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Designing a system to chart the development of the UK museum sector: an iterative approach[1]

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Abstract

Purpose

This paper presents our methodology for designing a system providing comprehensive data about the UK's museums and enabling research into the history, status and long-term development of the entire sector.

Design/methodology/approach

We have devised and applied an iterative methodology in order to deliver a knowledge base, web application, and website through which these and related resources are publicly accessed, allowing incorporation of the requirements of user stakeholders drawn from across the UK museum sector.

Findings

Our methodology has enabled the elicitation of usage scenarios, research questions, and feedback from a broad range of user stakeholders, allowing the system to be successfully delivered within the time and staffing constraints of a single publicly-funded research project. Feedback received from external evaluators and users of the system has been overwhelmingly positive.

Originality

The system includes the only comprehensive dataset of the UK's museums and is enabling new research by museum studies scholars and museum professionals. Our methodology can inform

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other projects aiming to create specialist knowledge resources involving a wide range of user stakeholders, particularly within constrained time and staffing resources.

1. Introduction

The number of museums in the UK increased massively during the late twentieth century, with official figures suggesting a rise from around 900 venues in 1963 (Morris, 1988) to approximately 2500 by 1990 (Museums Association[2]). Very little was known about that boom: whether there were national and regional variations within the UK, what subjects the new museums covered, which museums closed, and if there are the correlations between these variables. Equally importantly, it was not known how the sector subsequently changed.

Many regional and national funding bodies collect data on museums, but only within their specific institutional remit, e.g. Arts Council England (ACE), the Museums Association, the Association for Independent Museums (AIM), and the Department for Digital, Culture, Media and Sport (DCMS). However, there is no facility for synchronizing data between different organizations or reviewing the data over time. Data is not cross-referenced, routinely omits smaller venues, and closure is rarely documented.

The lack of a comprehensive dataset covering all museums has hampered research into the history and impact of the UK museum sector. It has not been possible to determine if particular types of museums, or in particular locations, have historically proved viable or unviable. Strategic development of the sector has therefore been hampered by the lack of information about whether museums are over- or under-represented in particular constituencies, and about the wider conditions that sustain or undermine the sector.

Mapping Museums[3] (MM) is an interdisciplinary project aiming to analyze the emergence and development of the UK museum sector from 1960 to the present day[4]. This has involved the discovery and integration of data on over 4000 museums (almost double that of any previous study) and the design of (i) a knowledge base to model the data using a new purpose-designed ontology, and to store the data, (ii) a web application allowing users to browse, search, and visualize the data, and (iii) a website through which these and related resources are made publicly available. In this paper we use the term "system" to refer collectively to the knowledge base (KB), web application (Web App) and website developed by the MM project.

The MM project team comprises researchers from museum studies, historical geography, oral history, political history, computer science and geographic information science. Although the project's original aim was to create a resource to support the research of the project's own humanities scholars, it became evident after the first trial with external users that the system was going to be of wider interest and significance to UK museum professionals and specialists. The challenge then faced was to devise and apply an effective methodology to deliver a system meeting the requirements of a broad range of user stakeholders for a single digital resource providing data on the UK's museums and supporting analysis of the status and long-term development of the sector. This paper presents our methodology for incorporating these wider perspectives into the design of the system, and the outcomes of a series of validation studies undertaken to evaluate the system's usability and usefulness.

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[2] https://www.museumsassociation.org/about/faqs/
[3] www.mappingmuseums.org
[4] Supported by the UK Arts and Humanities Research Council (AHRC) grant AH/N007042/1, 2016-2021.

Section 2 describes related work on digital cultural heritage archives and applications. Section 3 presents our methodology. Section 4 presents the results of the validation studies undertaken on each iteration. Section 5 discusses findings and contributions. Section 6 gives concluding remarks and directions of future research.

