Medieval manuscripts online

The usability and usefulness of website interfaces of digitised manuscript collections

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1. Introduction

Medieval Manuscripts

It has been estimated that today there are between 600,000 and 800,000 surviving medieval manuscripts in Latin script alone.[1] Another estimate is that in total, including manuscripts in other types of script such as Greek, there are close to 1,000,000 medieval manuscripts.[2] The term 'medieval manuscripts' in this thesis refers to handwritten books produced in the western world between approximately 500 and 1500. They were normally made of animal skin and in later centuries sometimes of paper. Commonly they were bound as codices, which is the format of the book as it is still known today: a stack of pages (leaves, folios) that are attached to each other on one side and protected by some kind of cover. Some other formats exist as well, such as scrolls or codices folded like a concertina. The great value of medieval manuscripts has been summed up accurately by Wendy Scase:

> Medieval manuscript books are our principal source of evidence for human history and culture in Europe for just over a millennium, from the fifth century to the later fifteenth century. They are also the key means by which the textual culture of classical antiquity survives.[3]

In other words, if we want to learn anything about the history, culture, literature, language, philosophy and religion of the middle ages and classical antiquity, medieval manuscripts are our main textual resources. They are our primary way of access to over a millennium of history and culture.

Digitisation

The ENUMERATE Thematic Network has carried out an extensive survey about digitisation in Europe among cultural heritage institutions such as museums, archives and libraries. Of the institutions that have text-based materials, 30% have analogue medieval manuscripts, and

[1] W. Scase, 'Medieval manuscript heritage: digital research challenges and opportunities', in M. Fioravanti and S. Mecca (eds.), *The safeguard of cultural heritage: a challenge of the past for the Europe of tomorrow: COST strategic workshop* (Firenze: Firenze UP, 2011), p. 97.
[2] T. Hassner et al., 'Computation and Palaeography: Potentials and Limits', *Dagstuhl Manifestos*, 2.1 (2013), p.17.
[3] Scase, 'Medieval manuscript heritage', p. 97.

19% have digital medieval manuscripts.[4] If an institution has digitised medieval manuscripts, it does not necessarily mean that they have digitised all their medieval manuscripts: they may have digitised only a portion of their collection and they may still be in the process of digitising. According to Sanderson et al. 'less than 1% of existing medieval documents' were available in a digital form in 2011.[5]

The term 'digitisation' is used in this thesis to refer to the process of creating digital facsimiles of primary sources - in this case medieval manuscripts - by scanning or photographing their pages and preparing these scans and photographs for preservation and dissemination. The digitisation process consists of a number of steps. Manuscripts are selected and prepared for digitisation. Scanning or photographing hardware needs to be available or manuscripts need to be transported to a location where they can be scanned. Software and hardware for preserving the digital files need to be arranged, and metadata need to be created. These are the basic requirements to at least preserve manuscripts digitally. After scanning and storing the manuscripts, the images and relevant metadata can be made accessible to users. Other forms of digitisation are possible too, for example creating a machine-readable version of the text of a source, or making catalogue entries available digitally, but this thesis focuses on digitisation where digital images are a central part of the end result.

The two main reasons to digitise medieval manuscripts are preservation and access. Preservation by digitisation works in two ways. First of all, the manuscripts are preserved digitally in their present state. Even though parchment is a durable material, the pigments used for illumination are damaged by abrasion and exposure to daylight.[6] No matter how carefully manuscripts are handled, they inevitably deteriorate over time. There is always a risk of greater damage too, for example by water, fire or pests. By capturing their pages in scans or photographs, preservation of their exact current state can be safeguarded. The second way in which digitisation can preserve manuscripts is that the original manuscripts will need to be consulted less often. As will be explained in 2.1, for many research purposes, consulting digital surrogates of manuscripts can suffice. This means that the manuscripts themselves will

[4] N. Stroeker and R. Vogels, *Survey Report on Digitisation in European Cultural Heritage Institutions* (2014), *ENUMERATE*.
[5] R. Sanderson et al., 'SharedCanvas: A Collaborative Model for Medieval Manuscript Layout Dissemination', *Proceedings of the 11th annual international ACM/IEEE joint conference on Digital libraries* (New York: ACM, 2011), par. 1.
[6] P. Ainsworth and M. Meredith, 'e-Science for Medievalists: Options, Challenges, Solutions and Opportunities', *Digital Humanities Quarterly* 3.4 (2009), par. 1.

need to be taken out less often, because their audience can resort to the digital images. The manuscripts will therefore be subject to less wear and tear and will be preserved better.

As for access, digitisation allows a much wider access for a potentially much larger audience. A challenge with medieval manuscripts has always been that they can only be handled by a handful of experts, because they are so valuable and vulnerable. Moreover, they are kept in institutions all over the world, so each individual manuscript is only accessible to a limited number of people. Even in the institutions themselves, visitors are sometimes only permitted to view black-and-white microfilm reproductions of uncertain quality.[7] When they are allowed to work with a manuscript, they are still limited by the opening hours of the repository. It can also happen that a manuscript they want to see is temporarily unavailable due to for instance restoration work or an exhibition. Digitising medieval manuscripts provides the opportunity to make them accessible to everyone and everywhere all the time, 'whether their interest is specialist, professional, educational, commercial, or simple curiosity'.[8] If the scans or photos are of very high quality, the details on a page may even be better visible than in the manuscript itself. Apart from increasing the access to individual manuscripts, digitisation also enables people to place manuscripts from all over the world side by side on a screen. Thus, they can compare artefacts that would have been very difficult to compare otherwise. Notably, manuscripts that come from the same collection but are now spread across multiple countries can be 'virtually reconstitute[d]'.[9]

The main audience of medieval manuscripts, both physically and digitally, are humanities scholars in the fields of codicology and palaeography.[10] Therefore, this thesis will focus on their needs, which will be considered in more detail in paragraph 2.1. There is also some interest among other user groups, such as school teachers and senior people with a personal interest in for example medieval books, art and history.[11] Earlier research has indicated, however, that their demands of digitised manuscripts are very different from those of scholars. Rather than being presented with detailed descriptions and complete manuscripts, these users would mainly like the content to be editorialised.[12] They would approach a visit to a website with medieval manuscripts as they would approach a museum exhibition, where

[7] Ainsworth and Meredith, 'e-Science for Medievalists', par. 1.
[8] Scase, 'Medieval manuscript heritage', p. 98.
[9] P. Chevallier, R. Laure, and L. Bouvier-Ajam, 'Consultation of manuscripts online: a qualitative study of three potential user categories', *Digital Medievalist* 8 (2012), n.pag.
[10] These terms will be explained in 2.1.
[11] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
[12] This has for example been put into practice with the tool Kiosque, see: Ainsworth and Meredith, 'e-Science for Medievalists', par. 29-30.

they are presented with highlights that are put into context. For these users, digitised manuscript collections should arouse curiosity and bring collections to life.[13]

Thesis

This thesis explores the meeting point between digitised medieval manuscripts and the scholars that study them. The aim of this thesis is to describe the state of affairs of the user interfaces of websites presenting digitised medieval manuscripts. The usability and usefulness[14] of three website interfaces will be analysed to discover their strengths and weaknesses at this moment. As will be discussed in paragraph 2.2, interface design is of the utmost importance when making any digital collection available online. However, more attention is often given to the digitisation and preservation processes than to the usability of the interface. It has been asserted that libraries take digital photographs of manuscripts more to preserve the originals than to serve the scholarly community.[15] By shedding light on scholars' needs as well as the interfaces of existing websites, this thesis can contribute to the improvement of the user interfaces of websites with digitised medieval manuscripts. This is relevant for libraries holding medieval manuscripts, the scholars who study medieval manuscripts and web and tool developers.

The main research question addressed in this thesis is: to what extent do websites with digitised medieval manuscripts meet scholars' needs in terms of usability and usefulness? In order to answer this question, it will be divided in several facets.

Chapter 2 is the theoretical framework for the analysis, divided in several paragraphs. To begin with, in paragraph 2.1 it will be investigated why humanities scholars need access to primary sources such as medieval manuscripts, for what kind of research medieval manuscripts are used, and which concrete tasks scholars carry out in this research. The reasons why scholars study primary sources have been explored in some user studies with digitised primary sources. The main activities in manuscripts studies have been described in *Introduction to Manuscript Studies*.[16] They are described in this paragraph and for each activity it is considered whether it is transferable to digitised manuscripts. Thus, this section lists scholars' needs regarding digitised medieval manuscripts.

[13] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
[14] These terms will be defined in Chapter 2.
[15] Ainsworth and Meredith, 'e-Science for medievalists', par. 3.
[16] R. Clemens and T. Graham, *Introduction to Manuscript Studies* (Ithaca, NY: Cornell UP, 2007).

In paragraph 2.2, the meaning of interface and the importance of interface design are explored, mainly by analysing Kirschenbaum's and Drucker's articles about interface.[17] This paragraph lays the theoretical foundation for paragraph 2.3, in which evaluation criteria for interfaces will be researched. The two most important evaluation criteria for interface from a user's point of view, namely usability and usefulness, will be defined there.

In paragraph 2.3.1, the most important general usability features of websites are explained, based on Krug's work about web usability.[18] This section will elaborate on how overall website navigation, searching, and browsing should be designed. Usefulness will be considered in paragraph 2.3.2. Usefulness features for digitised medieval manuscripts have not been described in published literature yet. Therefore, in this paragraph several user studies of digitised primary source repositories and articles about manuscript viewing tools will be analysed. The usefulness functionalities that are found in these articles will be listed.

Paragraph 2.4 consists of a checklist of the usability and usefulness functionalities that were found in paragraphs 2.3.1 and 2.3.2.

In chapter 3, the checklist of usability and usefulness functionalities from paragraph 2.4 will be used to analyse three leading websites with digitised medieval manuscripts, namely e-Codices, Digital Scriptorium, and the manuscript section of the British Library website.[19] This chapter will demonstrate to what extent the functionalities from paragraph 2.3 are already present on such websites and which are not.

In chapter 4, the main research question – to what extent do websites with digitised medieval manuscripts meet scholars' needs in terms of usability and usefulness? - will be answered.

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[17] M. Kirschenbaum, '"So the Colors Cover the Wires": Interface, Aesthetics, and Usability', *A Companion to Digital Humanities* (Malden, MA: Blackwell, 2004), pp. 523-543 and J. Drucker, 'Humanities Approaches to Interface Theory', *Culture Machine*, 12.0 (2011).

[18] S. Krug, *Don't Make Me Think! A Common Sense Approach to Web Usability*, 2nd ed., (Berkeley, Calif: New Riders, 2005).

[19] e-Codices, <http://www.e-codices.unifr.ch/en> (9 June 2016).
The British Library, 'Digitised manuscripts', <http://www.bl.uk/manuscripts/> (5 June 2016).
The University of California Berkeley Library, 'Digital Scriptorium', <http://bancroft.berkeley.edu/BANC/digitalscriptorium/> (7 June 2016).

2. Theoretical Framework

The aim of this chapter is to find out which functionalities a website with digitised medieval manuscripts should ideally offer to scholars. To start with, in paragraph 2.1 the needs of scholars who use these websites will be considered. This consideration is based on an assessment of their overall scholarly objectives.

The focus of this thesis lies on the user interface of websites rather than on digitisation practice and tool and web development processes. Therefore, paragraph 2.2 will continue by looking at what interface actually is and what its importance is in the context of this thesis.

Next, in paragraph 2.3 it will be investigated how user interfaces can be evaluated. There are two evaluation criteria from a user's point of view, namely *usability* and *usefulness*. These terms have been used in literature about digital library evaluation. In this literature, reviewed by Heradio et al. in 'A review of quality evaluation of digital libraries based on users' perceptions', three main components of digital libraries can be distinguished: the *content* of a digital library, the technological *system* and the digital library *user*. Websites with digitised manuscripts can be seen as a type of digital library too, and indeed they have these same components.[20] Because the focus in this thesis is on user needs, two combinations of these components are relevant: the *user-system* pair and the *user-content* pair. The *user-system* pair is about *usability*, which 'evaluates whether the system is manipulated effectively by the user, in an efficient and enjoyable way that supports exploitation of all the available functionalities'.[21] The *user-content* pair is about *usefulness*, which 'evaluates the relevance of the [digital library] content to the user's tasks and needs'.[22] These two evaluation criteria will be studied separately.

The chapter will end in 2.4 with a checklist of usability and usefulness features that a website with medieval manuscripts should ideally offer to scholars. This checklist follows from the previous sections: the exploration of why and how scholars use medieval manuscripts combined with concrete usability and usefulness functionalities that they need on user interfaces.

[20] In the same article, Heradio et al. define a digital library as 'a collection of information that has associated services delivered to user communities using a variety of technologies'.
[21] R. Heradio et al., 'A review of quality evaluation of digital libraries based on users' perceptions', *Journal of Information Science*, 38.3 (2012), p. 272.
[22] Ibid.

2.1. Needs and expectation of scholars

The first part of this chapter is an exploration of why scholars study medieval manuscripts and what they study. This is important to consider because their research needs ultimately determine which concrete functionalities user interfaces for websites with medieval manuscripts should offer. First, the reasons why humanities scholars study primary sources in general will be specified, in order to clarify why access to primary sources is important in the first place. Primary sources in this context refer to textual archival and library sources, mostly written or printed on paper or parchment. Medieval manuscripts fall into this category too. Then, the focus will shift to the study of medieval manuscripts and the specific research needs for this type of primary source.

The question of why scholars use primary sources can be approached from two directions, as for example Audenaert and Furuta demonstrate in 'What Humanists Want: How Scholars Use Source Materials'.[23] Firstly, one can ask why scholars take the trouble of using primary source materials rather than using reproductions of primary sources, which are generally easier to access than the primary sources themselves.[24] Secondly, one can ask what exactly it is that scholars look for in primary sources. Audenaert and Furuta interviewed eight scholars who regularly use primary sources. The participants' fields of research were scholarly editing (two participants), bibliography, textual criticism, linguistics and palaeography, English, organic chemistry (this participant researches laboratory notebooks), and nautical archaeology.[25] The answers that they find give a broad overview of the reasons why humanities scholars use primary sources.

Considering the first question – why spend the time and money to study primary source materials? – five reasons can be discerned.[26] The first reason is availability. In many cases, scholars need to see primary sources because no suitable alternatives are available. This is especially the case in the fields of scholarly editing and bibliography, in which the scholar needs to identify and examine all existing primary sources and specifically does not rely on existing editions, if there are any. Secondly, scholars obtain a holistic impression from primary sources that is not found in an edition. Some scholars commented on the importance of the visual appearance of source documents, whereas others held the opinion that each primary source was merely one possible form to carry a text. However, as Audenaert and

[23] N. Audenaert and R. Furuta, 'What Humanists Want: How Scholars Use Source Materials', *Proceedings of the 10th Annual Joint Conference on Digital Libraries* (New York: ACM, 2010), pp. 283-292.
[24] A scholarly edition of a work, for instance.
[25] Audenaert and Furuta, 'What Humanists Want', p. 284
[26] Ibid, pp. 285-287

Furuta noticed, all scholars possessed much implicit knowledge about various physical aspects of the sources they used. Even if they do not make their knowledge explicit, it was clear that working with original sources is important for a deeper understanding of their context and meaning. The third reason is nuanced detail. There will always be details in a physical object that get overlooked, even if an editor describes the physical appearance of a source at length. Some details might be skipped because their relevance is not clear at the time of editing. However, someone else could notice an aspect of a source that further increases the understanding of the content or the object itself. The fourth reason is accuracy and authenticity. Because much of the research with primary sources depends on small details, such as punctuation and spelling variations, it is important for scholars to be able to check the sources themselves. Scholars have reported that they would rather make their own transcriptions than rely on someone else's, and that even their own transcriptions needed to be checked again at a later stage simply because humans make mistakes. The last reason is aesthetics. Although of lesser concern to scholarly practice, all participants from Audenaert and Furuta's study mentioned the aesthetics of the physical objects they worked with, one of them even joking about a 'scratch and sniff screen' to get a library smell.

