

# 19 The Born Digital Graduate: Multiple Representations of and Within Digital Humanities PhD Theses

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## Abstract

This chapter examines the production and utilisation of digital tools to create and present a born-digital theses, and in so doing, considers the changing function of traditional theses. It asks how (relatively) new technologies and methodologies should affect the representation and function of graduate scholarship in the Digital Humanities (DH), and moots an alternative to the print thesis, proposing instead two alternative texts: one a static PDF (representative of a traditional print thesis), and another enriched version, congruent with DH methods and tools, which incorporates functional boundary objects such as interactive timelines, and also explicitly documents the use of historical sources. These objects serve both to enhance the readers' experience, and to expose the scholarly process. An overview is provided of the methodology used to generate the multi-format digital thesis – derived, modified, transformed and visualised from XML – encoded scholarship. As such, we consider the implications of the creation of this single base XML encoding that, combined with software processing tools, can generate multiple representations of research. This chapter is based upon the working methodology of Webb's (2011) PhD thesis.

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**Keywords:** digital humanities, digital scholarship, born digital graduate, XML, XLST, XLS-FO.

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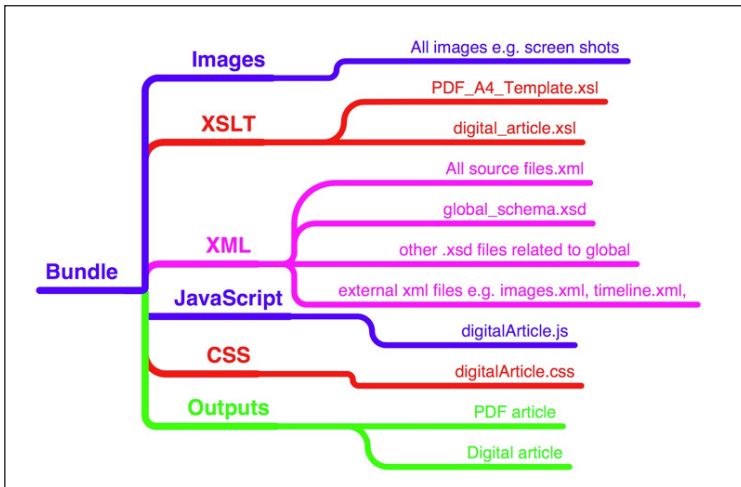
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# 1. Introduction

Given the digital humanities place within traditional research, this chapter asks, if a digital approach is used to create research, why should its presentation be limited to the traditional, static representation of that research. Here, we discuss one approach or methodology to present scholarship online that takes advantage of the digital medium and its inherent functionality, moving beyond static scholarly texts. Webb's (2011) thesis examines procedures and strategies for conducting humanities research using digital tools and applications within a historiographical system. Thus, this chapter is central to a reflective and reflexive process resulting from, and in, the critical self-evaluation of such theses and their outputs. As Webb's (2011) PhD indicates, we use digital humanities methodology to create or formulate knowledge, but how do we adequately represent such a digital humanities thesis? It should embody the digital humanities principles and research that helped to create it. In an effort to address this, we have instead used XML and XSLT along with software libraries to create a framework, encapsulated in a Bundle Object, to add dynamic functionality to an otherwise static text (see Figure 1).

Figure 1. Visualisation of the Bundle Object, taken from Webb's (2011) thesis



Generic characteristics are encoded, which enable the use of the described framework. The digital thesis proposed here takes multiple formats depending on user needs and reading environment. The two formats we will discuss are a static, printable, electronic version – a PDF – and a dynamic, interactive, enhanced version. Both of these are generated from a single, base XML encoding of the research; the thesis is both polymorphic and dynamic. Polymorphism refers to an object’s ability to take many possible forms; the form to be taken is chosen at instantiation depending upon the conditions extant within the environment at the time. It is dynamic in the sense that the form can change, even after instantiation, upon interaction with the user and in response to their actions within the environment.

## 2. Literature review

This new means of presenting the research output from a digital humanities PhD has been long heralded. The last few decades have seen a noticeable shift in the way we represent, codify and present knowledge. Theorist such as Nelson, who coined the phrase hypertext in the 1960s to refer “to non-sequential writing...[or] text that branches” (Nelson, 1981, cited in Landow, 2006, p. 2), and Landow, whose 1992 and 2006 editions discuss the paradigm shift in writing in response to technological changes, provide an historical account of these changes while demonstrating the impact digital media have on our consumption and production of text and narrative. Nelson’s (1974) publication *Computer lib/Dream machine* is a liberal manifesto that considers the personal computer and information technology to be a means to promote knowledge creation and dissemination. Nelson’s (1974) hypertext can be described as “the deep connections and entanglements in human knowledge” (Webb, 2011, p. 341). He states that “everything is deeply interwinged”; human knowledge is intertwined and connected, and indeed linked (Nelson, 1974, p. 307). It is this characteristic of human knowledge that is reflected in his idea or concept of hypertext.