2. Related Work

Digitizing cultural heritage-related information. There has been much work on digitizing and publishing data about cultural heritage collections, for example through an integrative semantic portal (Hyvönen *et al.*, 2005), through translation of cultural heritage metadata into linked open data (Haslhofer *et al.*, 2011; De Boer *et al.*, 2012; Matsumura *et al.*, 2012; Knoblock *et al.,* 2017) and through the development of specialist ontologies and knowledge bases (Schmitz and Black, 2008; Brownlow *et al.*, 2015; Carriero *et al.*, 2019). Other works on digitizing museum-related information include sharing of museum visit experiences via web and smartphone apps, digital bookmarking, or real-time video (Kostoska *et al.*, 2013; Pisoni *et al*. 2020), digitization of historical archives (Colla *et al*., 2021), and application of machine-learning approaches to automatically generate cultural heritage content or metadata utilising public resources such as Wikipedia and Wikidata (De Benedictis *et al*., 2021; Colla *et al*., 2021). In contrast to such works, the MM project aims to support experts' research into the history, status and development of a whole museum sector. Thus, the MM data aims to capture attributes such as the governance, accreditation, thematic focus, size, opening/closing dates and geodemographic context of all of the UK's museums in existence since 1960, and draws on a broad range of specialist data sources as well as the knowledge and requirements of museum professionals from across the sector (see Section 3).

Methods and methodologies. Several works (e.g. Petrelli and Not, 2005; Schmitz and Black, 2008; Pettrelli and Whittaker, 2010; Pisoni, 2020) stress the importance of involving end-users from the outset in the design of heritage-related applications, e.g. through interviews, questionnaires, iterative prototyping and trialling, and content/statistical analysis of participants' responses. We have employed similar instruments in developing the MM system, discussed in Sections 3 and 4. For delivering our system, we devised and applied an iterative methodology (see Section 3) that allows the incorporation of requirements from a broad range of user stakeholders under tight timing and resource constraints. Methodologies such as DILIGENT (Pinto *et al.,* 2004), HCOME (Kotis and Vouros, 2006) and the NeOn iterative-incremental life-cycle (Suárez-Figueroa *et al.,* 2015) similarly propose iterative approaches to ontology development. However, as discussed in Poulovassilis *et al.* 2020, designing the MM knowledge base posed additional challenges because it needed to proceed concurrently with the data collection and the development of the Web App.

Personalization of cultural heritage. Beyond the scope of our work is the personalization of online content and functionality towards the needs, preferences and context of individual or groups of users, c.f. the adaptive mobile museum guide of Petrelli and Not, 2005, the personalization of museum websites, virtual collections and visitor guides discussed by Ardissono *et al*., 2012, and the personalized cultural heritage lesson planner of De Benedictis *et al*., 2021. This would be an interesting direction of future enhancement of the MM system.

Whole-sector datasets. In terms of similarity of scope to the MM data, the Institute of Museum and Library Services (IMLS) has published a dataset of approximately 30,000 USA museums[5]. However, IMLS adopts a narrower definition of what constitutes a museum (that of the International Council of Museums) whereas the MM project adopted a more inclusive definition so as to fully cover the small independent museums (see Section 3.1). IMLS adopts a single-level classification of museums' subject matter into nine categories whereas the MM project developed a

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[5] https://www.imls.gov/research-evaluation/data-collection/museum-data-files