Regarding the second question – what do scholars study in primary sources? - there were four themes that appeared to be particularly important.[27] The first one is textual transmission. A common goal of scholars working with various primary sources is studying how a text has changed over time, for example in an attempt to reconstruct the authorial text. Examining different versions can also give evidence of language change, or show whether some information was prioritized or omitted in different versions of the same text. The second theme is survey of evidence, which is to say systematically going through an entire collection of source materials to gather evidence about a certain topic. This path of research is perhaps less relevant in manuscript collections than in collections of periodicals and newspapers, which contain a more or less continuous dissemination of information over a certain period of time. The third theme is agents. Apart from textual content, primary sources can also contain clues about agents connected with the source, such as scribes, publishers, editors, illustrators, and the audience. Changes may have been made in one document, or in between the creation of different versions, which can inform scholars about the possible influence of agents. The fourth theme is context. On the one hand, context is necessary to understand documents. On the other hand, documents can also contain information about all sorts of contexts and thus

[27] Audenaert and Furuta, 'What Humanists Want', pp. 289-290.

help answer questions about people, dates, places, and social, economic, and political contexts.

In short, access to primary sources is important for scholars for two sets of reasons. The first set explains why they are willing to make a considerable effort to be able to access primary sources. The second set of reasons sheds light on what information scholars look for in primary sources. All these reasons apply to primary sources in general. Next, the focus will be narrowed down and it will be investigated what scholars study in medieval manuscripts.

Medieval manuscripts are the main sources for the history, history of science, literature and art history of the Middle Ages. Apart from all their textual and visual content, medieval manuscripts as artefacts also convey knowledge about 'the history of the book, scribal and monastic culture, the history of the development of handwriting systems, languages and dialects, the history and genealogy of texts over time, and the evolution of strategies for organizing texts and knowledge'.[28] In short, medieval manuscripts are sources for many different areas of research related to the Middle Ages within the humanities, and are not just valuable because of the texts and images they contain, but also because of all the information they contain as physical objects. As such, they are not objects of research for a single group of humanities scholars, but they are of interest to scholars of many different backgrounds. Scholarship that is centred on the study of medieval manuscripts is often grouped under the terms palaeography and codicology. Palaeography refers to the study of old scripts, and codicology means the study of books as objects. Both can be areas of research in their own right, but also auxiliary disciplines to other disciplines such as history.

The most important tasks in codicology and palaeography are described by Clemens and Graham in *Introduction to Manuscript Studies*.[29] They give an overview of the most important aspects of medieval manuscripts that students who are learning to study manuscripts should be familiar with. In order to be able to understand medieval manuscripts, they need to have knowledge about how medieval books were made, learn to read and transcribe various types of script, learn how to determine the origin and provenance of manuscripts, and know the characteristics of several widespread types of manuscripts.[30] These can be said to be the basic knowledge that is necessary for manuscript research, regardless of any further research questions that could be asked. In the next few paragraphs, an overview

[28] Hassner et al., 'Computation and Palaeography', p.17.
[29] Clemens and Graham, *Introduction to Manuscript Studies*.
[30] Ibid, p. xiii.

will be given of how manuscripts are studied when putting this knowledge into practice, with attention to what can and cannot be studied through digital images.

To begin with, to understand medieval manuscripts it is important to have knowledge about the production of manuscripts. This is not the place to discuss manuscript production at length, but the basic elements and whether they can be studied in digital surrogates will be taken into account. A fundamental component of a manuscript is its writing support. By far the most common writing support used in medieval manuscripts was parchment or vellum.[31] Sheets of parchment would be put together to form quires, and they would be pricked and ruled to prepare them for writing.[32] Ruling was done in drypoint[33] until the late eleventh century, and with plummet (leadpoint) after that.[34] Although it is not ideal to study the writing support in a digital image, there is still information to be found there: depending on how visible these aspects are, the hair and flesh side of the parchment can be distinguished, as well as pricking holes, ruling (especially plummet), and defects in the parchment.

Once the writing support was prepared, the pages could be written on. To begin with, the main text and decoration would be entered. This happened in several stages, as can be seen in many manuscripts in which later stages are omitted.[35] First, the plain writing would be entered, and after that rubrication (titles), initials and illustrations were added. After the text and decoration were finished, corrections would be made and glosses and annotation might be added. It is not surprising that mistakes were made regularly in the process of writing, so finished manuscripts were checked and corrected. The main methods of correction were erasure – scraping a thin layer of the parchment to erase a mistake – and subpunction – adding dots under a word or phrase to indicate it should be ignored.[36] Next, quite often explanatory glosses have been added in medieval manuscripts, commonly copied from other manuscripts rather than being added spontaneously by scribes or readers.[37] Finally, manuscripts can contain many types of annotation, not all of which are easy to categorise. Still, there are some common types that are helpful to recognise. Finding aids in the form of leather strings or marks at the edge of pages were used when skipping between pages or books.[38] There are also finding aids for important passages, such as *nota* and *nota bene* markings, and *maniculae*,

[31] Ibid, p. 9
[32] Ibid, pp. 14-15
[33] Drawing or writing by scratching the page with a sharp object.
[34] Clemens and Graham, *Introduction to Manuscript Studies*, pp. 16-17
[35] Ibid, p. 20
[36] Ibid, p. 35
[37] Ibid, p. 39.
[38] Clemens and Graham, *Introduction to Manuscript Studies*, p. 43.

little drawings of a hand with a pointing finger. In order to create rectangular columns of text, scribes would spread the text in such a way that all lines were equally long, or they would use line fillers of various designs.[39] After a scribe had cut his pen, he might try out his pen on an empty space with a few strokes, letters or lines.[40] Before drawing more elaborate initials, artists would often make a draft first, in the place intended for the final version or in the margin. In the early Middle Ages these drafts were usually made in drypoint, and later on with lead or watered-down ink.[41] Some markings do not seem to add anything functional to a manuscript but might just be doodles by scribes or readers.[42] Most of the text and illustrations described above can be studied in digital images as well: the main text, miniatures and other decoration, and most types of glossing and annotation.[43] Corrections by means of subpunction are visible too. Only ruling and drafts in drypoint and corrections by erasure are probably hard to decipher, because it can already be difficult to distinguish them in the physical manuscript.

After all the text and decoration were finished, a manuscript would be assembled and bound. To ensure that all the loose quires were folded correctly and laid in the right order, quires were commonly numbered in the bottom margin. Because these numbers or letters were often added at the very bottom of the page, they often got lost when the manuscript was trimmed after binding and cannot be found anymore. Sometimes catchwords were added as well: at the end of a quire, the first word of the next quire was added, usually in the bottom margin too.[44] Some manuscripts were kept as loose quires, but most were bound in a parchment cover, or a binding with wooden boards covered in leather.[45] To study the binding of a manuscript thoroughly, digital images are not sufficient. At most, they can give an impression of the type and state of a binding. For more details, such as how the quires are sewn, the physical manuscript will need to be studied. Therefore, two-dimensional digital images of manuscript folios do not convey enough information for this area of codicology.

Next, some basic tasks that can be carried out when working with manuscripts will be noted. One of the most elemental tasks is perhaps recording textual data from a manuscript. This is done by making a transcription of text, which means ‘to provide an accurate record of

[39] Ibid, p. 44.
[40] Ibid, p. 45.
[41] Ibid.
[42] Ibid.
[43] Apart from traditional research with digitised manuscripts, there is also a field of research into computerised palaeography, see for example: A. Ciula, ‘Digital palaeography: using the digital representation of medieval script to support paleographic analysis’, *Digital Medievalist*, 1.1 (2005), n.pag. and F. Wahlberg et al., ‘Spotting words in medieval manuscripts’, *Studia Neophilologica*, 86.sup1 (2014), pp. 171-186.
[44] Clemens and Graham, *Introduction to Manuscript Studies*, p. 49.
[45] Ibid, p. 50.

the text, or a portion of the text, in a particular manuscript'.[46] In order to transcribe text, it is important that all text is clearly visible, because a lot of small details are noted down in a transcription, such as the exact used spelling, capitalisation and punctuation as well as where abbreviations and line and page breaks occur.[47]

Two other tasks are determining the origin and provenance of a manuscript, which means finding out when and where it was made and what journey it has made since. For both of these, there are clues that might be found on the folios of manuscripts. Regarding the origin of manuscripts, the most obvious clue is a colophon, which is a statement about the origin of a manuscript, often at the beginning of the book. Colophons were not very common in all periods and regions.[48] There can also be evidence about origin in the content, because 'all scribes were editors' and they would sometimes add information about for example local events.[49] If the hand of a scribe is recognised who was known to work at a certain place at a certain time, this also gives information about the origin of a manuscript.[50] Finally, clues to help date a manuscript can be the mention of a date, for example in a colophon, or when one event is mentioned but a similar subsequent event is omitted.[51] All of these clues can be found in scans of manuscripts too.

Regarding the provenance, there can be clues in later additions to a manuscript. It is not uncommon to find ownership inscriptions on flyleaves or in the margin of the first page. Similarly, the coat of arms of an owner is sometimes entered. Library shelfmarks are telling because they differ in format for each library and are usually written by one person in books from the same library.[52] Finally, new owners have frequently added texts, glosses and notes, which can also give information about provenance.[53]

To conclude, scholars study medieval manuscripts because they are the main sources for the history, history of science, literature and art history of the Middle Ages. Moreover, as objects they also contain knowledge about the history of the book, scribal and monastic culture, and about the history of language, dialects, texts, and handwriting systems. The study of medieval manuscripts is known as codicology and palaeography. Important basic aspects of codicology and palaeography are knowing how medieval manuscripts were made, being able

[46] Clemens and Graham, *Introduction to Manuscript Studies*, p. 75.
[47] Ibid.
[48] Ibid, p. 117.
[49] Ibid, p. 119.
[50] Ibid, p. 120-1.
[51] Ibid, p. 121.
[52] Ibid, pp. 124-125
[53] Ibid, p. 127.

to read and transcribe them, and determining their origin and provenance. Considering the production process, the writing, decoration, correction, glossing and annotation can potentially be studied in digital images of the manuscript. The writing support, gatherings and binding, however, cannot be studied in depth in just images. Transcribing text from images is usually possible, assuming they are of sufficiently high quality. Since many clues for determining origin and provenance are found in and around the text of manuscripts, digital images are useful for this too.

2.2. Interface

Before investigating the usability and usefulness features that scholars need for their research on website interfaces with digitised medieval manuscripts, it needs to be defined what interface actually is. The Oxford English Dictionary (OED) gives two definitions of the word. The first one is '[a] point where two systems, subjects, organizations, etc. meet and interact'. So, at the most basic level, and interface is a meeting point between two entities. As is indicated by the definition, these entities can consist of a variety of things. Similar terms are reported by Kirschenbaum, who says that whenever interface is defined, terms that are used often include '"surface" or a "boundary" where two or more "systems", "devices", or "entities" come into "contact" or "interact"'.[54] Notably, he remarks here that there can be contact between more than two 'systems'.

The second definition in the OED is '*Computing* - A device or program enabling a user to communicate with a computer'. So, taking the first definition into account, in computing, interface is the point where a user and a computer interact. In computing, interface usually refers to the graphical user interface (GUI), of which a desktop windows environment is the most common example.[55] The websites that will be analysed fall into this category too. Computer interfaces belong to the field of research of human-computer interaction (HCI). In order to understand some key characteristics of GUIs, a significant moment was in 1968, when Douglas Engelbart demonstrated the use of a mouse for the first time in San Fransisco. This would lead to GUIs becoming very popular, and it would replace the use of a command line for a large part, which used to be the most prevalent type of interface. Engelbart then also showed how multiple adjoining windows could be displayed on one screen. Several years later, some of his colleagues came up with windows that could overlap, demonstrating the concept of a three dimensional virtual environment. Both the concept of the mouse indicator – or, in the case of touch screens, human fingers tapping the screen where the mouse would click – and the three dimensional aspect of screens with overlapping windows are still used today in GUIs.[56]

In computing, interfaces are not one individual boundary or meeting point, but they consist of different levels or layers. For example, if a user opens a web page, he accesses the interface of that specific website. This website interface is embedded in the interface of the particular web browser in which the website is opened. This web browser has been opened

[54] Kirschenbaum, '"So the Colors Cover the Wires": Interface, Aesthetics, and Usability', p. 523.
[55] Ibid.
[56] Ibid, p. 527.

within the operating system of the computer. Each of these 'systems' adds a layer to the interface with which a user interacts. Therefore, it can be said that multiple systems come into contact in computer interfaces. When looking at the general definition of interface, one can even say that the computer screen itself, whether it is a desktop computer, laptop or yet something else, is another interface layer, because this is the most literal 'surface' or 'boundary' between the computer and the user.[57]

As mentioned above, this thesis looks at the GUIs of websites with medieval manuscripts. Interface design for any online cultural heritage collection is very important, especially since more and more often people access cultural heritage collections digitally. The importance of interface lies in the fact that users interact with the interface, not with the digital content itself. In HCI, interface is seen as something separate from content. Digital content is in essence made up of bytes, and it is translated for human users by means of an interface. The interface is not directly connected to the content in terms of programming, and the content can exist independently. In some cases, an interface seems to be added 'as an afterthought', as if the content can speak for itself.[58] However, this is not in line with decades of humanities scholarship that says form and content are always linked.[59] The form in which a text or other content is presented always influences its meaning, and content cannot be conveyed without a form. In this case, the interface is the form and determines both which content users access and how they access it.[60] As Drucker explains, an interface is not an independent thing, but it relies on a 'user/viewer, as a situated and embodied subject'.[61] The interface on a screen is not like a window *through* which a subject looks at content, but it is the combination of both *what* a subject reads and *how* he reads. A subject can only access content by means of mediation. As Drucker says, 'I don't access 'data' through a web page, I access a web page […]'.[62]

To conclude, good interface design deserves attention. After all, content such as digitised manuscripts, in the case of this thesis, is made available so that people can make use of it. If the user experience is not satisfactory, scholars are less likely to use the digital

[57] Kirschenbaum, '"So the Colors Cover the Wires": Interface, Aesthetics, and Usability', p. 524.
[58] F. Gibbs and T. Owens, 'Building Better Digital Humanities Tools: Toward Broader Audiences and User-Centered Designs', *Digital Humanities Quarterly* 6.2 (2012), par. 29.
[59] See for example: D. McKenzie, *Bibliography and the Sociology of Texts* (Cambridge: Cambridge UP, 1999).
[60] M. Whitelaw, 'Generous Interfaces for Digital Cultural Collections', *Digital Humanities Quarterly* 9.1 (2015), n.pag.
[61] Drucker, 'Humanities Approaches to Interface Theory', p. 8.
[62] Ibid, p. 10.

surrogate and that in turn makes it less likely for the surrogate to persist.[63] One usability expert, Donald A. Norman, has said that '[t]he real problem with interface is that it is an interface. Interfaces get in the way. I don't want to focus my energies on interface. I want to focus on the job'.[64] This suggests that interfaces need to be designed carefully so as not to draw attention to themselves, but support users in their task.