Landow (2006) discusses Nelson in-depth, and in his publication refers to hypertext essays and new types of academic writing, namely blogs (p. 77). More

recently Fitzpatrick's (2011) *Planned obsolescence, published, technology and the future of the academy* discusses the changes in scholarly communication, focusing on topics such as peer review, authorship and preservation. This text also refers to hypertext and the reconfiguration of academic writing in line with this form of electronic publishing. Fitzpatrick (2011), however, discusses "the difficulties in readerly engagement" and the readers' "desire for fuller participation that hypertext could not itself satisfy" and suggests that we need "to think differently about the networked relationships among our texts and, and among the readers who interact with them" (p. 99). It is in this sense that we consider DeStefano and LeFevre's (2007) article to inform the method and production of the digital articles presented in this chapter as they discuss the cognitive effects of hypertext on readers and users alike. In our case, the cognitive load can be adjusted (lower in the static, higher in the dynamic version) by the reader depending on the level of complexity at which they wish to read. Thus, the enriched, dynamic version is not a 'better' version of the thesis while the static printable one is a 'lesser' one; rather they each have a context (reader or environment) to which they are more suited.

In its polymorphic multiplicity of presentation (depending upon reader and environment), our e-thesis exemplifies the 'born digital' object. As Armstrong (2008) indicates about born digital e-books:

"a book may be first created for use only in a digital form, having no previous version existing on paper – the term 'born- digital' has been coined – and this may be typified by a much greater use of the design features available. If, from its inception, a book has been planned and designed for reading electronically the author and publisher are both able to take advantage of the medium to add value to plain text [...]. However, if it has the essential qualities of a book [...] and is accessible to be read on computers or on e-book readers, the origin does not affect its classification" (p. 6).

Our scholarly e-thesis is very much designed to take advantage of the digital medium to add value to plain text, and has no previously existing paper version; in this sense, it is born digital. Despite this, it is still essentially an e-thesis; it is

designed to communicate research, following a novel methodology, and existing in multiple possible final formats.

While this project engages with the desires and concerns articulated by Nelson (1974), Landow (2006), and DeStefano and LeFevre's (2007) as discussed above, it also serves as an example of the problematising nature of born digital scholarly documents. Vanhoutte (2007) outlines the difficulties associated with categorising 'electronic editions' of texts; the various types of taxonomic categorisations that can be employed complicate the typology of editions. These can be predicated upon, for instance, an underlying textual theory, the method of editing, or the format used to present the final text (Vanhoutte, 2007, p. 159). The fractured nature of the evolving typologies makes it difficult to categorise an 'electronic edition' of an existing traditional text, let alone one that is born within, and designed to take advantage of, the digital. While an e-print or e-thesis can be considered a surrogate of a traditional document, it is produced using a single method, and uses one format to present the final text; this born digital thesis does not. This object has multiple, reconfigurable versions of itself, differing in format depending on user and environment. Thus, even as it addresses the concerns of some scholars, it adds to those of others.

The first representation of the PhD theses is the print ready document, rendered as a PDF. The generation of this print based document satisfies academic requirements and is part of the examinable component of a thesis. The PDF document also caters for different user activities and learning requirements, which include the novice reader or the traditionalist and is used to scaffold the user's learning and comprehension requirements. The digital articles (the web delivery format) described here are markedly different from the electronic PDF version (the printable format) many Irish universities now require to be deposited into institutional repositories such as NUI Maynooth's ePrints and eThesis archive. The digital articles move from the electronic, though still static printable PDF format, to an interactive web delivery format dynamically created using HTML and accompanying technologies. Although any printed thesis can take a static electronic form, such as a PDF, it would offer no functional benefits or advantages beyond basic search, which in the context of digital humanities,

does not adequately reflect the use or creation of new digital tools and artifacts as part of the research process. Our digital articles are generated from a Bundle Object, which adds dynamic functionality to otherwise static-research output, presenting the research in an online environment. This online environment presents an enriched version of the chapters: for instance, a referencing model in XSLT automatically generates a dynamic bibliography for each chapter, including features such as “intertextual links” (Samraj, 2008, p. 55) between the text and source material. In addition, software libraries can be used to support the innate variability of a boundary object – defined as an object with user dependent functionality and meaning (Thomas, Sargent, & Hardy, 2008) – which can take the form of diagrams, tables, timelines, etc. Thus, depending on the user’s activity and perspective, the presentation of the boundary object will change.

### **3. Documents as products of praxes**

Traditional humanities doctoral research in any number of disciplines, such as history or literary studies, all produce a print thesis despite their markedly different praxes. The print medium has been exploited in various ways in order to encode research, resulting in the development of a variety of boundary objects capturing the process or results of enquiry. For instance, history research may require the use of timelines, as traditionally represented in print. These timelines have evolved in response to the 2-D material nature of paper. Their digital counterpart, rather than merely representing a print-bound flat timeline, could seek to better represent the underlying historical data, perhaps in a dynamic timeline. However, these mechanisms for expression of research are often generic enough to be implemented in any discipline; the methodology is generalisable.