detailed Subject Matter taxonomy comprising 21 top-level categories and 108 sub-categories (see Section 3.1). There are no facilities for keeping the IMLS dataset up-to-date whereas MM provides facilities for adding data about new museums and editing data about existing museums (see Section 3.4). Another related work is the Finding GLAMs wiki project[6] which provides information on institutions of cultural significance across a number of countries. However, it does not give data quality guarantees in relation to its listed sources. In contrast, the provenance and accuracy of the MM data is of paramount importance to ensure its usefulness to domain experts and museum professionals. For the UK, Finding GLAMs sources its information from just two of the primary data sources used for MM (the Museum Association and Arts Council England), so it is limited to England and does not include unaccredited museums (whereas most small independent museums are unaccredited).
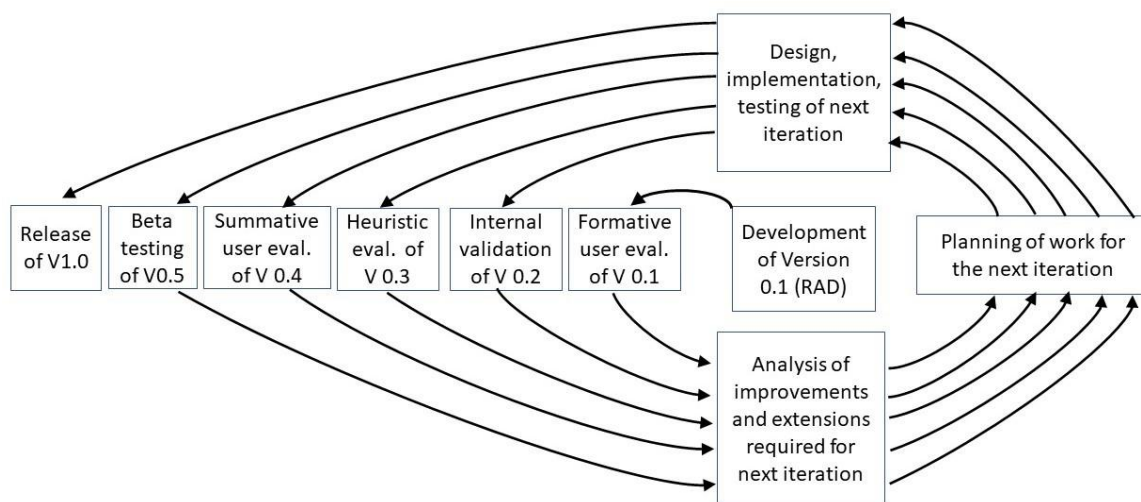
3. Methodology

Fig. 1 Iterative Methodology

Figure 1 illustrates the iterative methodology we devised and applied to deliver the MM system. It comprises five iterative cycles, starting from a first prototype of the Web App (Version 0.1) and associated KB developed using Rapid Application Development methods – see Poulovassilis *et al.*, 2020. Each iterative cycle begins with an Analysis activity identifying the extent to which the system meets the currently articulated requirements, and the improvements and extensions that need to be delivered in this iteration. The Planning activity articulates responsibilities, deliverables, and scheduling of the work to be undertaken. Design, implementation and testing of this iteration follows, concluded by a User Evaluation, Validation or System Testing activity.[7]

The staffing resource available for delivering Version 0.1 was 21 months of an experienced software developer over two years (Poulovassilis *et al.* 2020). The staffing resource available for delivering the subsequent five versions that are the focus of this paper (Versions 0.2 to 1.0) were 25

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[6] https://meta.wikimedia.org/wiki/FindingGLAMs/GLAM_datasets/Europe

[7] The activities involving human participants (Formative evaluation of Version 0.1, Heuristic evaluation of Version 0.3 and Summative evaluation of Version 0.4) were approved via our institution's ethical procedures. For all three activities, participation was voluntary, an information sheet detailing the aims and conduct of the activity was circulated to all participants, an informed consent form was provided for them to sign, and they were free to withdraw at any time. Their data was stored securely in compliance with our institution's data management policy, and the informed consent form stated that no reference would be made in oral or written form that could identify them or link them to information they provided as part of the study.

months of a computer science Postdoctoral Researcher/Developer over a further two years (3 months' effort undertaken by one person and 22 months' by another).

Our methodology is inspired by the spiral model of software development (Boehm, 1988) but goes beyond it in that the formulation and investigation of the users' overarching research objectives proceeds in parallel with the development of the system itself – informing, and being informed by, the system's iterative development.