[63] Sanderson et al., 'SharedCanvas', par. 1.
[64] Qtd. in Kirschenbaum, '"So the Colors Cover the Wires": Interface, Aesthetics, and Usability', pp. 523-524.

2.3. Functionalities

The aim of the previous sections was to establish the needs of scholars who work with medieval manuscripts, to define the term 'interface', and to explain why good interface design is important. This section will link the last two sections. It will be investigated how user interfaces can be evaluated and what kind of functionalities interfaces of websites with medieval manuscripts need to have in order to meet scholars' needs.

As mentioned before, there are two evaluation criteria for digital library interfaces from a user's point of view: *usability* and *usefulness*. *Usability* is connected to the *user-system* pair, whereas *usefulness* is connected to the *user-content* pair.

First, I will look at *usability*, which 'evaluates whether the system is manipulated effectively by the user, in an efficient and enjoyable way that supports exploitation of all the available functionalities'.[65] An overview of important general principles for web usability is given by Steve Krug in *Don't Make Me Think!*[66] These principles apply to any kind of website, so also to websites with digitised manuscripts. In concrete terms, the principles are about the layout of web pages and the navigation on a website. If the usability of a website is good, users can find what they need easily, without too much effort and without getting lost. In user studies of digitised primary source collections, it has been stressed that ease of use is valued highly by scholars.[67] In the case of this thesis, scholars should be able to easily locate the manuscripts they are interested in. I will investigate which usability functionalities are important for websites with medieval manuscripts.

Second, I will look at *usefulness*, which 'evaluates the relevance of the [digital library's] content to the user's tasks and needs'.[68] For this, I will not look at the content in the strictest sense of the word, which consists of the (collections of) manuscripts that are available. Instead, I will look at the specific functionalities that scholars need at the level of the digitised manuscripts in the website in order to work with them, because the functionalities that come with the digitised items are very important in ensuring that scholars can make optimal use of the items.

In other words, for the *usability* criterion I will look at the general structure and design of website interfaces with digitised medieval manuscripts, and for the *usefulness* criterion I will look at the functionalities offered at the item level.

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[65] Heradio et al., 'A review of quality evaluation of digital libraries based on users' perceptions', p. 272.
[66] Krug, *Don't Make Me Think*.
[67] D. Sinn and N. Soares, 'Historians' Use of Digital Archival Collections: The Web, Historical Scholarship, and Archival Research', *Journal of the Association for Information Science and Technology* 65.9 (2014), p. 1801.
[68] Heradio et al., 'A review of quality evaluation of digital libraries based on users' perceptions', p. 272.

2.3.1. Usability

This section will describe which usability functionalities are important on websites with digitised medieval manuscripts. To begin with, there will be an overview of general web usability principles that apply to any kind of website. After that, searching and browsing will be considered. Searching and browsing are particularly important aspects of usability, because the website interfaces are at their core a means to get access to digitised manuscripts. Search and browse functionalities are the way to make this possible.

General usability principles

The most important usability principle, according to usability consultant Steve Krug, is the title of his book: 'don't make me think'.[69] In other words, the ideal website is completely self-evident. Users should be able to work out with a quick glance what the elements on a page mean and what they are for, without having to think about it. Gibbs and Owens state, along similar lines, that 'both the interface and documentation must err on the side of obvious rather than clever'.[70] Choices about which path to follow on a site and where to click to find what they need should not puzzle users but the options should be clear and obvious.[71] As Krug writes, every thought that web users spend on working out how a website works, rather than on the content of a website, is an addition to their cognitive workload that should be avoided whenever possible. These thoughts, if they are frequent and demanding, can leave users frustrated.[72]

An important assumption that is made in *Don't Make Me Think!* is that web users treat websites more like billboards than like books: they scan pages quickly to find what they want instead of reading everything. Users also 'satisfice', which means that they pick the first acceptable option they see and do not keep looking for the best option. They muddle through, rather than figuring out how a website works. This assumption is based on the many usability tests that Krug has carried out, in which he observes people using websites.[73] The following usability aspects are based on this assumption and the principle 'don't make me think'.

To begin with, there are four important points to keep in mind for evaluating the design of individual web pages to make sure that they are understood as quickly as possible by users. First of all, there needs to be a visual hierarchy. More important elements should be

[69] Krug, *Don't Make Me Think*, p. 11.
[70] Gibbs and Owens, 'Building Better Digital Humanities Tools', par. 24.
[71] Krug, *Don't Make Me Think*, p. 41.
[72] Ibid, p. 15.
[73] Ibid, pp. 21-29.

more prominent on the page, elements that are related logically should be related visually, and visual nesting – embedding elements according to their hierarchy – should be used. Second, pages need to be divided into clearly defined areas. This way, users will know quickly which parts of a page they want to use and which they do not need. Third, it needs to be obvious what is clickable, because this supports smooth and fast navigation within a website. Fourth, the amount of noise needs to be minimised. Noise can either fall in the category of banner ads and other hyperlinks and buttons, or background noise in the structure of the page, for example dark lines in tables. Noise often adds to the cognitive workload of users unnecessarily.[74] Krug also recommends limiting the amount of text on websites – not by reducing the content, but for example by shortening introductory text on the home page and instructions on how to use the site. This does not only diminish noise, but also makes important elements more prominent and reduces the amount of scrolling that users need to do.[75]

Apart from the design of individual web pages, the navigation on websites is very important for usability. Although there are similarities between navigating in the physical world and online, some vital cues are lacking.[76] First, users have no sense of direction apart from moving up and down in the hierarchy of a website. Second, there is also no sense of location, except perhaps the number of levels a user is removed from the homepage, because web pages do not have a physical location. Finally, users do not have a sense of scale: especially on very large websites, it is not possible for users to see how 'large' exactly a website is and what percentage of the total number of pages they have visited. The lack of these three cues can make users feel disoriented and lost on a website, which has been called 'one of the worst things researchers can experience in an online interface'.[77] Therefore, navigation should be designed carefully. Navigation should help users with several things, namely give them an overview of what the website contains, make clear how they can use it, tell them where they are on the website, and help them find what they are looking for.[78] The navigational functionalities that are necessary to achieve this will be described in the next paragraphs.

[74] Krug, *Don't Make Me Think*, pp. 31-39.
[75] Ibid, p. 45.
[76] Ibid, p. 57.
[77] J. DeRidder and K. Matheny, 'What Do Researchers Need? Feedback On Use of Online Primary Source Materials', *D-Lib Magazine* 20.7/8 (2014), par. 5.
[78] Krug, *Don't Make Me Think*, pp. 59-60.

An important part of the navigation is the so-called global or persistent navigation. This is an area of a web page that is the same on every page within one website. It tells users on which website they are and what the main components of that website are. Several elements have been identified that should be visible on every page to these ends, namely the website name or logo so that users know they are still on the same website, a link to the home page in case their chosen path has led them astray, a way to search on the website, an overview of the main sections of the website, and utilities such as 'about' and 'help'.[79] Standardised navigation, branding and the presence of a search box on every page have also been mentioned by DeRidder and Matheny as important elements on websites with digitised primary sources.[80]

There are two basic methods to let users know where exactly they are in the hierarchy of a website at any given time. The importance of this has also been found in user studies among scholars on websites with digitised primary sources.[81] The methods can be used simultaneously. The first is known as 'breadcrumbs'. Breadcrumbs are a string of clickable section and sub-section names, usually at the top of the page. These show a user which path they have followed into a website, starting from the homepage and then from level to level into the website. The other method is making use of the global navigation and highlighting the current section in the section overview. The advantage of the second method is that users can oversee and jump to other parts of the website more easily, which they cannot with breadcrumbs.[82]

Finding content: search and browse

To find what they are looking for on a website, in this case digitised manuscripts, users can employ two strategies: search and browse. Before considering browsing, searching will be explored here first. Searching depends on technology that belongs to the field of information retrieval (IR) and is based on on *indexing* and *matching*. Relevant metadata, in this case metadata related to digitised manuscripts, are *indexed* in a computer system. Users can then submit a query in a search engine, and with *matching*, similarities are sought between their query and the metadata.[83] If there are items with similarities, these are presented to users in a

[79] Krug, *Don't Make Me Think*, p. 62.
[80] DeRidder and Matheny, 'What Do Researchers Need?' par. 7.
[81] Ibid, par. 5.
[82] Krug, *Don't Make Me Think*, pp. 74-78.
[83] E. Voorhees, 'Natural Language Processing and Information Retrieval,' *Information Extraction: Towards Scalable, Adaptable Systems*, Ed. Maria Teresa Pazienza. Vol. 1714. Springer Berlin Heidelberg, 1999, p. 34.

result list. Offering users a simple search function is essential for retrieving any manuscript or other object from a database. As mentioned above, a search bar should ideally be present on all pages of a website. In one study, websites such as Google and JSTOR were found to be the most widely used online resources among humanities scholars because of their intuitive interfaces and ease of use. This indicates that high-level searches such as on these websites are important. Scholars said they appreciated these websites because they do not want to dig into a website deeply.[84]

Apart from a functionality to search, there should be a browse option as well. Browsing is a complex process that is 'widely recognized as an important information seeking technique'.[85] It can be seen as an expression of natural exploratory behaviour in which many species engage, including humans. Browsing has been defined as 'the activity of engaging in a series of glimpses, each of which may or may not lead to closer examination of a (physical or represented) object, which examination may or may not lead to (physical and/or conceptual) acquisition of the object'.[86] This definition contains the main stages of browsing behaviour: glimpsing a vision, focusing on an item within this vision to which the attention is drawn, examining the item, and consequently acquiring or abandoning the item. Shneiderman has proposed that browsable collection interfaces should also be designed with these stages in mind: 'overview first, zoom and filter, then details-on-demand'.[87] Just like the navigation in websites in general, the navigation in browsing environments should be 'flexible and fluid',[88] and there should be continuity between the overview or glimpse, the preview of an item, and the items themselves.

The underlying assumptions of search are that users can formulate precisely what information they need, and that the results generated by their queries are always the best answer to their information need.[89] Therefore, while searching is normally satisfactory for scholars who know what they are looking for, browsing is very important for scholars who have not yet defined a specific goal. It is also important for scholars to be able to resort to browsing when search fails to yield useful results and they want to look further. As Whitelaw

[84] Gibbs and Owens, 'Building Better Digital Humanities Tools', par. 10.
[85] M. Bates, 'What Is browsing—really? A model drawing from behavioural science research', *Information Research*, 12.4 (2007): n.pag.
[86] Ibid.
[87] B. Shneiderman, 'The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations,' *Proceedings of the 1996 IEEE Symposium on Visual Languages* (1996), p. 337.
[88] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
[89] Whitelaw, 'Generous Interfaces for Digital Cultural Collections'.

described, search 'withholds information' and 'demands a query'.[90] With this, he means that if the only entry to a digital collection is search, users can never see all of a collection, and while they can search for anything they want, they cannot know what they miss. This resembles closed stacks in a library where users can request any book they would like to see, but they cannot have a look at the shelves themselves to see if there are interesting books that they would not have thought of.

Transparency and control are key terms when it comes to searching and browsing. Control has been defined by Koohang and Ondracek as one of the main aspects of usability, but has not been mentioned in much other literature about the topic.[91] In order to accomplish their task, users need to feel in control of an interface and need to know how it works so they can find what they want. Users can be given a sense of control by increasing the transparency of a website. Gibbs and Owen found that ease of use and transparency are very important to scholars.[92] They reported that if the utility of any digital resource was not clear, scholars often became confused and frustrated and might even abandon a resource altogether.[93] (par. 4)

Transparency and a sense of control can be achieved with intuitive interfaces, clear documentation, and 'help with understanding how a given tool interfaces with data'.[94] In practice, several functionalities have been proposed to improve control and transparency in searching and browsing.[95] First, the search rules of a database need to be explained, so that users know how to mould their queries in order to get the most useful results. Second, there needs to be an explanation of the relevancy ranking of the results, so that they understand why certain results are placed higher in the list of results than others. Naturally, search needs to be designed in such a way that the results in the list are indeed relevant to users' queries. Third, advanced search and browse options are desirable too, for example fielded search and faceting and limiting options in searching and browsing. Fielded search allows users to search only in certain parts of the metadata of all manuscripts, for example search only for names of persons. Faceting and limiting allow them to search and browse in subsets of a database, for example only manuscripts from before or after a certain date. There does not seem to be a consensus on which categories are the most important in advanced search and browse, and the practical application relies heavily on the extent and quality of the metadata, but some useful categories

[90] Whitelaw, 'Generous Interfaces for Digital Cultural Collections'.
[91] A. Koohang and J. Ondracek, 'Users' Views about the Usability of Digital Libraries', *British Journal of Educational Technology* 36.3 (2005), p. 415.
[92] Gibbs and Owens, 'Building Better Digital Humanities Tools', par. 6.
[93] Ibid, par. 4.
[94] Whitelaw, 'Generous Interfaces for Digital Cultural Collections'.
[95] DeRidder and Matheny, 'What Do Researchers Need?' par. 5.

for manuscripts are date and place of origin, title, incipit and explicit, author, shelfmark, provenance, and current location.[96]

There are some difficulties with searching in databases with digitised medieval manuscripts, namely multilingualism and the lack of standardised spelling in medieval texts.[97] Ideally, therefore, the search system should support variant spellings of names and words, support fuzzy searches and topical searches, recognise common synonyms and suggest similar results.[98] A long-term goal of the Manuscript Digital Library is even to implement a multilingual search, which would mean that users only have to enter a query in one language to find relevant results from metadata in any language.[99]

[96] Z. Uhlíř and A. Knoll, 'Manuscriptorium Digital Library and ENRICH Project: Means for Dealing with Digital Codicology and Palaeography', *Codicology and Palaeography in the Digital Age* Vol. 2, Norderstedt: BoD, 2009, p. 73.
[97] Ibid, p. 74-75.
[98] DeRidder and Matheny, 'What Do Researchers Need?' par. 7.
[99] Uhlíř and Knoll, 'Manuscriptorium Digital Library and ENRICH Project', p. 75.

2.3.2. Usefulness

This part will describe functionalities that are important for the usefulness of digitised medieval manuscripts. Usefulness, as Heradio et al. say, 'evaluates the relevance of the [digital library] content to the user's tasks and needs'.[100] As mentioned before, I will not concentrate on the literal content, and considerations on the selection and digitisation process of manuscripts lie outside the scope of this thesis. Instead, the focus will be on how scholars can work with individual items of the content when they have been digitised and made available online. Two groups of functionalities can be distinguished. First, there are functionalities to support the direct interaction between a scholar and a digitised manuscript, for example a magnifying glass and zooming functionalities to examine details on a page closely. Second, there are functionalities that allow scholars to record and transfer information from a manuscript, for example an option to download the images of manuscript pages.

The functionalities described below were collected from user studies about scholars working with digitised manuscripts and from articles about existing tools for displaying and manipulating manuscripts. Regarding the user studies, Chevallier, Laure and Bouvier-Ajam have recorded many comments of scholars in 'Consultation of manuscripts online: a qualitative study of three potential user categories'.[101] This article is relevant because it is entirely about the consultation of digitised medieval manuscripts. Two other interesting user studies are 'What Do Researchers Need? Feedback On Use of Online Primary Source Materials' by DeRidder and Matheny,[102] and 'Historians' Use of Digital Archival Collections: The Web, Historical Scholarship, and Archival Research' by Sinn and Soares.[103] Both these articles do not concentrate specifically on medieval manuscripts, but do contain valuable comments from scholars about using digitised primary sources in general. Scholars' opinions were also asked and taken into consideration when VirtualVellum was designed, 'an electronic tool for viewing, transcribing and manipulating manuscripts'.[104]

[100] Heradio et al., 'A review of quality evaluation of digital libraries based on users' perceptions', p. 272.
[101] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
[102] DeRidder and Matheny, 'What Do Researchers Need?'
[103] Sinn and Soares, 'Historians' Use of Digital Archival Collections', pp. 1794–1809.
[104] Ainsworth and Meredith, 'e-Science for Medievalists'.