The same is not true of the process of research itself, which often develops into quite distinct praxes, depending on the discipline. Researchers will all be familiar with the community ‘rules’ that guide the production of their scholarly outputs. For instance, the rules of production that scholarly editors follow will differ from language to language, and even within language but between historical period. Consequently, though the Bundle Object developed here utilises generalisable

expressions of research (for instance digital or non digital boundary objects), it is specifically supportive of the historical research praxes. In order to reuse this Object within a literary studies discipline, for example, changes would be required in the hosting system, and the interaction mechanisms with the sources.

Traditionally, research outputs codified as chapters or sections can be seen as the final manifestation of a PhD thesis and reflect the use of print or static technology. The functionality of these outputs varies according to different headings and ranges from literature reviews, general narrative and concept generation, to the development of structured arguments based on theory and source material and to the provision of essential referencing and bibliographic material. These functions are referred to as “generic characteristics of academic discourse” in linguistic structural analysis (Mingwei & Yahjun, 2010, p. 95). Chapter functionality represents and reflects the original research statement and provides the means to convey and articulate traditional scholarship within the medium of print. However, the product of a digital humanities thesis, which describes a process of digitally-influenced scholarship, should not be restricted to a printed document.

This approach reflects the innate capability of the digital medium to layer extra functionality over that of printed works. Rather than creating a single representation of scholarly output, the use of XSLT, an XML based language which adds functionality and form to XML encoded files as it incorporates languages such as HTML and JavaScript, and software libraries generates and encourages a reflexive process between text, argument, narrative and source material where multiple representations co-exist. Furthermore, it reflects the changing praxes of the digital humanities scholar, manifest in the nature of the documents used to record that scholarship.

## 4. Methodology

This chapter is based upon the working methodology of Webb’s (2011) PhD thesis, which applies a digital humanities approach to historical research at

each stage of investigation into *A study of associational culture in Ireland and the development of Irish nationalism, 1780-1830, with the construction of a software information environment*. Webb's (2011) thesis, funded by the HEA under the PRTL14 Humanities, Technology and Innovation award to An Foras Feasa (NUI Maynooth), includes a discussion of the creation of factlets and subsequent visualisation of factoids, as described in Webb and Keating (2009).

Factlets are defined as structured annotations which prompt users to follow the functional and genre specific steps taken to produce historical writing, specifically argument development regarding narrative, deduction and consequence. They provide a means to preserve transparency between "facts of the past" and "facts of history" (Elton, 2002, p. 50). Factoids are used as a method to connect "different kinds of structured information" (Bradley & Short, 2005, p. 9) and are a visual representation of the connections between different factlets and cultural objects or digital cultural objects. Factoids are presented as a network of factlets and primary sources. These digital artefacts fulfill two functions. In the first instance they inform historical research and support argument development, in the second, they provide the means to open up scholarship and the historical interpretation contained therein, as they can be reused to present the scholarly process on-line.

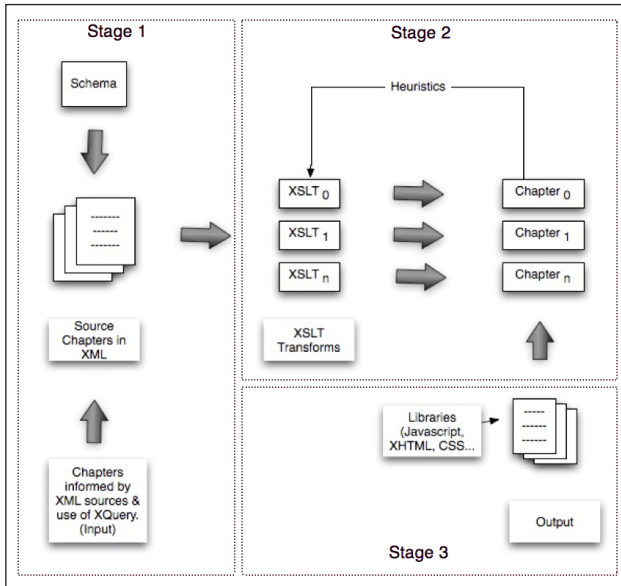
The creation of Webb's (2011) historical thesis is supported by a digital humanities methodology and demonstrates the use of digital technology as an essential feature of humanities research. This digital methodology includes the use of XML, a mark-up language designed to structure data, XSLT and XQuery, the querying language associated with XML. It also included software development, using the Adobe's Flex framework, which realises the creation and implementation of factlets and factoids within an interactive online environment created at An Foras Feasa. Webb's (2011) research is focused on a traditional historical question but relies upon a digital methodology to support source management, argument development and research presentation, the result of which is the creation of new research outputs, as digital artefacts, as well as scholarship contained in the traditional written thesis.



