and IR.	2 separate sections for ProQuest and IR embargo. Embargo length options are customizable by the institutions.
Content release	Embargoed ETDs are hold in the system until the embargo expires, then they are sent to ProQuest and released in the OhioLink ETD Center’s repository.	Embargoed ETDs can either be: a) put on hold in the system until the embargo expires, then released to ProQuest and the IR or b) sent with the others, leaving ProQuest to enforce the embargo in the PQDT.
Content display	Metadata of embargoed ETDs will not display in PQDT but will display in the OhioLink’s ETD Center.	Only metadata of embargoed ETDs will display in the IR and PQDT. Full text will be automatically available upon embargo expiration.
Reported issues	None reported	

Access restrictions in the IR

Most of the tools used in the FTP workflows provide students with the option to apply full, partial, or audience restrictions to their ETDs in the IR. Vireo allows partial access restrictions to be applied in the IR, but does not allow full-text access restrictions. All the homegrown tools in this study, for except one, have settings students can use to apply access restrictions in the IR. The OhioLink’s tool provides options for temporary access restrictions in the OhioLink ETD Center’s repository, but not in the individual IRs.

Option to opt-out from ProQuest submission

All the workflows that use FTP provide the option to opt-out from ProQuest submission, if allowed by the institution. In the case of Vireo and the OhioLink’s tool, there is a feature inside the tools where students can select to opt-out. The other tools in this study provide that option, but not inside the tool, but through the publishing agreements that are submitted to the graduate school.

ORCID ID provision

The provision of ORCID IDs in the FTP workflows will depend on the options available in the metadata template students fill in the IR or submission tool. Some tools, like VIREO and the OhioLink’s tool, provide an ORCID entry in their metadata templates while some of the other systems do not. When ORCID IDs are provided in the system, they are integrated into the ProQuest XML metadata that is sent to ProQuest and they display as a <DISS_orcid> tag in the <DISS_ author> section of the ProQuest XML document (ProQuest, 2015). In the case metadata is sent in a spreadsheet, the ORCID IDs are included there.

Controlled vocabulary options

In the FTP workflows, the type of controlled vocabulary utilized will depend on the system used. Vireo provides the option to use more than one controlled vocabulary besides keywords. The OhioLink’s tool is more restrictive and only allows terms from the ProQuest controlled vocabulary list and keywords in the metadata template (Flynn, 2020). The other

homegrown submission tools investigated in this study only allow keywords to be used and one of them requires terms from the ProQuest controlled vocabulary in addition to the keywords.

Harvesting workflows

There is 1 type of workflow that use harvesting to submit ETDs to ProQuest.

Workflow 7: IR gets harvested by ProQuest

How does it work?

In this workflow, approved ETDs and supplemental files are deposited in the IR, where a template with the student's information and ETD metadata is filled. Access restrictions and publishing agreements that apply to the ETDs in the IR are handled through paperwork that is submitted to the graduate school, which is later uploaded to the IR. Access restrictions and publishing agreements that apply to the ETDs in ProQuest are managed by either adding a ProQuest distribution clause to the IR's paperwork that is submitted to the graduate school, or by completing forms in the ETD Administrator light version, which has become increasingly used after ProQuest's decision to stop accepting paper permissions in 2019 (Fazzino, 2020). The ETD Administrator light version can also be used to select publishing options in ProQuest or to submit payments for any additional services requested, such as copyright registration or copy ordering.

After the ETDs have been submitted in the IR, they are forwarded to the graduate school for final review, and sometimes to the library for additional metadata, before they are publicly displayed in the IR. Afterwards, the full-text ETDs are harvested by ProQuest, either automatically through the IR's OAI feed or through a spreadsheet that is sent by email to ProQuest with the ETDs' URLs. The harvests are performed monthly or quarterly, depending on the institution's agreement with the company. Though most of the institutions that use this method get the full-text content harvested by ProQuest, a small number only gets the abstract and metadata harvested and displayed in the PQDT database.

Systems requirements

Any IR software that is compliant with the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH).

Are metadata conversions between different schemas/formats necessary?

No conversions are necessary on the institution's side.

Transfer of special characters between systems

Because this workflow does not receive metadata from other systems, there are no issues in the transferring of special characters on the institutions' side. However, if there were any issues in the metadata transferred, the burden of fixing them would fall under ProQuest as they are the recipients of the metadata.