Working with the content

The first requirement of the images of manuscript pages is that they are of high quality.[105] In order to be useful to scholars, the images need to show at least as much detail as would be visible to the naked eye when studying the physical manuscript. This is because of the importance in codicology and palaeography of details in letters, punctuation and illumination. Preferably, the quality is even higher, so that even more details can be discerned by zooming in. In that case, digitised manuscripts can even have an advantage over the originals, because it is possible for scans to show details that would otherwise only barely be visible through a magnifying glass.

This brings us to the next requirement: size and enlargement functionalities should be available, ideally both a virtual magnifying glass to select a small area of a page, and a zoom function for the entire image. Gradual zoom is desirable,[106] as well as the possibility to zoom to a particular percentage.[107] It can also be convenient to be able to maintain zoom when moving to another page. In order to maintain a sense of scale, it is important to have an indication of what the size of a zoomed in area is relative to the size of the page. Apart from relative sizes, the absolute sizes in centimetres or inches should be made clear too. This can be accomplished by adding a ruler, either in a fixed place or moveable across the image. Some scholars noted that they found a ruler more useful than merely having written sizes.[108] In any case, they need to be able to measure any element on a folio.[109]

Several other desired functionalities for working with individual images were mentioned. Because glosses and annotations are sometimes written in another direction than the main text, it is convenient to have the possibility for 360˚ rotation. Options to work on the contrast, luminosity and colours of images were mentioned too, for example an option to filter particular colours or offering several pre-set filters to simulate different light sources.[110] Quite often, parts of text in medieval manuscripts have become difficult to decipher, for example if

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[105] Ibid, par. 2.
Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
DeRidder and Matheny, 'What Do Researchers Need?' par. 5.
Sinn and Soares, 'Historians' Use of Digital Archival Collections', p. 1805.
[106] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
[107] DeRidder and Matheny, 'What Do Researchers Need?' par. 5.
[108] Ibid.
[109] Ainsworth and Meredith, 'e-Science for Medievalists', par. 10.
[110] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
E. Lyman, '"May the Text Rise up to Meet You": New Ways of Reading Old Manuscripts', *Digital Humanities Quarterly* 3.3 (2009), n.pag.

the colours of the ink have faded. These functionalities can help bring difficult to read text back to sight.[111]

In addition to images of single pages, scholars have also commented that they would like to view multiple images in one window, so that they can compare different pages from one manuscript or from different manuscripts, or perhaps even from manuscripts from different collections.[112] This has for example been realised in Virtual Vellum, in which users can add panes to view more images at the same time. Each viewing pane has its own zooming and other controls.[113]

Apart from high quality images and related functionalities, scholars also need metadata about the images. Chevallier, Laure and Bouvier-Ajam found that they at least want to have access to the information that would be available when visiting a library, so they want to have access to the library catalogue records and librarians' cards. They would welcome any additional information too, such as bibliographies, descriptions of illumination, and introductions to a project or corpus, perhaps also through links with other websites.[114] Some scholars liked seeing some metadata, such as date, description and repository location, on the same page as where they viewed the item. Possibly there is not enough room to show all metadata, in which case it should be clear where to click to access the rest of the relevant metadata.[115] Accessing the metadata should be possible without abandoning the screen in which the manuscript is opened, so a new window or small pop-up window would be suitable.

Taking a step back, navigation on the item level is important too, so that scholars can easily move through the various folios of the digitised manuscript. To begin with, scholars have indicated that they wanted the images of the manuscripts to load quickly, and they wanted 'flexible and fluid' navigation.[116] Because they will likely spend many hours examining the manuscripts, and especially if they have to switch often between different pages or different manuscripts, slow access can be very off-putting.

For the navigation within and between digitised manuscripts, several functionalities have been proposed. First of all, scholars need to know where they are in a manuscript. Therefore, an overview of the content of the manuscript in which the current location is

[111] See for example: H. Havens, 'Adobe Photoshop and Eighteenth-Century Manuscripts: A New Approach to Digital Paleography', *Digital Humanities Quarterly* 8.4 (2014), n.pag.
[112] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
[113] Ainsworth and Meredith, 'e-Science for Medievalists', par. 10-11.
[114] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
[115] DeRidder and Matheny, 'What Do Researchers Need?' par. 5.
[116] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
Sinn and Soares, 'Historians' Use of Digital Archival Collections', p. 1801.

highlighted is important. This could for example be implemented with a table of contents or list of folios on the side or top of the page.[117] Second, scholars need to be able to navigate easily within a manuscript. According to comments in user studies, this can be achieved with strategically placed paging buttons, for example at the top and bottom of pages.[118] In addition to navigating folio by folio, it is also important to have a functionality to jump to a particular folio quickly.[119] Some scholars would also like to be able to choose between different modes of consultation, mainly between an 'open book' view or viewing only a single folio at a time.[120]

Adding and extracting information

As mentioned before, scholars do not only need functionalities for immediate interaction with the digitised manuscripts, but also for extracting, saving and sharing information.

Extracting and saving information for individual use

For their own use, scholars would like to be able to download sources, entirely or selected parts.[121] Moreover, downloading parts of images has been listed as a useful functionality.[122] As with the manuscripts online, the image quality of downloaded files has to be of high quality.[123] Some scholars reported that dividing sources in a file per page was not practical.[124] Preferably the downloaded files have automatically generated, logical file names that help scholars to find them on their computer at a later time, for example containing shelfmark or title information. Also, the files should contain identification and citation information.[125] Apart from functionalities for downloading (parts of) the manuscripts themselves, several other functionalities for information extraction were mentioned by the scholars in Chevallier, Laure and Bouvier-Ajam's study. They would like to export information from the results list, and

[117] DeRidder and Matheny, 'What Do Researchers Need?' par. 5.
[118] For research about in-document navigation, see for example Liesaputra, V. and I. Witten, 'Realistic electronic books', *International Journal of Human-Computer Studies*, 70.9 (2012), pp. 588-610 and Liesaputra, V. and I. Witten, 'Seeking information in realistic books: a user study', *Proceedings of the ACM International Conference on Digital Libraries* (2008), n.pag.
[119] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
[120] Ibid.
[121] DeRidder and Matheny, 'What Do Researchers Need?' par. 5.
[122] Ibid, par. 7.
[123] Ibid, par. 5.
[124] Sinn and Soares, 'Historians' Use of Digital Archival Collections', p. 1801.
[125] DeRidder and Matheny, 'What Do Researchers Need?' par. 5.

buttons for printing pages and requesting facsimiles.[126] Finally, scholars would like to be able to save the exact settings of a screen, so that they can easily resume their work later.[127]

Sharing and adding information for collaboration

Perhaps the most challenging and interesting future area for working with digitised manuscripts is online collaboration among scholars and institutions. So far, functionalities to serve individual scholars have been considered. However, as some research and comments point out, the development of functionalities for digitised manuscripts in the future will likely be driven by the question how scholars can share their knowledge more online so it is useful to others as well, and on how institutions can link information to serve scholars better. Because medieval manuscripts are complex sources that can be approached in many different ways, it would be beneficial for research if information related to them, for example manuscript descriptions and scholarly articles about a manuscript, was exchanged more easily. That way, a deeper understanding of medieval manuscripts can be reached. For example, the tool *Virtual Vellum* was developed to support real-time collaboration between scholars in different locations. Important functionalities are 'a facility for collaborative annotation, and a sophisticated blogging tool'.[128]

Another approach was used in the data model SharedCanvas, which aims to increase interoperability between institutions. At its basis lies the manuscript page, to which different layers of images, text and annotation can be added. Instead of 'the current set of disparate content silos' of various institutions, the developers of SharedCanvas envision 'a coherent landscape of interconnected systems' in which digitised manuscripts and related data are brought together virtually.[129] Important topics in SharedCanvas are integration of collections and integration of for example transcriptions and scientific data and publications. Supporting linked data across databases was one of DeRidder and Matheny's suggestions for the future too,[130] and it is also the main goal of the Manuscriptorium and ENRICH projects, which are ultimately intended to form one European digital library of cultural heritage materials such as manuscripts, incunabula and archival materials, by aggregating all relevant data and metadata.[131]

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[126] Chevallier, Laure, and Bouvier-Ajam, 'Consultation of manuscripts online'.
[127] Ainsworth and Meredith, 'e-Science for Medievalists', par. 10.
[128] Ibid, par. 22.
[129] Sanderson et al., 'SharedCanvas', par. 1.
[130] DeRidder and Matheny, 'What Do Researchers Need?' par. 7.
[131] Uhlíř and Knoll, 'Manuscriptorium Digital Library and ENRICH Project', pp. 68-69.

Going further into such large-scale integration of resources lies outside the scope of this thesis, yet there are some functionalities that existing websites could offer to increase collaboration. Firstly, buttons to share a manuscript or folio on social media are a simple way to share information. Secondly, offering a platform such as a blog or wiki allows scholars to exchange thoughts in various stages of their research.[132] Thirdly, providing the possibility to add for example scholarly annotations and manuscript descriptions could enrich digital collections.[133]

[132] Ainsworth and Meredith, 'e-Science for Medievalists', par. 34.
[133] Sanderson et al., 'SharedCanvas', par. 2.

2.4. Checklist

Usability

General usability principles

Design of web pages

Clear visual hierarchy

Pages divided in areas

It is clear what is clickable

Minimal noise

Global navigation on every page

Website name and/or logo

Home button

Search bar

Section overview

Access to utilities

Sense of location

Current section highlighted in section overview

Breadcrumbs

Finding content: search and browse

Guiding information about the collection content

Explanation of the search rules

Explanation of the relevancy ranking of the results

Yielded results are relevant

Advanced search possibilities (fielded search; limiting; faceting)

Browsing is possible (limiting; faceting)

Usefulness

Working with the content

Images

High quality images

Magnify elements of the image

Zoom in on the entire image

Ruler or other way to measure elements in image

Image rotation

Change contrast, lighting and colours

Multiple viewing panes (for comparing different folios or manuscripts)

Display metadata

Navigation in manuscript

Current folio is indicated clearly

Leaf through a manuscript

Jump to any folio quickly

Choice between viewing one folio and an ‘open book’ view

Extracting and adding information

For individual use

Download entire manuscripts and individual folios in high quality

Export information from results list

Print button

Downloaded files have logical file names

Files contain identification and citation information

Save screen settings for resuming work later

For collaboration

Share buttons (for social media)

Blog or wiki to exchange ideas

Add annotations and (manuscript) descriptions

3. Analysis

In this chapter, three websites with digitised medieval manuscripts will be analysed using the checklist from chapter 2. This analysis will give an impression of the current state of affairs regarding the usability and usefulness of such websites, and it may bring to light possible areas for improvement.[134] The websites to be analysed are Digital Scriptorium, e-Codices, and the digitised manuscript collection of the British Library. These three websites are hosted by organisations that are renowned internationally. Although they cannot represent all digitised manuscript collections, this sample gives a good impression what has been achieved at the forefront of digital cultural heritage collection development. To avoid confusion, the term 'page' is used in this chapter to refer to web pages, and the term 'folio' is used for the pages of manuscripts.

Usability

General usability principles

Design of web pages

Generally, the design of the websites is both functional and easy on the eye. Different page areas can be distinguished easily, the visual hierarchy is clear, and there are no unnecessary hyperlinks or other types of noise.

On all websites, visual hierarchy is shown by using bold titles and item and section names. On the British Library website, titles are also in a larger font and they are separated from the text by white space, making the hierarchy even clearer. The use of outlined page areas on e-Codices aids the understanding of the hierarchy. Because the section names on Digital Scriptorium are in a rather small font, they do not catch the eye immediately. However, some other strategies on the website are very helpful, for example different levels of text indentation for different levels of manuscript description.

The global navigation is separated from the rest of the pages on each website. On Digital Scriptorium and the British Library website, a large logo makes the global navigation stand out. On e-Codices, the global navigation bar is very narrow, but because it is black it stands out from the rest of the white page. The remaining part of the pages is divided in distinct areas. This is particularly clear on e-Codices, where different parts of the pages are separated by means of white space, lines, boxes, and slightly different background colours.

[134] For a better understanding of the analysis, screenshots of the websites have been included in Appendix I.

Boxes are also used on the left of the pages of Digital Scriptorium, where they contain the subsections. Some lines and different background colours are used too. The only lack of clear areas on Digital Scriptorium occurs in the result list and item pages, where long catalogue records look like one large block of text, because the different parts such as 'description', 'notes' and 'incipit' are strung together without clear distinction. On the British Library website, different parts of the text are separated by white space, and in some places different background colours and lines are used too. Boxes and different colours are used for the highlights on the 'About' page.

It is generally obvious what is clickable on all websites. Hyperlinks change colour or become underlined when hovering over them with the mouse indicator and the mouse indicator always changes from an arrow to a hand. On Digital Scriptorium, hyperlinks are recognisable because they are in blue, bold font. There are some links that initiate the download of a document, for example on 'For Content Contributors' under 'About DS'. These look exactly the same as other links, which can be slightly confusing. On e-Codices, sometimes tabs and drop-down menus can be opened within the same page. This is clearly indicated with small triangles or arrows.

None of the websites contain a lot of noise. There are no advertisements or unnecessary hyperlinks, and the design of each is clean and simple with light background colours and simple fonts, which keeps the background noise low. On e-Codices, although there is no unnecessary noise, sometimes there is a lot of information on one page which can take some time to process. For example, the browse and search page contains four drop-down menus, a search bar, paging buttons, a statement of the number of results found, and all faceting options. This can make the page seem noisy at first sight, but the function of each part of the page becomes clear quickly.

Global navigation

All websites have global navigation at the top of the page. On e-Codices, the global navigation bar is present on all pages including the manuscript viewer, but on the British Library website and Digital Scriptorium manuscripts are opened in a new tab that has no global navigation.

On the British Library website, the library name and logo are visible on every page in the top left corner. The logo is also the home button to the homepage of the general British Library website. In the manuscript viewer, opened in a new tab, the logo is also visible but there it is no longer a home button. Additionally, the 'Search the British Library website'

button in the global navigation is a hyperlink to the homepage too. ‘Home’ in the global navigation links to the homepage of the digitised manuscripts part of the British Library website. e-Codices also shows their name and logo in the subtle but clear global navigation bar at the top of each page. Here, it remains a home button in the manuscript viewer, which is opened in the same tab in which the rest of the website is accessed. On Digital Scriptorium, the logo/name is visible everywhere except in the manuscript viewer, which only contains the folio number and the image itself. The home button of Digital Scriptorium is given as a ‘DS Home’ link on every page.

Every page in the digitised manuscripts section of the British Library website contains a ‘Quick Search’ bar for keyword search within the digitised manuscript collection. This works well, except that ‘quick searches’ cannot be refined later. When a query is entered in the actual ‘search’ section, it is always possible to click on ‘refine search’ just above the result list, but this is not possible when queries are entered in the ‘quick search’ bar, even though the ‘refine search’ button appears. On Digital Scriptorium, every page contains a link to ‘Basic Search’ and ‘Advanced Search’ except the image viewer and the homepage, which simply has a link to ‘Search’. Although there is no simple search bar for quick keyword searches, ‘search’ can be accessed sufficiently easily from every page. e-Codices contains a search bar within the global navigation bar that reads ‘Search manuscript metadata’, so users can carry out a simple search from each page of the website.