This approach changes reader and user activity – one user may read the article while another may interact with the digital records of scholarly process. In order to realise the born digital thesis we used an existing framework, an interactive repository developed at An Foras Feasa. This environment, which is a highly interactive, front end driven, Fedora based repository (Fedora is an open source repository system to manage and store digital content), was previously used to manage the digital objects or collections linked to the historical research. Within this system we realised the factlet and the factoid model which informed the creation of the historical narrative contained in the born digital thesis and transformed through the Bundle Object. Functionality in the system includes annotations, discussion forums, automatic relationship graphing, media hosting and digital archiving and preservation. The use of this existing system allowed us to extend the functionality of the Bundle Object and the XSLT templates contained therein. This activity realises the importance of data reusability and supports the creation and presentation of the multiple representations of research. While part of an existing framework at An Foras Feasa, the products now described can be realised in a number of environments and they are not specific to this system or indeed to the historical context of the research.

Transformation of a born digital text (a thesis) into both the print and digital media relies upon the existence of a single, defining text-model. [Figure 2](#) shows the process involved in creating new research objects. The first stage, the XML encoding, which creates the master document, makes possible all subsequent processes. Creating a unifying model allows the generation of XML schema and subsequent XML encoding in order to manifest the new research objects (the various chapters in a research thesis). The model considers presentation properties (chapter, paragraph, section), which allows for transformations specifically for presentation purposes, as well as semantic properties which encode the ‘textual semantics’ ([Eggins, 2005](#)) of the text – its logical class ([Teehan & Keating, 2010a](#)). This approach makes the text reusable and ensures “a single lexia can function very differently” ([Landow, 2006](#), p. 107) in different environments.

Figure 2. The process or stages involved in creating multiple representations of scholarship and new digital objects based on specified use cases – the dynamic generation of a static PDF document, the traditional thesis, and a dynamically generated interactive digital article delivered over the web



The model is translated into a schema which allows us to mark up the content of the scholarship, including narrative, which in historical research pertains to ‘logical’ rather than ‘ideological’ content. Stages 2 and 3, as illustrated in Figure 2, are the realisation of the various Use Cases. The XSLT transforms, which translate the XML files (the input) into HTML files (the output) and software libraries are templates from which text from different sources, (different sections of a thesis) can be modified and transformed. This essentially creates a suite of tools that support (different) user activity.

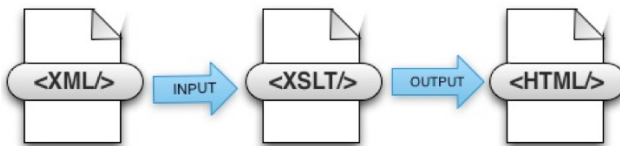
These various macros support the creation of multiple representations of the text. Our encoded texts reflect the functions embedded in standard print theses,

but augment those capabilities for these born digital theses. Here, two specific Use Cases address (i) the creation of a dynamic bibliographic referencing model, and (ii) the context-dependent presentation of boundary objects.

These low-level Use Cases (the implementation) support our higher level ones (the features or functions), that is the dynamic creation of static or interactive versions of a base text-model. The print model transforms the original text to a print ready text, and can account for various institutional templates. Embedding references to the various primary sources used in the XML encoding instructs an XSLT to create a hypertext of linked resources and creates ‘intertextual links’ and boundary objects for user interaction between the narrative and various digital objects within the digital medium.

The research activities which contribute to the development of Webb’s (2011) historical thesis are methodologically oriented within a digital humanities framework. This framework includes support for historical research activities such as source gathering and management, source querying, argument development and visualisation and formal write up of narrative, argument and conclusions. While these activities help create scholarship, the creation of multiple representations focuses on research presentation and dissemination, and as such the PDF and digital article cater to this specific activity. These multiple representations also consider the digital artifacts that are created and generated as a result of this research e.g., factlets and factoids.

Figure 3. A visualisation of the interaction between the different technologies used



The XML source file (the input, the master document) is translated into HTML (the output) using the XSLT transform, of which multiple templates can be

created. The XSLT contains all HTML and references to JavaScript, CSS, etc. XSL-FO is used within an XSLT template but uses a different processor to create the PDF.

An XSLT transform, incorporating the use of XSL-FO, a formatting language for XML, was created (see Pawson, 2002). XSL-FO is used to format XML documents and can output high quality, print ready documents in PDF and as such is described as a typesetting language or specification. Unlike XSLT which has no formatting rules, but essentially converts the XML to a different format (e.g., HTML, a different XML schema, TEI, etc.), XSL-FO has specific rules associated with design and layout. As such the XSL-FO style-sheet formats and controls all content design, formatting and organisation. This enables us to create multiple templates that cater to different institutional demands but use the same master document (see Figure 3). Using XSL-FO within an XSLT transform enables the dynamic generation of content. The print ready text, created using the XSLT XSL-FO template, dynamically generates the table of contents, footnotes, the bibliography and a glossary of terms from the master document (see Figure 4 – an extract of a XSL-FO/XSLT template). Bi-directional internal links create a navigational document and any figures, images, etc., are also handled. This template can be used for all chapters of a thesis, or other encoded articles, to create standardised print documents which adhere to institutional and academic formatting requirements.