The initial research objectives of the project's humanities scholars included:
- identifying broad patterns of museum openings and closings;
- understanding the relationships between high rates of museum openings/closings and attributes such as accreditation, governance, location, size and subject matter;
- understanding the geodemographic contexts of museums' openings/closings;

and these were extended through the project's subsequent interactions with external user stakeholders (see Section 3.2). Thus, the Analysis activities involve consideration of what additional research the system needs to support, which informs the articulation of additional requirements to support users in undertaking these research investigations.

For completeness, Section 3.1 summarizes work on developing the first prototype (see Poulovassilis *et al.* 2020). Section 3.2 describes work on Iteration 1, Section 3.3 on Iterations 2 to 4, and Section 3.4 on Iteration 5.

3.1 Development of the first prototype

The MM project team spent two years collecting, cross-checking and cleansing data from over 15 existing primary sources in order to compile an integrated dataset. These sources[8] include museum lists, surveys, and reports from a range of national, regional and independent bodies. That data was supplemented with information from historic and specialist guidebooks and gazetteers, and digital resources such as museums' websites, Wikipedia and TripAdvisor. The MM team also contacted hundreds of people from museums, local history societies, tourist boards, and other relevant organizations to track down missing items of information, such as museums' addresses, dates of opening/closing, and governance (which may be Government, Independent, University, and subcategories thereof).

The inclusion of venues into the MM KB was based on broader criteria than official definitions of a 'museum' such as those of ICOM[9] and the UK Museums Association[10] to ensure the inclusion of museums run by businesses and private individuals, which would not have been fully covered using official definitions. A definition of 'museum' based on assembly theory was developed by the MM team, requiring responsibility for the long-term care of a collection of objects, provision of a demarcated display space, and access to the public (Candlin and Larkin, 2020).

The data was checked with all nine branches of the Museum Development Network (MDN) in England, who conducted museum-by-museum scrutiny of data relating to their region. Staff from the national offices for museums in Northern Ireland, Scotland, and Wales also scrutinized the data, as did specialist groups such as the National Army Museums and Transport Museums Trust.

The MM KB was implemented using semantic web technologies – specifically, RDF[11] and RDFS[12] – representing both data and ontology information using (subject, predicate, object) triples so that it could easily be extended as new data was gathered and as the domain experts' conceptualizations of the data evolved[13]. The ontology has 'museum' as its central concept, with approximately 50 properties including museum name, address, accreditation status, governance, size, year opened,

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[8] See https://museweb.dcs.bbk.ac.uk/sources

[9] https://icom.museum/en/resources/standards-guidelines/museum-definition/

[10] https://www.museumsassociation.org/about/faqs/

[11] https://www.w3.org/TR/rdf-schema

[12] https://www.w3.org/2001/sw/wiki/RDFS

[13] The MM ontology and MM data can be downloaded from http://museweb.dcs.bbk.ac.uk/data.

year closed, primary data source, and visitor numbers. The Subject Matter subsection of the ontology is a new taxonomy comprising 21 top-level categories and 108 sub-categories, designed to meet the research needs of the MM project (see Poulovassilis *et al.* 2020). It was reviewed and evolved in collaboration with several external museum consultants and members of the nine MDN branches.