On the British Library website, there is a section overview in the global navigation area with ‘Home’ (of the digitised manuscripts section), ‘About’, ‘Browse’, ‘Search’, ‘Help’, and a link to the British Library general website. On Digital Scriptorium, there are links to ‘DS Home’, ‘About DS’, ‘Using The Images’, ‘Basic Search’, ‘Advanced Search’ and ‘Help’. The homepage is somewhat different, as it contains links to ‘Search’, ‘Using The Images’ and ‘About DS’ that are presented in a different layout than on the rest of the website. Moreover, the homepage links to ‘Highlights of Digital Scriptorium’ and ‘News and Announcements’, both of which cannot be accessed from another page of the website. The global navigation of e-Codices contains links to ‘Person Index’, ‘Annotations’, ‘About’, and ‘Browse & Search’. There is a small triangle next to ‘About’ to indicate that there is a drop-down menu there. ‘Person Index’ links to a searchable and browsable overview of all persons that have some connection with a manuscript in the collection, from authors, scribes and illuminators to sellers, owners and librarians. ‘Annotations’ links to an overview of the manuscripts to which annotations have been added. ‘Search & Browse’ links to the digitised manuscripts. ‘About’ links to all other content of the website. This consists of ten sections with several pages each,

which is quite a lot to store under a drop down menu. Therefore, the focus is on the manuscripts and on people, and all information about the website and partner libraries is somewhat hidden.

Utilities can be accessed from every page on the British Library websites. The utilities offered are ‘About’ and ‘Help’. The same is true for Digital Scriptorium, except that ‘Help’ cannot be accessed from the homepage. On e-Codices, ‘About’ can be accessed from every page too, but the drop-down menu underneath contains many sections and it can take some scanning and reading to find the right page. There is no ‘Help’ section, but there is a question mark button on for example the search and browse page. This opens a small window with the essential information about how this works.

Sense of location

Each website uses a different strategy to give users a sense of location. The British Library website has breadcrumbs and on e-Codices the current section is highlighted in the global navigation bar. Digital Scriptorium does not use a particular strategy, but the page titles usually make it clear where a user is.

On the British Library website, the current section is not highlighted in the section overview, but breadcrumbs indicate where users are. The breadcrumbs start with the homepage of the library website followed by the digitised manuscripts section. The breadcrumbs give users sufficient sense of direction, because the structure of the digitised manuscripts section is easy to understand. On Digital Scriptorium, the clarity of the current location depends on the section. The section ‘About DS’ contains subsections, which are listed in a box titled ‘About DS’ on the left of the page so that users know what the section contains. The current page has a title that refers one of these subsections. For example, ‘Finances’ leads to a page called ‘Digital Scriptorium Finances’, and ‘Privacy Policy’ leads to a page with the same name. This is sufficiently clear. However, when clicking ‘Feedback’ under ‘About DS’ users are suddenly transported to the ‘Help’ section. ‘Using The Images’ contains only one page with the same name, which is clear too. ‘Basic Search’ and ‘Advanced Search’ link to different search forms, but both contain the same list of subsections on the left of the page, so the website structure is not entirely straightforward here. On e-Codices, the current section is highlighted in the global navigation bar, and if it falls under ‘About’ then it is highlighted in that drop-down menu as well.

Finding content

It is helpful for users to have an idea about how many and what kind of manuscripts a digitised collection contains, because this can help them find content. The British Library and e-Codices contain some general information about their collections, and e-Codices and Digital Scriptorium list all collaborating partners and the number of manuscripts they have contributed. Each website has some information about how search and browse work, and they all offer some browsing and advanced searching possibilities, although this is realised in different ways. e-Codices has the most fluid and user-friendly search and browse facilities.

On the 'About' page on the British Library website there is some background information about its manuscript collection and the digitisation progress, and there are links to several highlights of the digital collection. This helps users to get a general impression of the collection: they know what kinds of manuscripts to expect in the digital collection, how some of the manuscripts made their way to the British Library, and they know the size of some subsets of the manuscript collection and how much of each of these subsets has been made available digitally yet.

Digital Scriptorium is not intended as a comprehensive database of completely digitised manuscripts, but rather a searchable catalogue of premodern manuscripts with varying numbers of (sample) images. The content of the collection depends on what their members contribute, and no general description of what can be found is given. Therefore it is hard for users to get an overview of what Digital Scriptorium contains. The only way to find this out is going to either 'Basic Search' or 'Advanced Search' and then to 'Browse By' > 'Location'. This results in a list of all institutions that have contributed to Digital Scriptorium. When clicking on each of the institutions, the number of items they added to Digital Scriptorium and a list of these items are stated.

The home page of e-Codices starts with a section with information about the website and some of the collaborating libraries. The first thing that users read is a statement about what e-Codices is, namely a virtual manuscript library of Switzerland. Users can also leaf through this section of the home page to find information about some of the collaborating libraries. Underneath, there is a list of all partner libraries, along with the total number of documents on the website and the number of documents from each library. Under 'About', pages can be found with for example facts and figures, a brief history of the website, and sub-projects. This gives users a good grasp of the number of digitised manuscripts available and where they come from.

On the ‘Help’ page of the British Library manuscript collection, there is a brief overview of the search possibilities, but it is not explained if and how queries can be refined further, for example with Boolean operators and wildcards. Digital Scriptorium has a list of ‘Search Tips’ in the ‘Help’ section, with an elaborate explanation of how all aspects of search can be used, which helps users understand how exactly their query is interpreted by the search system. For example, entering multiple words in one of the search boxes will be interpreted as search terms separated by Boolean operator ‘and’, and wildcards can be used on the website. On e-Codices, the search and browse page contains a question mark button. When clicking this, a small pop-up screen with the essential search rules is opened, namely how wildcards, fuzzy searches and quotation marks can be used.

Users of the British Library digital manuscripts can order the results by the same metadata categories by which they can search, so the ranking is clear. The default ranking is by manuscript shelfmark. On Digital Scriptorium the relevancy ranking of the results is not explained, although the results seem to be ordered alphabetically by repository. On e-Codices users can order their results by relevance, ‘settlement, shelfmark’, date of origin and ‘online since’. On all websites, the yielded results seem to be relevant because it can be traced back on the manuscripts’ metadata pages why they showed up. On e-Codices, the result list even contains an overview of all the fields of the metadata where their query was found, so that users can immediately see why each result is shown to them.

All websites present advanced searching and browsing options. In the British Library manuscript collection, fielded search is possible for shelfmark, title, author/scribe, provenance/acquisition, and bibliography. The bibliographies contain mostly references to physical catalogues. Faceting is possible for periods of time of at least 25 years, so users can for example search for manuscripts from the first half of the 12th century or any manuscript made after 1475. They can browse under several facets: shelfmark, author, title, or scribe. For each category, the number of available items is given. The items are listed alphabetically per category. All categories except ‘manuscript’ (shelfmark) have a tab for each letter to make browsing quicker. Browsing by shelfmark can therefore take a long time, because users can only skip four pages at a time. There are 100 items per page and at the moment there are almost 9000 items available. Additionally, users can browse in all manuscripts from a certain period of time, at least 25 years and at most 2000 years. This can be done by selecting a certain period in the advanced search section and then searching without entering a query: this will return all manuscripts from that period.

On Digital Scriptorium, fielded search is possible for shelfmark, author, title, docket, language, provenance, binding, and caption. On the 'Advanced Search' page, there are three search bars, which allows users to create very specific queries. Users can filter the results for any period of time, the country of origin, and the current repository. They can also choose 'Yes', 'No', or 'Default' for 'Dated MS?', 'Document?' and 'Figurative Decoration?' although it is not explained what exactly this means. In the result list, the number of results is given, as well as the search terms and time range. Users can browse all manuscripts, but 'browse' is hidden under search. Therefore, it is not immediately clear that a browsing option is provided, which is a shame. Users can only browse by current location and language.

e-Codices presents all search and browse options together, which gives users a lot of control over how they manipulate their query. They can change all aspects of their query in one screen, and the results are updated immediately. The basis is a list of all manuscripts ordered by 'settlement, shelfmark', so users can already leaf through the entire collection before submitting a query. There is one search bar, which lets users search in all text by default. They can also use a drop-down menu for a fielded search in 'basic metadata', 'collection/shelfmark', 'person name', 'text title', 'place of origin', 'incipit', 'explicit', and 'decoration'. It is not possible to combine different search terms, like on Digital Scriptorium. Results can be ordered by relevance, settlement/shelfmark, date of origin, and 'online since'. Finally, on the left side of the page there are many faceting options such as library, country of origin, text language and century. Immediately above the results is a drop-down menu with all shelfmarks from all libraries, so users can scan this list quickly to get a sense of what is in the result list.

Usefulness

Working with the content

Images

On all three websites, high quality images are available. Gradual zoom is possible on e-Codices and the British Library website, and Digital Scriptorium offers each image in three fixed sizes instead of zoom. Other image manipulation functionalities are still limited on all websites.

The images on all three websites are of such high quality that at least the same amount of detail can be discerned as would be possible in the physical manuscript. Both on the British Library website and e-Codices users can zoom in on the image very easily and fluidly with scroll and + and – buttons. When using scroll, the point in the image where the mouse indicator is at that moment stays in the same place of the screen, so users can control on which part of the image they zoom in. It is not possible to magnify only small elements of a folio; it is only possible to zoom in on the entire image. However, since zoom works so smoothly this option is not missed. On Digital Scriptorium, users can choose to open an image in three different sizes: small, medium and large. This is not very user-friendly, because users have to return to the page about the manuscript they are looking at, and then open another version of the image for another size. It is also not possible to use another zoom percentage than the three that are offered.

The manuscripts in the digital collection of the British Library and Digital Scriptorium have been scanned with a measuring tape in the image, so there is some indication of the size of the manuscripts. However, it is very hard to measure anything precisely, especially since the measuring tape disappears from sight when zooming in on the page. The only other way to gain information about size is in the manuscript description. On e-Codices, it is even harder to measure anything. Here, the size of the manuscripts can be found in the manuscript description too, but for each manuscript only the cover and one folio have been photographed with a ruler in the image. On all other folios no sense of scale is conveyed.

The images of the British Library website and Digital Scriptorium cannot be rotated. On e-Codices, Manuscripts can be rotated clockwise and anti-clockwise with arrow buttons, so text that is written sideways or upside down can be read with ease. None of the websites offer any other image manipulation tools, such as a way to change contrast, lighting and colours.

On Digital scriptorium, users can only view one image at a time. If users open another image from the result list, the tab with the manuscript viewer is refreshed and the last image is replaced with the new image. The only way to open multiple images at the same time is copy-pasting the image URL in a new tab, which does not allow for an easy and fluid workflow. In the manuscript viewers on the British Library website and e-Codices, users can view folios as an open book and they can view the recto and verso of one folio side by side. Other than that, is only possible to examine one image at a time. When clicking on a manuscript in the result list on the British Library website, it is opened in a new tab automatically, which makes it somewhat easier to work with multiple manuscripts at the same time. However, the images cannot be displayed together and the user has to switch back and forth between tabs. Although the standard viewer of e-Codices only supports viewing single and double folios, there is also the possibility of opening a manuscript from e-Codices in Mirador. This is an 'open-source, web based, multi-window image viewing platform with the ability to zoom, display, compare and annotate images from around the world'.[135] Mirador is opened in a new tab. In Mirador users can add viewing panes on all sides, with a maximum of five panes horizontally by five vertically. Everything in between is also possible, for example using half of the screen for one pane and dividing the other half in four panes. In each pane, a choice can be made between a single page view, an open book view, a scroll view with all folios placed side by side in line, and a thumbnail grid view.

In the British Library collection, the shelfmark, date, and manuscript title are shown at the top of the manuscript viewer. Since manuscripts frequently contain more than one work, the title of the work of which the current folio is part is displayed as well. All other available information, such as provenance, scribes, and material, can be found on the information page about a manuscript, outside of the manuscript viewer. On Digital Scriptorium, all metadata about a manuscript is available on the manuscript metadata page too. In the image viewer, only the folio number is shown, but no title or shelfmark or any other metadata. Within the manuscript viewer on e-Codices, there is a small tab at the right of the screen that can be opened and closed to display the metadata. This is a very user-friendly solution, because the metadata can be accessed at all times within the same screen, without losing sight of the current folio. Apart from this tab, city, library and shelfmark are always indicated in a bar directly under the global navigation. All metadata can also be accessed on the manuscript information page.

[135] Project Mirador <http://projectmirador.org/> (9 June 2016).

Navigation in manuscript

On e-Codices and the British Library website, manuscript navigation has been designed very well. Users can both move through a manuscript folio by folio and jump to any folio quickly, and they can always see where they are. On Digital Scriptorium, manuscript navigation is not very smooth, because users can only open a folio in a new tab and they have to return to the list of folio thumbnails to open another folio.

In the manuscript viewer of the British Library, the current folio is always given in the top right corner of the screen. This indication of the folio number is part of a drop-down list of all folio numbers, with which users can jump to a certain folio at once. Users can also leaf through a manuscript page by page with paging buttons. They can choose to view a single folio, an 'open book', or the recto and verso (front and back) side of a folio simultaneously. They can also choose whether the images are displayed above or next to each other. If the images are shown next to each other, they can choose which one is shown on the left and which on the right. The two images have individual zooming controls.

In Digital Scriptorium, the folio number is given in de image viewer, but no other information about the manuscript is shown there, such as shelfmark and title. The manuscript navigation consists of scrolling through a list of thumbnails of the available folios on the metadata page of a manuscript. Users can only open one image from that page, which is consequently opened in a new tab. Since usually only a small number of folios of a manuscript are available, it is not too cumbersome to navigate in a manuscript. However, if manuscripts are available in their entirety, scrolling the long list of thumbnails is rather inconvenient.

Navigation in the manuscripts of e-Codices is very flexible. Like on the British Library website, users can choose between viewing one folio, an open book, and both sides of the same folio. Users can leaf through manuscripts folio by folio with paging buttons. Additionally, they can view all the folios as a grid of thumbnails on the screen to get an overview of the whole manuscript and move to a certain folio quickly. Similar to this grid, a horizontal bar of folio thumbnails can be opened at the bottom of the screen while keeping the current folio in sight. There is also a drop-down list with folio numbers to jump to a particular folio quickly. This drop-down list always contains the current folio number, like on the British Library website. The current folio is indicated as well in a bar between the global navigation and the manuscript viewer, along with the city, library, and shelfmark, making it very clear to users where they are in the collection and manuscript.

Information extraction

For individual use

On all websites it is possible to extract some information, but the amount of support for this varies. For example, the British Library and e-Codices offer print buttons in some places, but only on e-Codices there is a download button for images.

In the digital manuscript collection of the British Library, it is not possible to download full images. The only utility is that each folio as shown in the manuscript viewer has its own stable URL, which is not only found in the URL bar, but also given separately immediately above the image. This makes it quite easy to bookmark folios and return to them later. It is possible to save images, but then only the portion of the image visible on the screen with the corresponding amount of detail is saved. This means that entire but very low quality images or high quality but small fragments of images can be saved by users. There is no download button for images from Digital Scriptorium either, although bookmarking the URL is possible. It is also possible to save all three versions of each folio, so here users are able to save high quality images. e-Codices allows users to download folios as JPEG files in four different sizes, as well as an A4 PDF file. Downloading more than one folio at once is not possible on any of the websites, which may have to do with rights.