Figure 4. An example of XSL-FO which controls the layout of a bibliography

```
<!-- bibliography -->
<fo:page-sequence master-reference="bibliography" format="1">

  <fo:static-content flow-name="xsl-region-after">
    <fo:block text-align="center" font-family="Times">
      <fo:page-number id="bibPage"/>
    </fo:block>
  </fo:static-content>
  <fo:flow flow-name="xsl-region-body">

    <fo:block>
      <xsl:apply-templates select="/" mode="bib"/>
    </fo:block>
  </fo:flow>
</fo:page-sequence>
```

The ‘page sequence’ stipulates where the bibliography will appear in the final document or PDF and the call to ‘<xsl:apply-templates/>’, controls the extraction of content for the bibliography from the XML input file.

The second use case, the creation of an interactive digital article, based upon the same master document, also contains footnotes, table of contents, etc., but its online environment allows for the inclusion of boundary objects, such as interactive time lines, key stones or tool tips. These are encoded in a separate XML file and provide extra contextual information to the reader, rendered as hover text (only visible when the user interacts with the text). Boundary objects within the digital article also include references to sources within the digital repository. Interactive spring graphs also demonstrate the relationships between factlets and their sources through a factoid and alerts the user/reader to the existence of these objects. This second representation of the source document also uses an XSLT which includes HTML, CSS and JavaScript. Both the printed article and the digital article consider different user requirements and scaffold the user. The inclusion of boundary objects described within the digital article takes into account increased cognitive load and effects on working memory which can impact different users when interacting with hyper texts (DeStefano & LeFevre, 2007). As DeStefano and LeFevre (2007) state, multiple interruptions in hypertext reading e.g., leaving the main text, can affect a reader’s comprehension. It is in response to this that we included additional contextual information within the main text, through key stones: rendered as a hover text, they reduce the user’s need to leave the main text or follow external links.

## **5. The Bundle Object within an interactive repository**

While these two representations, the PDF (printable format) and the digital article (web delivery format), can exist independently of each other and other systems, their inclusion in an interactive environment further improves their functionality. The use of an existing online repository, which utilises Fedora and handles various digital objects including bespoke objects, namely the Bundle Object, enabled us to load and render the representations of the thesis chapters,

the PDF and the digital article, as described above. The Bundle Object, which functions as a wrapper for all the XML, XSLT, XSL-FO, JavaScript, CSS etc. files, enables the system to dynamically generate and host the PDF and the digital article (or other templates produced). Importantly, it also provides access to the master document which created these representations which are essentially derivatives of this underlying encoding. The XML schema does not belong to a standard such as TEI (Text Encoding Initiative), which develops and provides guidelines and schemas for text encoding, instead a custom schema was developed to “encapsulate the process” described above (Teehan & Keating, 2010b, p. 385).

Figure 5. Visualisation of the relationship between various digital objects and the Bundle Object

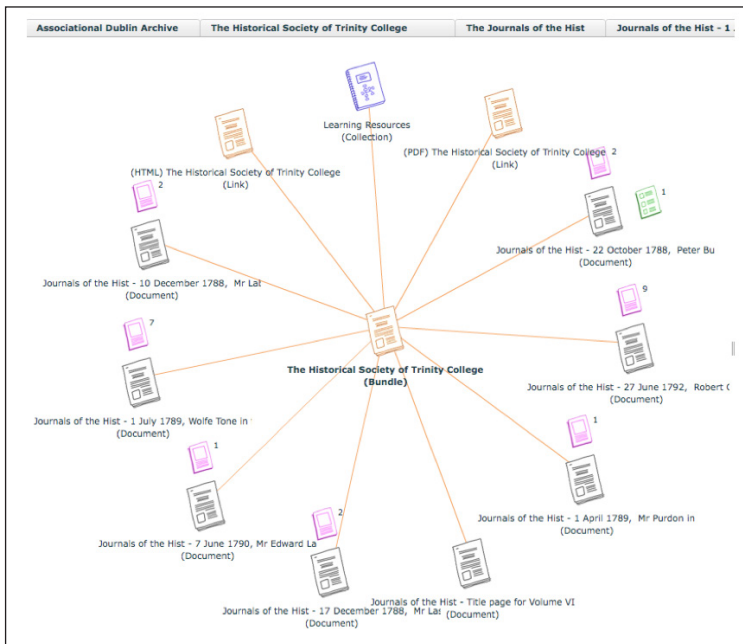


Figure 5 is the Bundle Object as it is presented in the online environment. As the central node in a relationship graph it maps all the digital resources in the

thesis chapter to the PDF and digital article. It graphically represents the thesis chapter and demonstrates its intrinsic link to the digital sources. The master document (in XML) contains the historical narrative and, through our templates, we can create the traditional narrative, but most importantly we can develop new representations with additional boundary objects, contextualisation and functionality. We use the Bundle Object to create different perspectives of the thesis. Aspects of the PDF and the digital article are illustrated in [Figure 6](#), [Figure 7](#) and [Figure 8](#).