Concurrently with the data collection and design of the KB, a first version of the Web App through which users access the KB was designed. Figures 2-5 show screenshots of the Browse, Search, and Visualise facilities of the Web App[14]. **Browse** allows users to explore the museums data by drilling down into key attributes such as Location, Accreditation, Governance, and Subject Matter. The resulting museums can be viewed on a map (as in Fig. 2), as a list (as in Fig. 3, right-hand pane), or by scrolling through the details of individual museums (as in Fig. 4). **Search** allows users to define their own search criteria by specifying one or more 'filters' on the data, using any combination of attributes (Fig. 3, left-hand pane). Again, the results may be viewed on a map, as a list, or by scrolling through individual museums' details. **Visualise** allows users to generate graphs showing numbers of museums of different categories, their growth and closure patterns, and the inter-relationships between pairs of categories. For example, Fig. 5 shows the number of independent museums of each type, in each region of England.
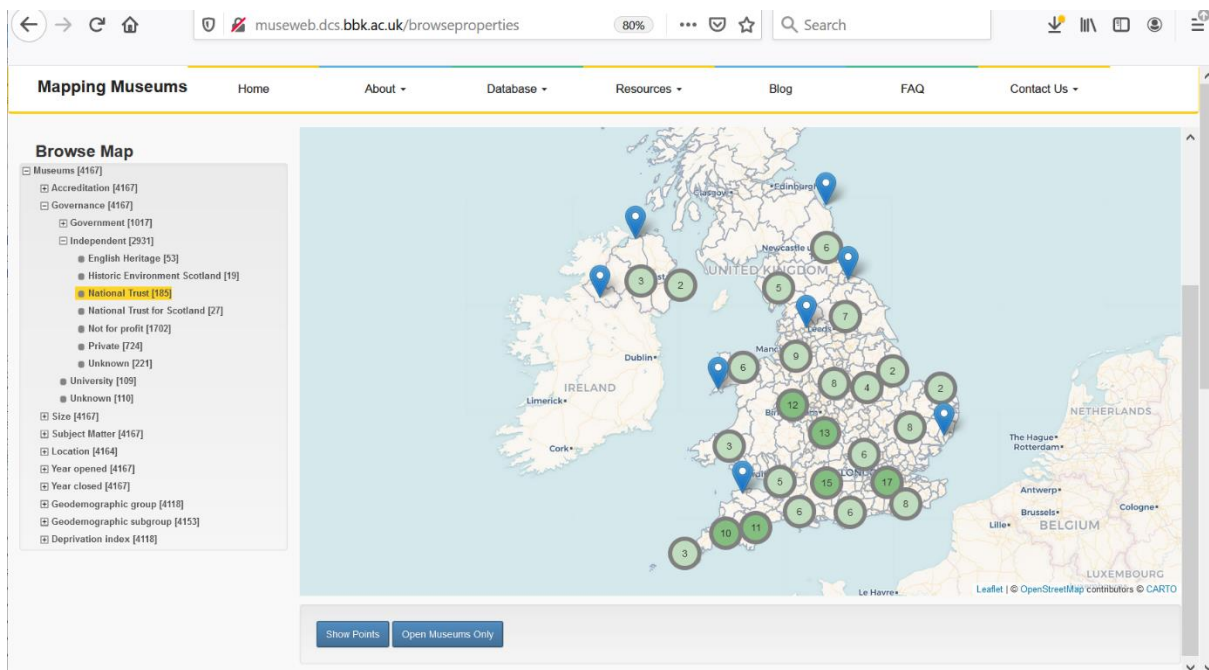

Fig. 2 Browse, showing all National Trust museums

Fig. 3 content

Quick search: [Text Input] 🔍

Search query:

Filter 1 Filter 2✕ Filter 3✕ **Filter 4**✕

Select attribute: [Year opened ▾]

Comparison criterion: [Possibly After ▾]

Value: [1970]

Select output attributes: [Default output attributes ▾]

- Filter 1 : Accreditation Matches Unaccredited
- Filter 2 : Governance Matches Independent
- Filter 3 : Admin Area Matches Wales
- Filter 4 : Year opened Possibly After 1970

[Add Filter] [Submit]

[Clear All]

Results (99)

List | Map | Details | Search Terms   Help [Download CSV]

Name of museum	Village, Town or City	Postcode	Accreditation	Governance	Size	Subject Matter	Year opened	Year closed	No
1940s Swansea Bay Museum	Swansea	SA1 8PT	Unaccredited	Independent:Private	small	War and conflict:Event or site	2005	Still open	
Aber Valley Heritage Museum	Senghenydd	CF83 4HA	Unaccredited	Independent:Not for profit	small	Local Histories	2009	Still open	Sm col (se vol pre red vol He
Aberaeron Toy Museum	Aberaeron	SA46 0AS	Unaccredited	Independent:Private	small	Leisure and sport:Toys and models	1997	1998-2017	