On the British Library website, users can use a print button to save or print the result list as it is displayed on the website, with a thumbnail image, shelfmark, title and date of each result. The details of the query, the way of sorting, and the number of results are listed clearly at the top of the file. When clicking on one of the results on the website, the user is taken to the information page about a manuscript, which can be saved and printed in the same manner. On Digital Scriptorium, there is no such option for downloading or printing information about results. On e-Codices this is also not possible, perhaps because the results are presented in such a fluid way: users can keep refining their query and the results are updated immediately. Therefore, the result list is more ephemeral than on the other websites and not as suitable for saving.

As mentioned above, the British Library provides a print button above the result list and on the information page of each manuscript. Digital Scriptorium does not offer print buttons anywhere. e-Codices offers print buttons in three different locations: one for the e-Codices document details, which include for example the direct link to a manuscript and the

creative commons licence, one for the scholarly manuscript description if available, and one for each folio in a manuscript.

Downloaded PDF's of the result list or manuscript information page from the British Library website do not come with standardised file names, nor are logical file names suggested when saving images from the British Library or Digital Scriptorium to save them. The files from e-Codices all get logical file names that start with 'e-codices' and include abbreviated library names, shelfmarks and folio numbers.

In the files of the result list from the British Library, the all query details, the way of sorting, and the number of yielded results are listed clearly at the top of the file. The files from e-Codices also contain identification and citation information, such as the bibliographic reference of a manuscript description. This means that files from both these websites contain sufficient identification and citation information. This is not applicable to Digital Scriptorium, where no files except the images can be downloaded.

On the British Library website and Digital Scriptorium, it is not possible to save screen settings, but there are no screen settings to save except the amount of zoom. The same is true for the basic manuscript viewer within the e-Codices website. However, users can bookmark their screen settings in the viewing tool Mirador when they open a manuscript from e-Codices there.

For collaboration

Collaboration is the area in which most work has yet to be done. On the British Library website and Digital Scriptorium users can only send feedback and comments to the website hosts, but on e-Codices functionalities have already been created that allow users to add comments and annotations to the website.

On the British Library website and Digital Scriptorium, users can only share a manuscript metadata page or folio by copy-pasting the URL. e-Codices contains a button in its manuscript viewer for e-mailing the current folio to someone. There is no other support for sharing manuscripts on social media or other websites.

On the British Library website and Digital Scriptorium, it is also not possible to exchange ideas on the website itself with other users: there is no blog or wiki and no possibility to add annotations or descriptions. The British Library only offers a small contact link on the bottom of each page, but other than that the website is entirely impermeable for users. Digital Scriptorium encourages users to share their feedback with a feedback form under 'About' and 'Help'. There is also a hyperlink at the top of each manuscript metadata

page saying ‘Comment on this record’ that links to the same feedback form. This form allows users to give input, but they have no control over what is done with their input on the website.

On e-Codices, users can add annotations and bibliography items to a digitised manuscript, and they can comment on these annotations and bibliography items. Annotations can relate to an entire manuscript, but also optionally to one folio or a range of folios. Although these functionalities do not seem to be intended as a platform for elaborate discussion, it still gives users a way to add information to the site and to address other users. In order to use these options, it is necessary to have an account on e-Codices. This is simple to create and only requires a first and last name, username and e-mail address – although users are encouraged to share more information.

Overview

The tables below show to what extent each website met the usability and usefulness criteria.[136]

Usability	e-C	BL	DS
General usability principles			
Design of web pages			
Clear visual hierarchy			
Pages divided in areas			
It is clear what is clickable			
Minimal noise			
Global navigation on every page			
Website name and/or logo			
Home button			
Search bar			
Section overview			
Access to utilities			
Sense of location			
Current section highlighted in section overview			
Breadcrumbs			
Finding content: search and browse			
Guiding information about the collection content			
Explanation of the search rules			
Explanation of the relevancy ranking of the results			
Yielded results are relevant			
Advanced search possibilities (fielded search; limiting; faceting)			
Browsing is possible (limiting; faceting)			

[136] Needs that are met are green, needs that are not met at all are red, and needs that are met to some extent but not completely are yellow.

Usefulness	E-C	BL	DS
Working with the content			
Images			
High quality images			
Magnify elements of the image			
Zoom in on the entire image			
Ruler or other way to measure elements in the image			
Image rotation			
Change contrast, lighting and colour			
Multiple viewing panes			
Display metadata			
Navigation in manuscript			
Current folio is indicated clearly			
Leaf through a manuscript			
Jump to any folio quickly			
Choice between viewing one folio and an ‘open book view’			
Extracting and adding information			
For individual use			
Download entire manuscripts and individual folios in high quality			
Export information from results list			
Print button			
Downloaded files have logical file names			
Files contain identification and citation information			
Save screen settings for resuming work later			
For collaboration			
Share buttons (for social media)			
Blog or wiki to exchange ideas			
Add annotations and (manuscript) descriptions			

4. Conclusion

The aim of this thesis was to find out to what extent websites with digitised medieval manuscripts meet scholars' needs in terms of usability and usefulness. These websites are important because they make medieval manuscripts accessible to everyone and everywhere, whereas the original manuscripts can only be accessed by a limited number of scholars. Much codicological research still requires examination of the original manuscripts, because it centres on the manuscript as three-dimensional object, which cannot be captured fully in two-dimensional images. However, websites presenting high quality scans or photographs of the manuscript folios may well be sufficient for palaeographic research about anything related to the text and decoration.

Usability and usefulness have been defined as the two main evaluation criteria for the user interfaces of digital libraries. In this thesis, these criteria have been applied to three leading websites with digitised manuscript collections: e-Codices, Digital Scriptorium, and the manuscript section of the British library website. For usability, the overall structure and design of the websites have been analysed, and for usefulness, facilities at the level of the digitised manuscripts were studied. Overall, the analysed websites were found to meet most usability criteria, but many of the usefulness criteria have yet to be met.

The websites met most of the needs regarding general usability, especially in the design of web pages and the global navigation. All websites also offered basic and advanced search and browse options. This is essential, because users need to be sure that they can locate the manuscripts they need and do not overlook items. e-Codices sets the most usable example by combining all basic and advanced search and browse facilities on the same page and updating the search results – also on the same page – continuously.

In the area of usefulness, the websites do not meet all scholars' needs yet. All websites offer high quality images of manuscript folios and a metadata page about each manuscript, by which they meet the most important demand. However, it would benefit research if some other facilities were added to the manuscript viewers. The British Library and e-Codices offer very easy and fluid zooming in a manuscript viewer that allows smooth navigation within manuscripts, but on Digital Scriptorium it is only possible to open single images in three fixed sizes. It is not possible to measure elements on a folio on any of the websites. Only on e-Codices it is possible to rotate images, and other image manipulation tools are absent on all websites. e-Codices is also the only website on which multiple images from different manuscripts can be compared. In future research, it would be valuable to explore the

technological possibilities for improving usefulness, because this thesis only focused on what the ideal situation would be for scholars and not on how this can be implemented practically.

Most needs remain unmet in the area of extracting, adding and sharing information around the digitised manuscripts. e-Codices offers some facilities for extracting and adding information by means of email and print buttons and the possibility of adding annotations and bibliography items. The British library contains some print buttons too, but other than that the British Library and Digital Scriptorium do not facilitate information extraction and addition. Therefore, this is where most growth is possible and how this kind of websites can gradually be transformed from separate 'content silos' to 'a coherent landscape of interconnected systems'.[137]

[137] Sanderson et al., 'SharedCanvas', par. 1.

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The University of California Berkeley Library, 'Digital Scriptorium', <http://bancroft.berkeley.edu/BANC/digitalscriptorium/> (7 June 2016).

Appendix I: Screenshots

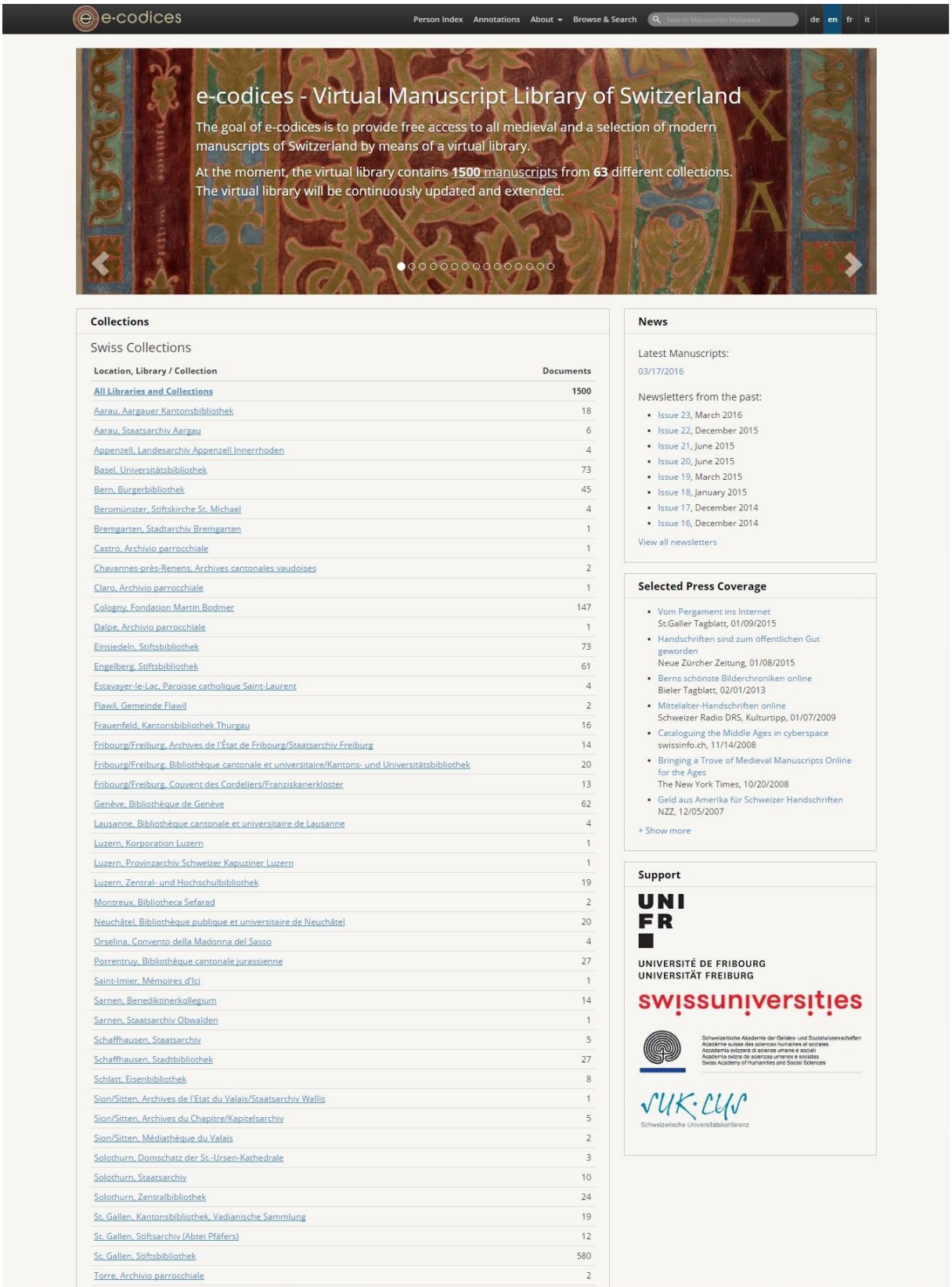

Figure 1: e-Codices, homepage, <http://www.e-codices.unifr.ch/en> (9 June 2016).

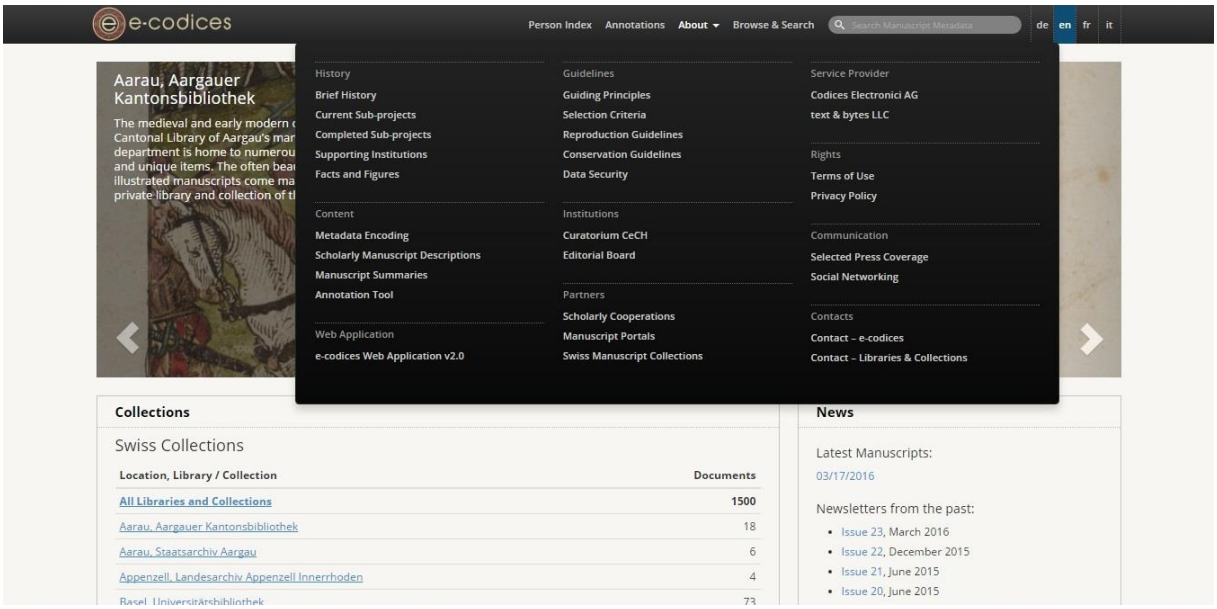

Figure 2: e-Codices, 'About', <http://www.e-codices.unifr.ch/en> (9 June 2016).