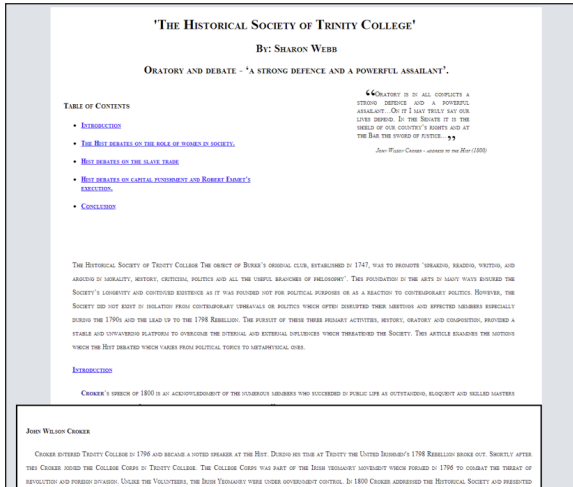
Figure 6. Dynamically generated table of contents in the PDF representation of 'The Historical Society of Trinity College and radical politics leading to the 1798 Rebellion'

Table of Contents:	
The Historical Society of Trinity College and radical politics leading to the 1798 Rebellion	
Introduction.....	1
The Historical Society of Trinity College.....	2
The Hist and the United Irishmen.....	3
Lord Clare's investigation.....	5
Outbreak of the 1798 Rebellion.....	7
Conclusion.....	8
Bibliography .....	10

Figure 7. The same table of contents in the digital article

THE HISTORICAL SOCIETY OF TRINITY COLLEGE	
THE HISTORICAL SOCIETY OF TRINITY COLLEGE AND RADICAL POLITICS LEADING TO THE 1798 REBELLION	
TABLE OF CONTENTS	
<ul style="list-style-type: none"><li>• <a href="#">INTRODUCTION</a></li><li>• <a href="#">THE HISTORICAL SOCIETY OF TRINITY COLLEGE</a></li><li>• <a href="#">THE HIST AND THE UNITED IRISHMEN</a></li><li>• <a href="#">LORD CLARE'S INVESTIGATION</a></li><li>• <a href="#">OUTBREAK OF THE 1798 REBELLION</a></li><li>• <a href="#">CONCLUSION</a></li></ul>	
<p>“DARK AND GLOOMY AS ARE OUR PROSPECTS, I DO NOT YET DESPAIR OF THE REPUBLIC. LET US SET OURSELVES SERIOUSLY TO THE WORK OF REFORMATION...BE ASSIDUOUS IN HISTORY; BE BOLD, YET TEMPERATE, IN DEBATE; BE CANDID AND CAUTIOUS ON THE MERITS OF COMPOSITIONS. THINK OF YOUR PAST GLORIES, THE INFAMY OF DEFECTION, THE GREATNESS OF REWARD, THE EASINESS OF ACQUISITION. THIS DO, AND YE SHALL LIVE! OMIT IT, AND YE ARE NOTHING!”</p> <p><i>THOMAS WALKER TONG, ADDRESS TO THE HIST (1798)</i></p>	

Figure 8. Screen shot of the digital article and key stone which provides contextual information about John Wilson Croker



Further representations of the thesis were enabled through the use of Mediasite, a webcasting technology. A recording of a lecture on *The Hist and Radical Politics* was uploaded along with related slides. This lecture, available in the interactive environment, also generated a number of discussions and reflects the ability to create dynamic scholarship as the system engages users and scholars in open dialogue and discussion. This audio-visual version, although not dynamically generated, provides another access point to scholarly dialogue and discussion which caters to different user needs and requirements.

## 6. Impact

As illustrated in Figure 5 this repository includes collections containing digital objects and learning resources, such as slides and presentations. It also supports user and source interaction through online discussions and annotations. This environment, which hosts the various digital objects including the Bundle Object, allows users to add and view factlets and factoids, promoting user interaction



with primary source material and the scholarly articles which are derived from these cultural artefacts. The provision of a discussion forum generates and encourages debate between users as well as engagement with scholarly content which can focus on primary sources as well as learning resources, e.g., digital articles or online lectures.

Within this type of environment the PDF version of the scholarly article transforms from a functional requirement, satisfying an academic need, to an object which caters to different user and learning requirements. The PDF, as well as the digital article which provides extra contextual information through key stones or hover text, provide users, scholars and students with different access points to knowledge and content. These representations consider issues born from hypertextual forms of reading which can impact user comprehension and working memory, or cognitive load, and relies on different levels of user expertise, both in the knowledge domain and hypertext engagement and experience.

The *Associational Dublin Archive* within the digital repository is specific to [Webb's \(2011\)](#) historical thesis on associational culture and Irish nationalism, and contains a number of different digital objects related to this work. The collection includes primary sources, digitised from records at the manuscript department at Trinity College and the Russell Library at NUI Maynooth, as well as factlets and factoids which relate directly to the historical research statement. Factlets are linked to digital primary sources and demonstrate the historical interpretations specific to the research topic. It is within this environment that the XML encoded chapters of the PhD thesis, contained in the master document, are transformed using the XSL-FO and XSLT templates and where both versions, the PDF and the digital article, are uploaded, effectively becoming boundary objects in the online collection.