Turnaround time for ETDs to display

In the IR, ETDs can display as soon as they are approved and uploaded in the system, but if they are forwarded to the library for cataloging and enhancement, the process may take longer. Display in the PQDT database takes an average of six to nine weeks after the ETDs have been

harvested by the ProQuest’s system. The harvesting frequency can be set by institutions, and can range from monthly, to quarterly, and semi-annually.

Other characteristics of the Harvesting workflows

Embargo control

Table 3. Embargo control in harvesting workflows

Embargo	IR deposit => then harvest by ProQuest
Control settings	IR embargo is controlled inside the IR’s settings and paperwork that is submitted to the graduate school. ProQuest embargo is controlled either: a) in the same paperwork that is submitted to the graduate school or b) in the “ <i>ProQuest Publishing Options</i> ” section of the ETD Administrator light version.
Content release	Only metadata of the embargoed ETDs will display in the IR’s OAI feed. The metadata contains a custom field that alerts ProQuest of the ETDs that are under embargo and cannot be harvested. When the embargo expires, the ETDs are harvested by ProQuest.
Content display	While on embargo, only metadata of the ETDs will display in the IR and PQDT. Full text will be automatically available upon embargo expiration.
Reported issues	None reported

Access restrictions in the IR

If allowed by the institution, access restrictions that apply to all or part of the ETDs in the IR are controlled through the IR’s settings or the paperwork that is submitted to the graduate school.

Option to opt-out from ProQuest submission

The harvesting workflows provide the option to opt-out from ProQuest submission if allowed by the institutions. This can be done by either suppressing the metadata that displays in the OAI for the ETDs that opted out, or by displaying a custom field in the OAI that alerts ProQuest of the ETDs that can or cannot be harvested. Institutions that send the spreadsheets with the ETD metadata to ProQuest can select to exclude the ETDs that opted out from the spreadsheet.

ORCID ID provision

In the harvesting workflows, ORCID IDs can be provided if the IR template students fill supplies that option. Most IR software can be customized to integrate ORCID ID fields in the submission forms. When ORCID IDs are supplied in the IR, they are integrated into the ETD metadata that displays in the OAI, which is harvested by ProQuest and later included in the PQDT records.

Controlled vocabulary options

Any type of controlled vocabulary can be used in the harvesting workflows as the ETD submission forms reside inside the IR, therefore, they are controlled and customized by the institutions. Those who use the ETD Administrator light version to submit the ProQuest publishing agreements can also add terms from the ProQuest controlled vocabulary list to their ETDs, in addition to the terms supplied in the IR submission form.

Additional characteristics of all workflows

Preservation services

Some of the systems used in these workflows provide preservation services, while others do not. In the ProQuest publishing agreement students consent to during the submission process, ProQuest agrees to preserve and archive the ETDs submitted to them. This is done in microfilm and in a digital Pdf back up (ProQuest, 2014). Proprietary IR software provides long-term preservation storage, but sometimes it can be limited to particular formats and/or sizes. Most of the open-source IR software do not provide long-term storage nor preservation services, therefore preservation has to be arranged separately by the institutions, either through an institutional archive or a third-party digital preservation storage system. ETDs submitted through the OhioLink's tool are archived by OhioLink, whereas Vireo and the homegrown submission tools do not provide preservation services as they are not permanent storage places nor repositories. Some institutions like to keep physical copies of their ETDs for archival purposes, in addition to the digital versions, and require students to pay a fee for the purchase of microfilm or print copies from ProQuest.

Usage statistics management

Usage statistics of the ETDs hosted in ProQuest can be accessed through an online tool called ProQuest ETD Dashboard. The tool is automatically available to users of the ETD Administrator, while users of other submittal methods, need to request access through an online application (ProQuest, n.d.-f). Usage statistics of the ETDs hosted in the IR are accessible through the IR's metrics, and in the case of the OhioLink's tool, the statistics are available through a customized statistics dashboard (Flynn, 2020). On the other hand, Vireo and the homegrown submission tools do not provide usage statistics as these are not permanent storage places.