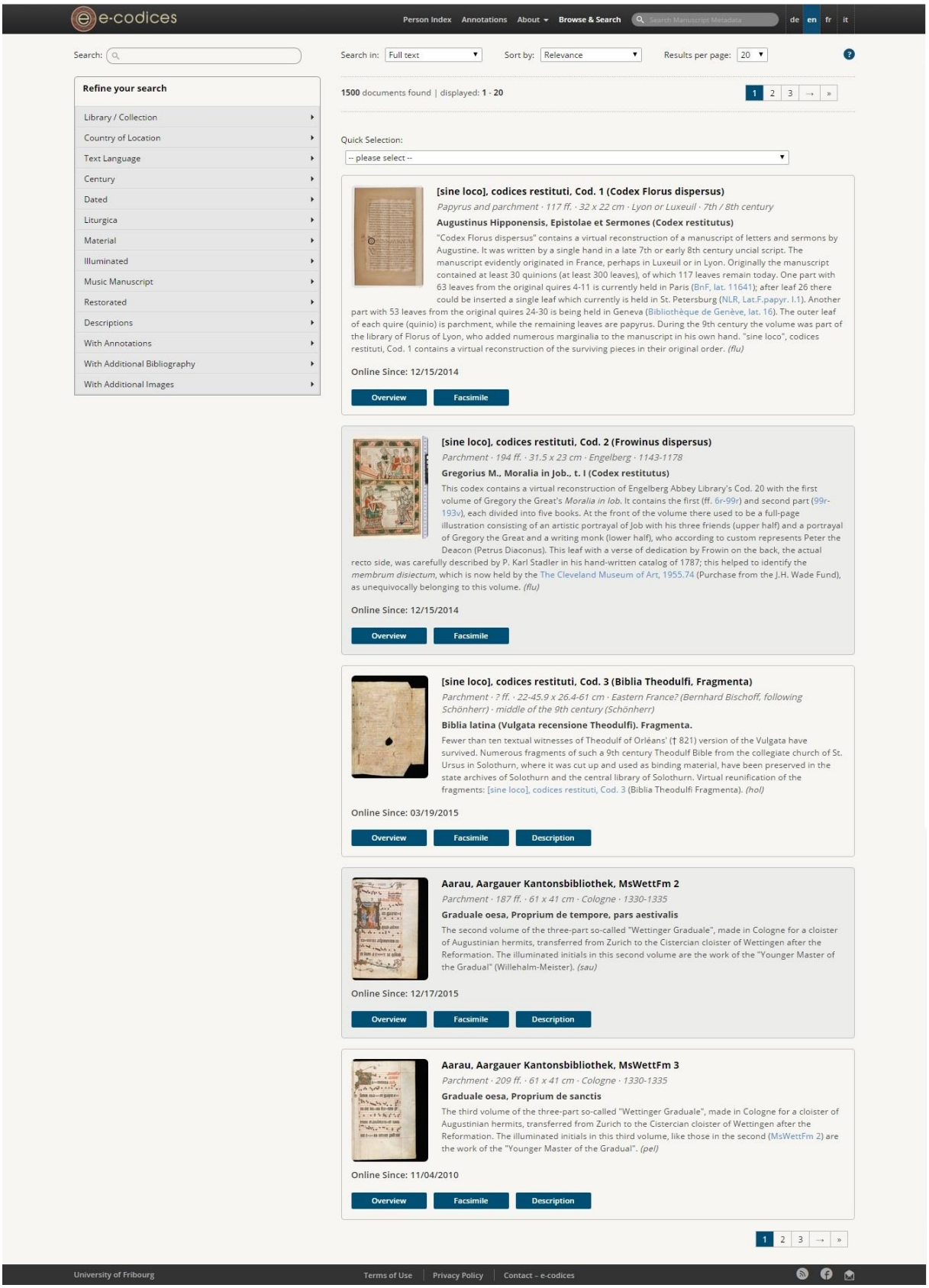

Figure 3: e-Codices, 'Browse & Search', <http://www.e-codices.unifr.ch/en/search/> (9 June 2016).

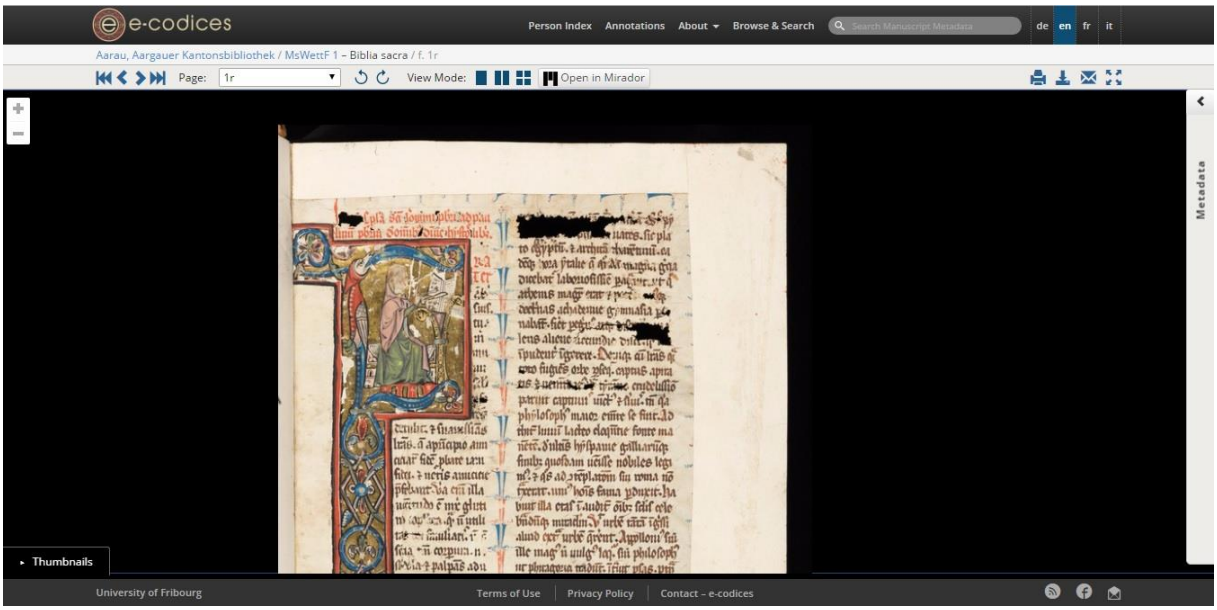

Figure 4: e-Codices, manuscript viewer, <http://www.e-codices.unifr.ch/en/kba/WettF0001/1r> (9 June 2016).

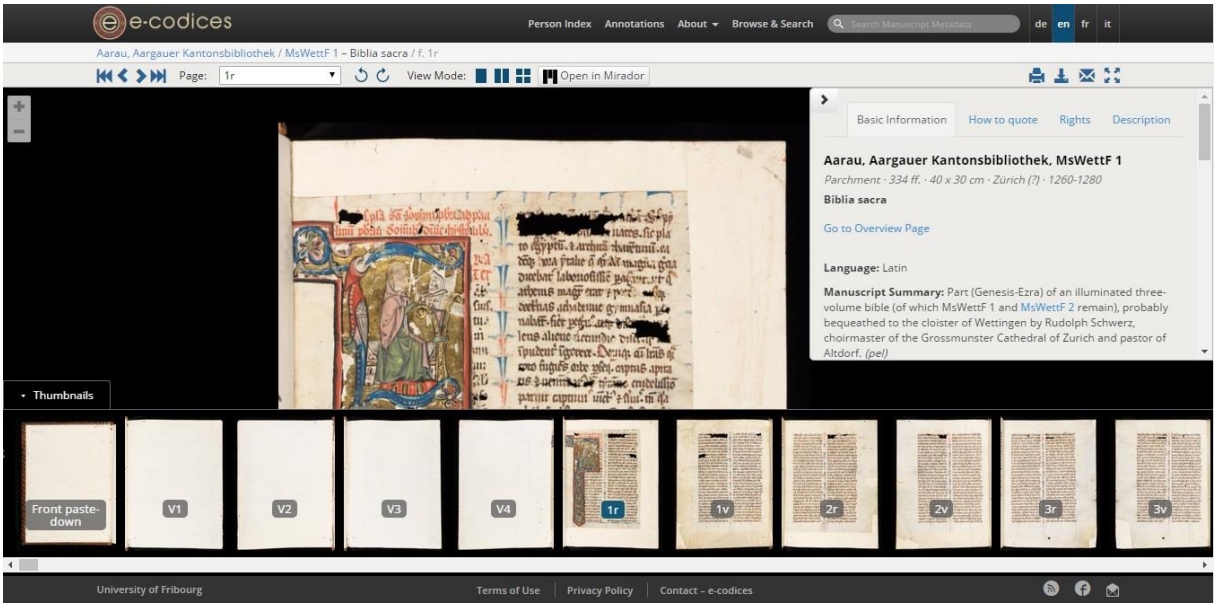

Figure 5: e-Codices, manuscript viewer with expanded metadata and thumbnails, <http://www.e-codices.unifr.ch/en/kba/WettF0001/1r> (9 June 2016).

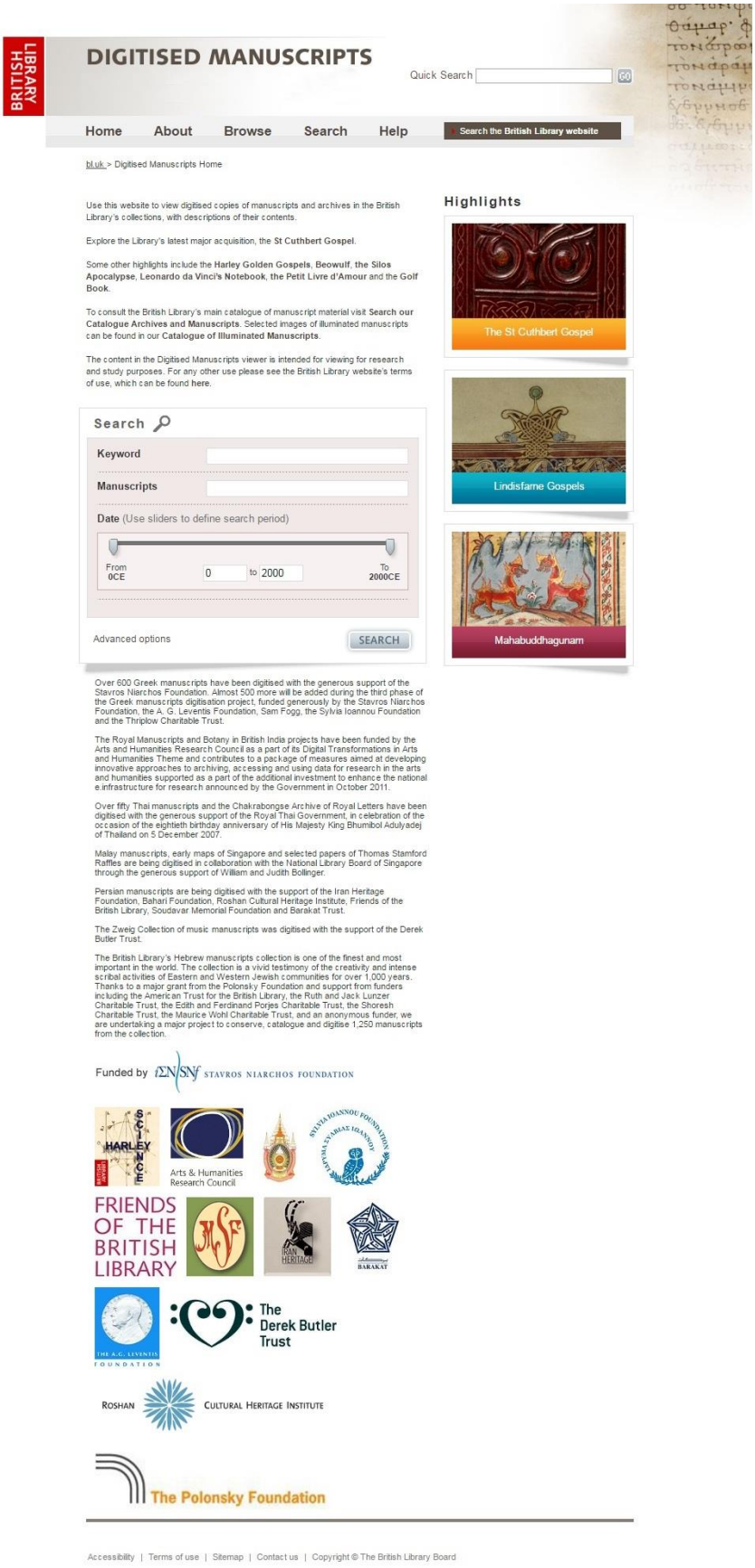

Figure 6: The British Library, Digitised manuscripts, 'Home', <http://www.bl.uk/manuscripts/> (5 June 2016).

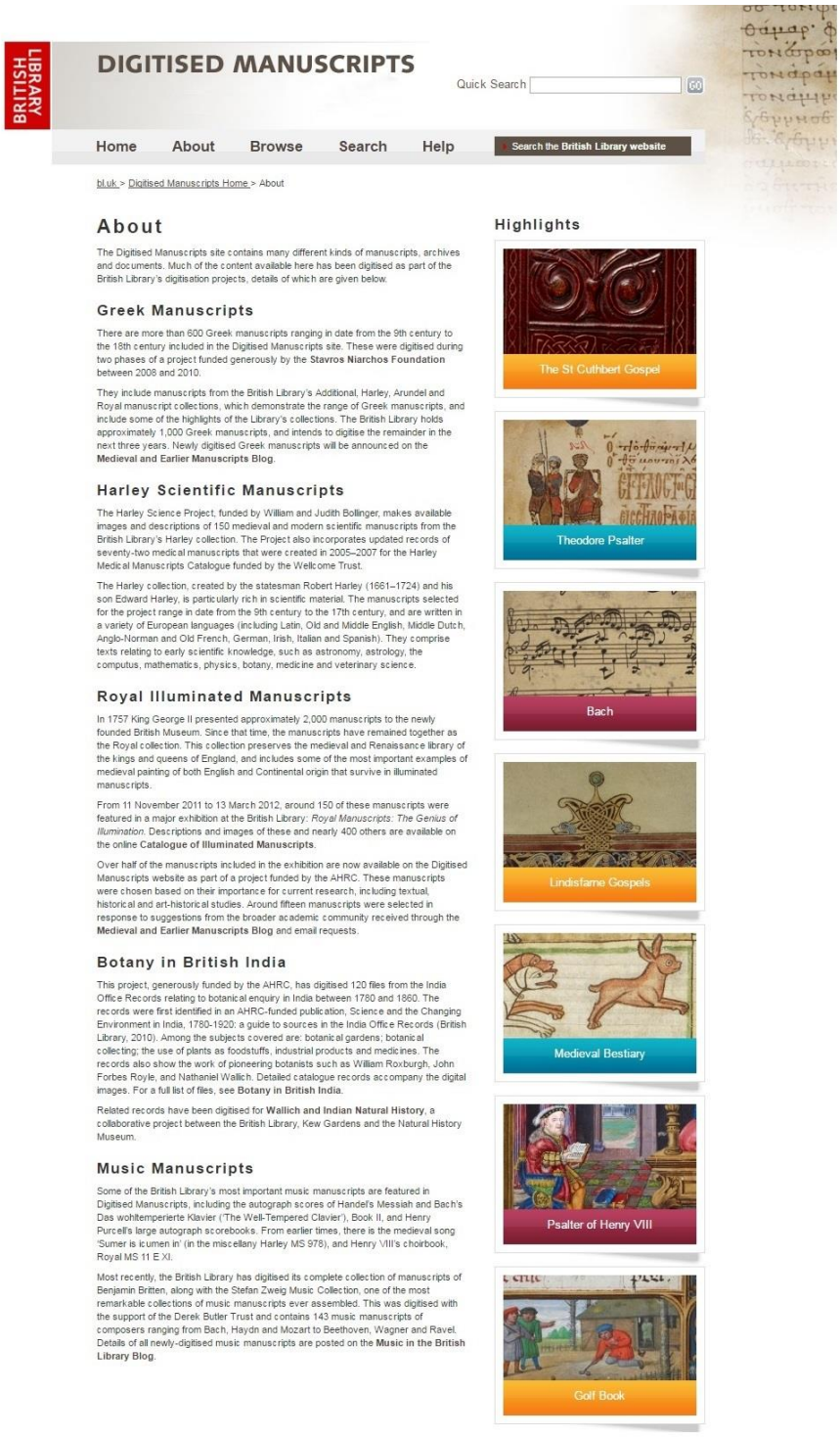

Figure 7: The British Library, Digitised manuscripts, 'About', <http://www.bl.uk/manuscripts/About.aspx> (5 June 2016).