Other boundary objects are presented in the digital article, including a dynamically generated spring graph which demonstrates the relationship between digital primary sources and factlets that are directly related to the scholarly content in the article ([Figure 9](#)). The digital article also supports the inclusion of an interactive timeline which more usefully visualises the topics of debate for the Historical Society of Trinity College than an equivalent static, print timeline ([Figure 10](#)).

Figure 9. Dynamically generated spring graph in the digital article which visualises the links between the primary document, the central node and the factlets which are utilised in the scholarly article

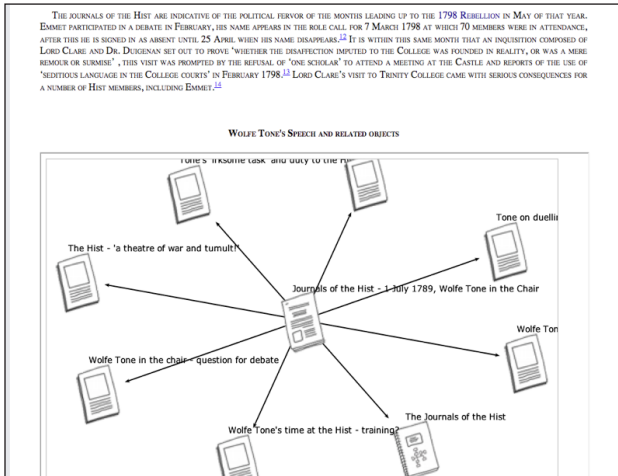
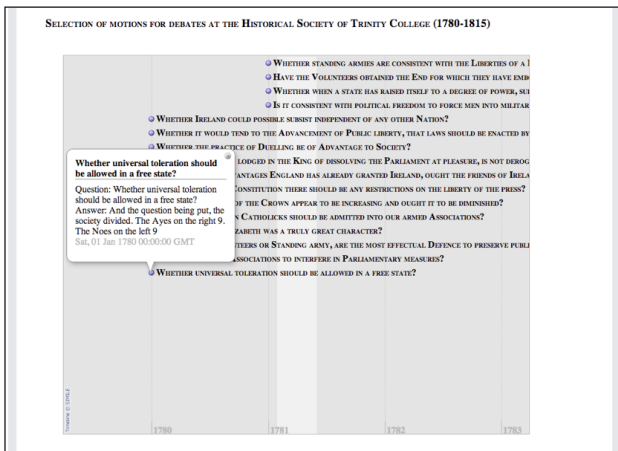


Figure 10. Dynamically generated timeline which chronologically maps the debates of the Historical Society of Trinity College and provides access to the Society's response



The online environment at An Foras Feasa supports scholarly research but the ability to upload the Bundle Object, which contains all the code required to produce the PDF article and the digital article, enables the user to present their research in its multiple forms. In this sense the environment, or system, supports scholarly research but also supports the presentation of the products of that research. Hosting digital humanities research in an environment which directly links back to the primary sources that informed the research presents scholarly interpretation and argument development through factlets and exposes associative thinking through the factoid visualisation, engaging users and readers alike in new explorations of scholarly research. It also creates transparency in research as it facilitates and encourages user or reader engagement with research content as well as sources and immerses users (within this example) in historical debate and inquiry.

The Bundle Object specifies the multiple representations of scholarly content. It contains all the XML, XSLT, CSS and JavaScript files which enable the production of multiple representations. The PDF and the digital article are but two representations which include personalised features of research. Yet these templates can be modified, extended and reused for new research by new users. Indeed, three M.A. students at An Foras Feasa have already reused these templates to present aspects of their thesis, both in a historical and literary perspective.

The production and use of multiple representations of scholarship, encapsulated in the Bundle Object, takes advantage of the possibilities offered by the digital medium and challenges the author to think in 3-D, real-time, dynamically and audio-visually. This process can improve readability and accessibility for various readers and users and allows the author to control the presentation of the work in response to a perceived audience, including the digital artifacts created through research. It also enables the reader to choose the version most suitable to their level of expertise and, in this sense, aligns the appropriate medium to the appropriate audience.

The digital article (web delivery format) offers advantages over the printable, static, format (the PDF), not only for accessibility but because it can include

different tools for users to engage and interact with content. It can include peripheral or contextual information, but also gives direct access to primary source material. As [Fitzpatrick \(2011\)](#) points out, the value of online scholarship or publishing “is the means of interacting with the content, rather than the content itself” (p. 47). It is in this sense that pursuing new ways to present and enhance online scholarship can add value to content. The methodology to create multiple representations of a digital humanities thesis, described above, enables us to dynamically generate the examinable component of a thesis. The same methodology allows us to dynamically generate the digital article but offers new ways to present the same scholarly content. The development of keystones, the inclusion of interactive timelines and the spring graph visualisation allow the reader/user to engage with the content in whole new ways. The functionality of the digital article, however, is extensible as we can add new features by simply changing the templates. Yet, the printable format is not made redundant by this process, as it can provide a sustainable method of access.