ProQuest publishing options and royalties

ProQuest offers two options for the publication of ETDs in their system: the Traditional publishing option and the Open Access publishing option. In both options, the full-text ETDs and abstracts are published in the PQDT database. The difference is that in the Traditional option, the ETDs can only be accessed through a paywall, while in the Open Access option, the ETDs are freely accessible to any user on a permanent basis. The Traditional option offers authors royalties on the ETDs sold, whereas the Open Access option do not pay royalties and requires a one-time submission fee. Some institutions only provide the Traditional publishing option to their students in the submission process, while others provide both options. The ETD Administrator tool can be customized to display the two publishing options in the submission forms, or only the Traditional, whereas Vireo and the OhioLink's tool only display the Traditional option in their submission forms (Larrison, 2019; OhioLink representative, personal communication, November 15, 2019). If the harvesting method is used, Traditional publishing is usually the only option offered, unless the ETD Administrator light version is also used. Institutions that FTP their ETDs to ProQuest, can select any of the publishing options in the publishing agreements they submit to ProQuest.

Copyright of the ETDs

In all these workflows, students retain copyright to their work.

ProQuest submission fees

There is no charge for using any of the submittal methods, or workflows, discussed in this study (Larrison, 2019; ProQuest, 2019). However, there can be submission fees if additional services are requested from ProQuest, or if a publishing option other than the Traditional is selected during the submission process. The Traditional publishing option is free, but the Open Access publishing option has a \$95 charge. A few institutions only submit their abstracts to ProQuest and there is a \$65 fee for that (Clement, 2013; Massachusetts Institute of Technology [MIT] Libraries, 2019). As for the additional services, if copyright registration is requested, there is a \$75 fee, ordering copies can range from \$31 to \$62, and microfilm copies can cost around \$25.

Conclusion

Despite skepticism to the contrary, the dual online submission of graduate ETDs into the IR and ProQuest is becoming an increasingly popular practice among many academic institutions today. Currently, there are 7 workflows identified in this study that could be used for the dual online submission of ETDs into the IR and ProQuest. Each one offers a different set of capabilities to manage the different aspects and stages of the ETD submittal cycle, but also present a series of advantages and limitations.

Workflows that use harvesting, FTP, or submit separately to the ETD Administrator and IR, provide better control over the embargo settings and content release, as embargo is controlled on the institution's side. Also, they can integrate customizations much easier, provide the option to opt-out from ProQuest submission, and ETDs have a faster turnaround time to display in the IR. In addition, workflows that use harvesting, or submit separately to the ETD Administrator and IR, do not have to perform metadata conversions, while in the Vireo workflow, these conversions are done automatically by the system. These workflows, however, present some limitations. In the case of the harvesting and the OhioLink workflows, ETDs are sent to ProQuest in cycles, rather than immediately after approval in the system, which may delay the time ETDs get to ProQuest. In the Vireo workflow, only IR software that is SWORD compliant can be used and preservation services are not provided. In the case of the FTP workflows, for except the ones that use consortia tools, metadata conversions are required. Also, they have double submittal points and do not manage the submission process in one place, which can be a laborious and time-consuming activity. This problem is also seen in the workflows that submit separately to the ETD Administrator and IR. Lastly, none of these workflows manage payments in their systems, but this limitation has been recently addressed by using the ETD Administrator "light" version on the side.

On the other hand, workflows that use the ETD Administrator, and do not submit separately to ProQuest and the IR, offer a centralized place to manage the whole submission process and only have one submittal point, which may be easier for institutions with a large volume of ETDs, but not much time nor staff to process them. In addition, these workflows handle payments in the system and provide preservation services. Nevertheless, the ETD Administrator workflows also have their limitations. First, they do not integrate customizations as easily as with the other workflows and do not provide the option to opt-out from ProQuest submission. They also are more prone to issues with embargo control and the metadata that is sent to the institutions, which usually has to be remediated. The embargo issues, however, can be addressed by either: not

displaying the IR embargo options in the ETD Administrator, by using the same embargo periods for the IR and ProQuest, or by catching any incongruences in the embargo periods at the review stage, before the ETDs are delivered to the systems.

While any of these workflows can be used by any institution, regardless of size and budget, their suitability and successful implementation will depend on various factors. Some of these factors relate to the institutions' available resources, including technology and support, ETD volume, staff and time to process the ETDs; whereas other factors relate to the institutions' preferences towards embargo control, metadata, student options, and ETD turnaround time. Finally, no matter what workflow is selected, there will always be constraints that institutions must address, which will have to be taken in consideration before any process is adopted and implemented.

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