Fig. 3 Search, a user query comprising four filters; results shown in List view

Fig. 4 content

All Properties

Name of museum	Ullapool Museum And Visitor Centre
Address line 1	7 & 8 West Argyle Street
Town or City	Ullapool
Postcode	IV26 2TY
Admin hierarchy	/Scotland/Highland (Scottish Council Area)
Accreditation	Accredited
Governance	Independent:Not for profit
Size	small
Subject Matter	Local Histories
Year opened	1995
Year closed	Still open

AIM size designation	Small Museum (up to 20,000 visitors p.a.)
AIM size source	mm.aim.1266
Accreditation source	mm.mgs.061
Alternative museum name	Ullapool Museum
Alternative museum name source	mm.mgs.061
DOMUS Subject Matter	social history
DOMUS identifier	646
Deprivation index	5
Deprivation index crime	3
Deprivation index education	6
Deprivation index employment	5
Deprivation index health	6

Deprivation index housing	6
Deprivation index income	4
Deprivation index services	10
Geodemographic group	Scottish Countryside
Geodemographic group code	3cr
Geodemographic group name long	3cr-Scottish Countryside
Geodemographic subgroup	Scottish Countryside
Geodemographic subgroup code	3c1r
Geodemographic subgroup name long	3c1r-Scottish Countryside
Geodemographic supergroup	Countryside Living
Geodemographic supergroup code	3r

Geodemographic supergroup name long	3r-Countryside Living
Identifier used in source database	SC000200
Latitude	57.895834
Longitude	-5.162632
Notes internal	DOMUS foundation date 1988
Primary provenance of data	domus
Region country	Scotland
Size prov	domus
Visitor Numbers Data	0 at 1996 from domus
Visitor Numbers Data	11500 at 1994 from domus
Visitor Numbers Data	11600 at 1995 from domus

Visitor Numbers Data	11500 at 1994 from domus
Visitor Numbers Data	11600 at 1995 from domus
Visitor Numbers Data	8401 at 2002 from Scottish National Audit
Visitor Numbers Data	8593 at 1999 from domus
Visitor Numbers Data	9000 at 1998 from domus
Visitor Numbers Data	9208 at 1997 from domus
Year closed source	https://www.tripadvisor.co.uk/Attraction_Review-g316004-d8445116-Reviews-Ullapool_Museum-Ullapool_Scottish_Highlands_Scotland.html
Year opened source	http://www.ullapoolmuseum.co.uk/articles.asp?a=4
media	0
project id	mm.domus.SC200
Street View	[Get link]

Fig. 4 Detailed view of Browse or Search results – showing details of the Ullapool Museum, scrolling down the list of attributes, left-to-right, top-to-bottom

Visualisations

- Visualisations
  - Number of museums
    - open at a given time
    - that opened up to a given time
    - that closed up to a given time
    - open over time
    - openings over time
    - closings over time
    - openings and closings over time
  - Table
    - X
      - Governance
      - Subject Matter
      - Size
      - Geodemographic group
      - Geodemographic subgroup
      - Deprivation index
      - Location
        - **England**
          - East Midlands
          - East of England
          - London
          - North East
          - North West
          - South East
          - South West
          - West Midlands
          - Yorkshire and The Humber
        - Wales
        - Northern Ireland
        - Scotland
    - Y
      - Governance
        - Government
        - **Independent**
      - Subject Matter
      - Size
      - Geodemographic group
      - Geodemographic subgroup
      - Deprivation index

	East Midlands	East of England	London	North East	North West	South East	South West	West Midlands	Yorkshire and The Hum.
English Heritage	0	5	7	5	6	11	6	3	8
Historic Environment Scotland	0	0	0	0	0	0	0	0	0
National Trust	14	12	7	8	15	36	46	18	7
National Trust for Scotland	0	0	0	0	0	0	0	0	0
Not for profit	104	177	123	34	93	242	201	101	96
Private	36	47	25	11	42	62	85	24	29
Unknown	19	10	4	2	5	13	16	15	6