We may ask if our process is respectful of or subversive to the print or PDF version of scholarly content? The PDF may serve a specific functional purpose, but we must examine its contribution to knowledge engagement and its utility as a means of access to content for different users and their cognitive or pedagogical requirements. This format also serves as a simple tool or mechanism for preservation of online content, as the scholarly content does not rely upon the existence of the digital or interactive representation. The PDF can exist in its entirety without reference to the online environment. So, while this process may be subversive to the print article as a means to represent born digital theses, it is respectful of the gains and benefits of this traditional format which cater to different user requirements working within an interactive online environment.

Sustained access to and maintenance of functionality within the digital article requires more work in comparison to the printable format presented as a PDF. [Fitzpatrick \(2011\)](#) remarks that “the digital may be more prone to a material obsolescence than [the] print” (p. 6), a fact that enforces our first use case described

above, the generation of a printable format, and supports the creation of multiple representations of scholarship using the master document – one source XML.

The inclusion of these representations within an online environment, such as that developed at An Foras Feasa, not only supports and enhances user engagement with content but offers solutions to the ‘material obsolescence’ described by Fitzpatrick (2011). Institutional support can help with digital sustainability but national developments, namely the creation of a national trusted digital repository by the Digital Repository of Ireland (DRI)<sup>1</sup>, are also important in terms of preservation and access to scholarly content. DRI’s mission, to develop a trusted digital repository, is inherently concerned with producing a technical framework that provides access to content and shares it, but which is also fundamentally concerned with the long-term preservation of that content. Within a national technical framework then, what other use cases can we satisfy in terms of multiple representations of a thesis?

## 7. Conclusion

This chapter demonstrates the process and production of support tools for digital scholarship, and how the creation of appropriate templates can make manifest various representations of digital humanities PhD theses from a single model. The use cases are reliant on the ability of the encoding and the schema to encapsulate both the functions of the text and the various transformations and software libraries.

Multiple representations of and within PhD theses pose new problems and issues for the individual researcher but also for academic evaluation. There are no rules or regulations on how to present digital theses which go beyond an e-version of a printed one, which in effect mimics the print version. It also challenges the idea of published theses, especially in terms of the prestige attached to being

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1. DRI is a four-year PRTL1 5 funded project which aims to develop an interactive trusted digital repository for contemporary and historical, social and cultural data held by Irish institutions. It is a research consortium lead by the Royal Irish Academy. Partners include National University of Ireland Maynooth, Trinity College Dublin, Dublin Institute of Technology, National University of Ireland Galway and National College of Art and Design. See [www.dri.ie](http://www.dri.ie) for more details.

‘published’ in an academic career. How do you ‘publish’ an interactive article in the same way you would publish a monograph? How is the work involved in creating these representation credited?

The products (PDF, digital article) of the methodologies discussed which use XML, XSL-FO, etc., impact not only the presentation of scholarship but how that scholarship is perceived and used. Presenting a chapter of a PhD with access to source content within an interactive environment creates dynamic scholarship. It exposes the interpretations embedded in the scholarship explicitly as the factlets reveal the connections between the sources and the interpretations. As a visualisation then, the factoids can move the user/reader away from the final product, the thesis chapter, which may be perceived as static scholarship. Factoids enable the user/reader to interact with the essence of the scholarship – the sources, the interpretations, etc., and not just the final product of it – the static article.

The various representations, the PDF, the digital article with boundary objects, and the video and slide show concerned with direct content of the PhD, held within the digital repository with direct access to primary sources and their interpretations, bring the user back to the original history, as it stands with and without interpretation, the difference between ‘facts of the past’ and ‘facts of history’. This is the essence or fundamental reason for the creation and use of factlets and factoids as it creates transparency between primary sources and historical interpretation. The online environment allows the reader/user to return to the sources which informs the scholarship and the user’s ability to create new factlets, start or enter discussions provides the user access to, and the opportunity to engage with, historical debate. The result of this interaction with primary source material and historical debate is the creation of dynamic history. It allows users to ‘do’ history, not only read it, and encourages debate and questioning of the interpretations presented in the final products of scholarship (e.g., the document).

The use of factlets and factoids are specifically employed for historical research but the Bundle Object is a generalised expression of research and as such can be

modified, extended and reused within different disciplinary contexts. However, given the historical context of Webb's (2011) thesis further work on the production or extension of the Bundle Object for a literary environment may be necessary. Other areas of development include additional boundary objects, two of which have already been identified since the finalisation of Webb's (2011) thesis: a geographical visualisation to map the various clubs and societies discussed on associational culture and social networking graphs to view relationships between clubs and their members.

Current research students in digital humanities constitute a newly born digital generation, the nature of whose outputs differs markedly from earlier generations. Reflections on this changing process should also include an analysis of new methods and techniques to create dynamic scholarship. The encoding of the final phase in a PhD thesis allows scholarship to be reused, modified, visualised and transformed, allowing for greater distribution and accessibility of digital scholarship. Thus the dissertation, in its multiple representations, can not only remain central to the discipline of Digital Humanities but shape its future development.

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