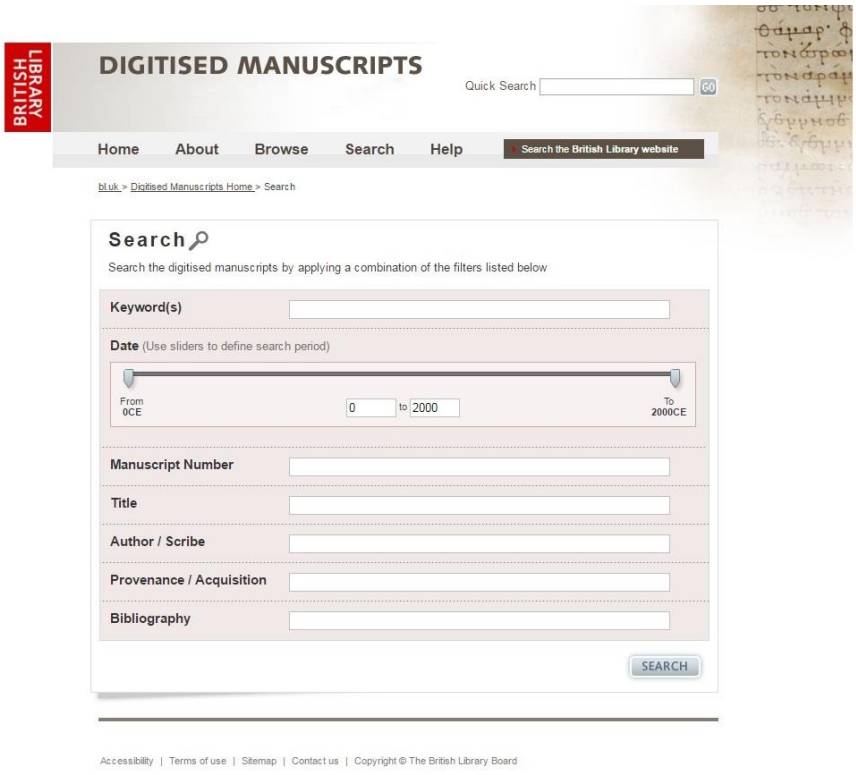

Figure 8: The British Library, Digitised manuscripts, 'Search', <http://www.bl.uk/manuscripts/AdvancedSearch.aspx> (5 June 2016).

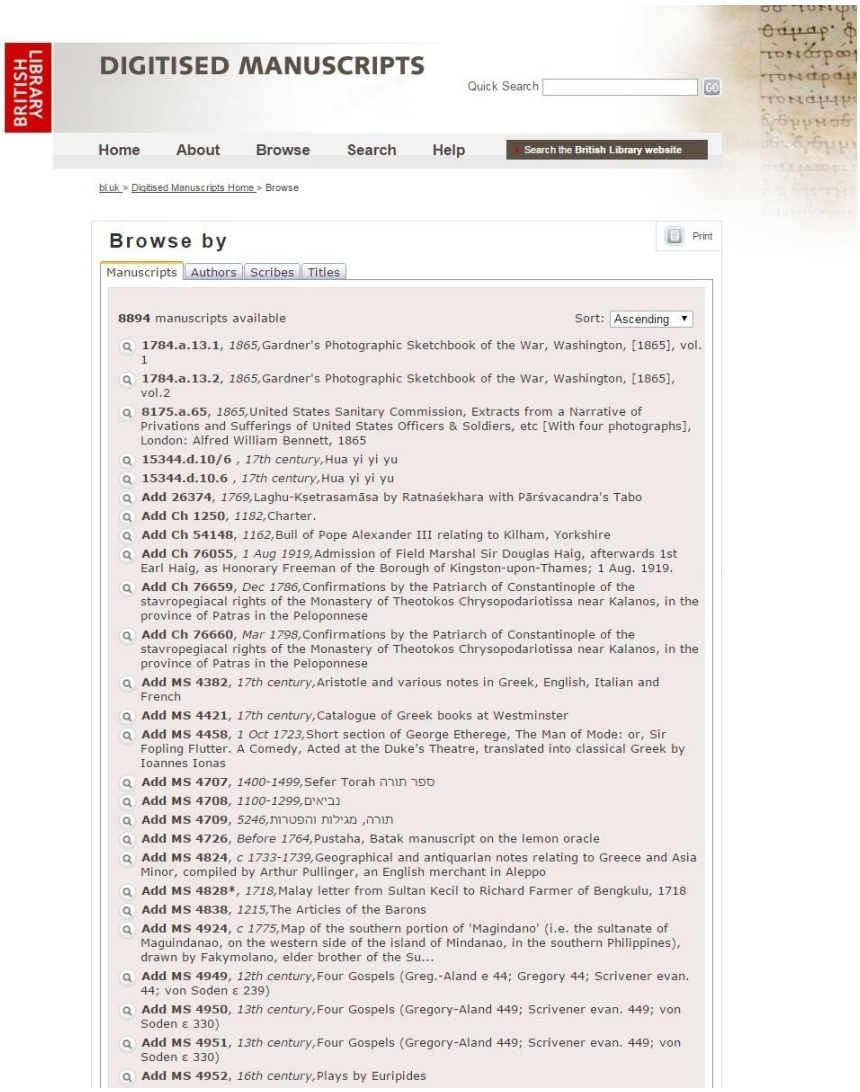

Figure 9: The British Library, Digitised manuscripts, 'Browse', <http://www.bl.uk/manuscripts/Browse.aspx> (5 June 2016).

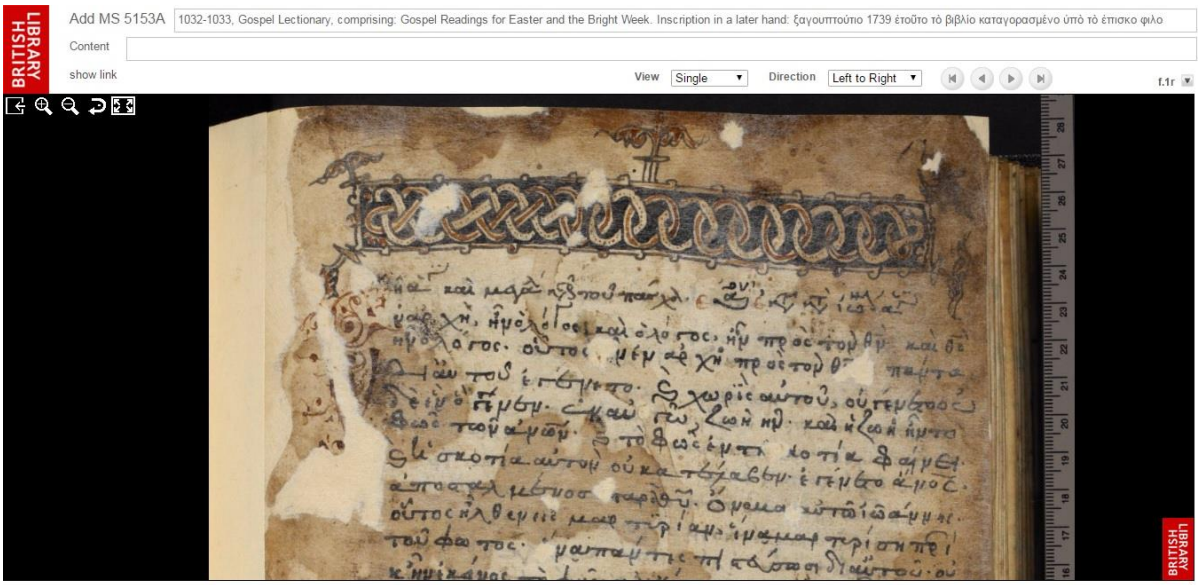

Figure 10: The British Library, Digitised manuscripts, manuscript viewer, <http://www.bl.uk/manuscripts/Viewer.aspx?ref=add_ms_5153A_fs001r> (5 June 2016).

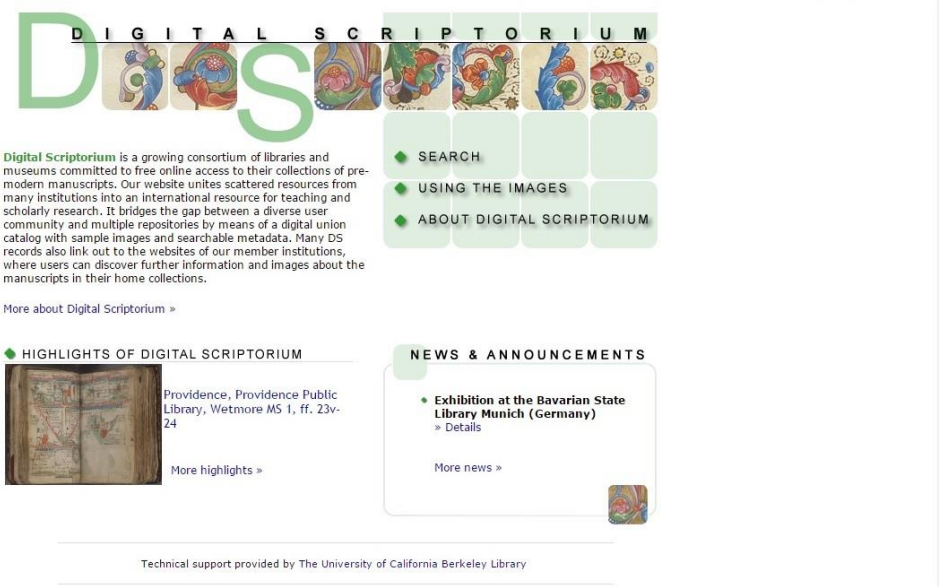

Figure 11: Digital Scriptorium, 'DS Home',
<http://bancroft.berkeley.edu/BANC/digitalscriptorium/> (7 June 2016).

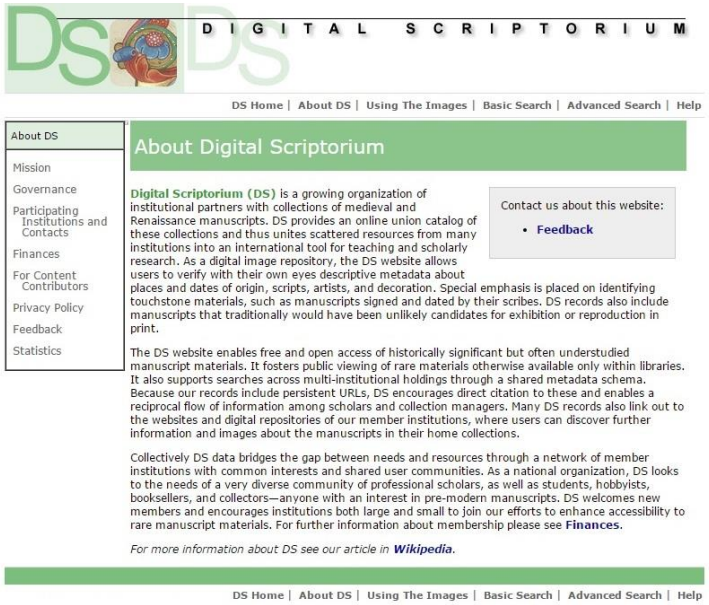

Figure 12: Digital Scriptorium, 'About DS',
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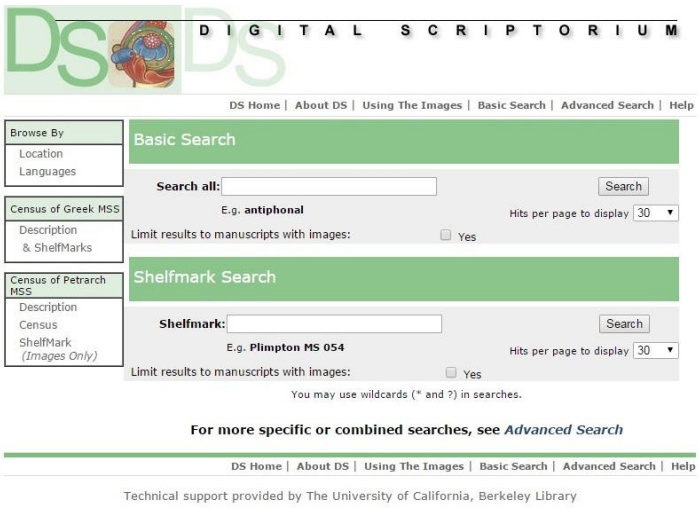

Figure 13: Digital Scriptorium, 'Basic Search', <http://bancroft.berkeley.edu/BANC/digitalscriptorium/basicsearch.html> (7 June 2016).

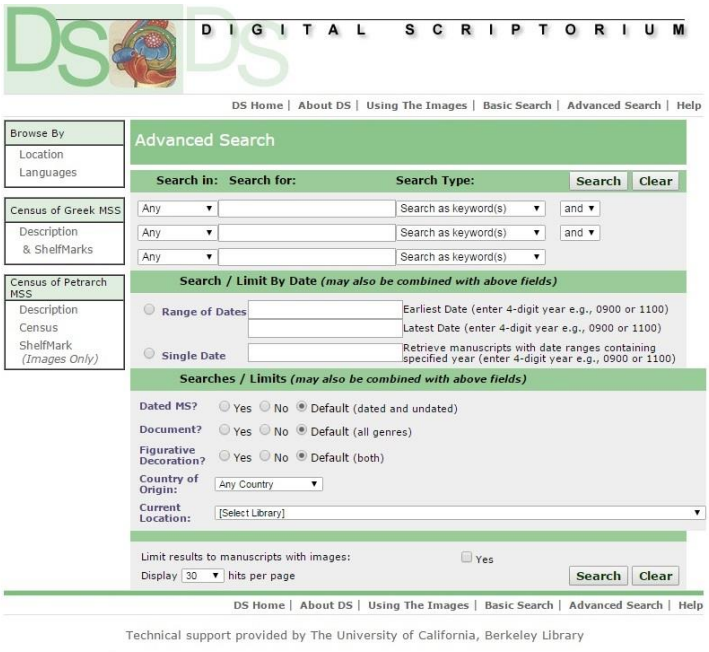

Figure 14: Digital Scriptorium, 'Advanced Search', <http://bancroft.berkeley.edu/BANC/digitalscriptorium/advancedsearch.html> (7 June 2016).

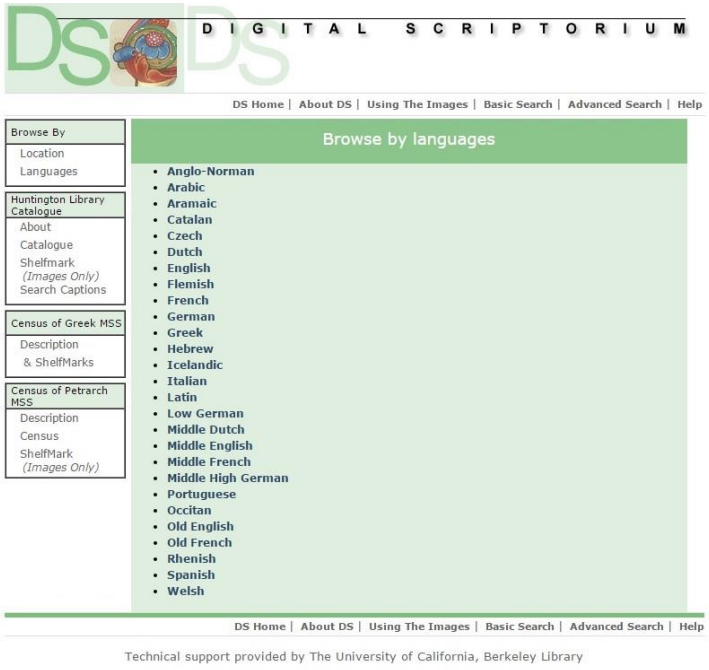

Figure 15: Digital Scriptorium, 'Browse by languages', <http://bancroft.berkeley.edu/BANC/digitalscriptorium/browse_language.html> (7 June 2016).

Figure 16: Digital Scriptorium, 'Browse by location', <http://bancroft.berkeley.edu/BANC/digitalscriptorium/browse_location.html> (7 June 2016).