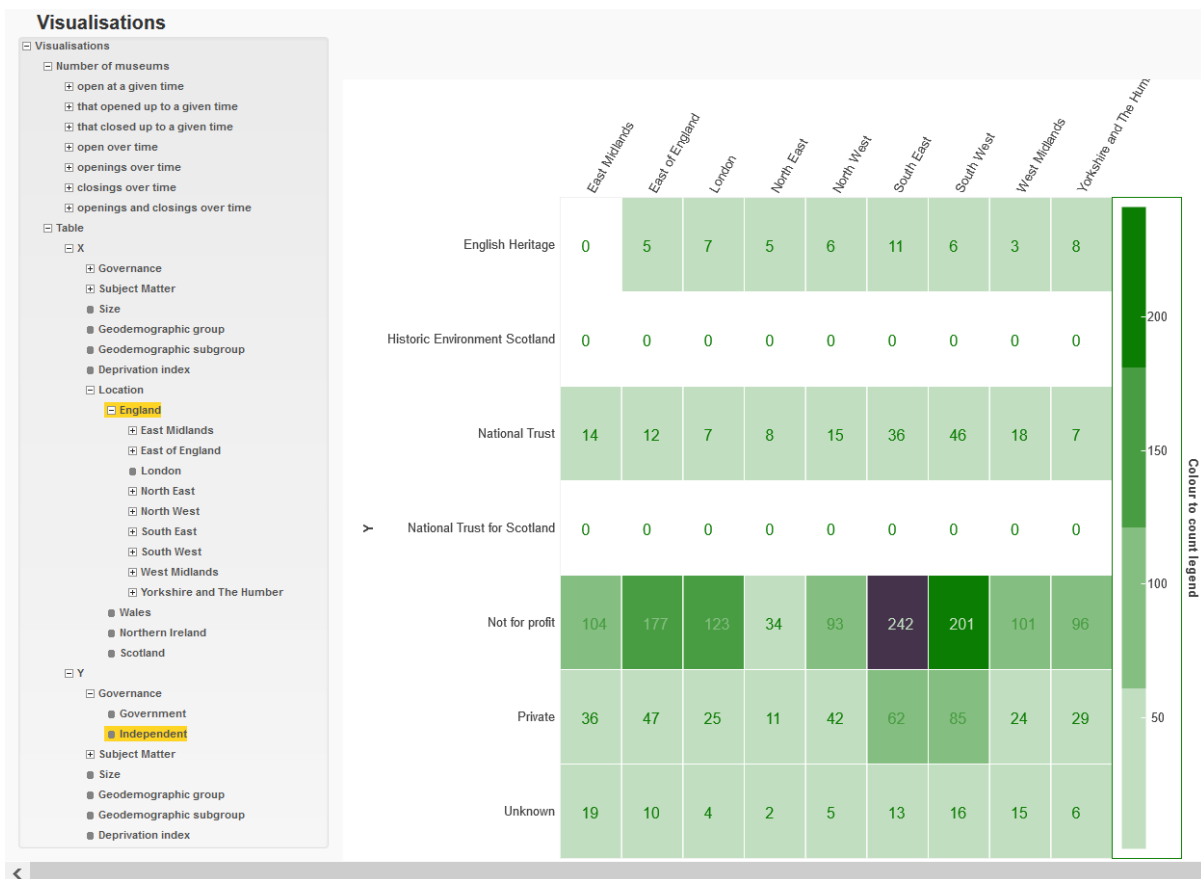Colour to count legend: 200, 150, 100, 50

Fig. 5 Visualise, showing a heatmap cross-tabulating Location and Governance, having drilled down into locations in England (X axis) and Independent governance (Y axis)

3.2 Iteration 1

Formative evaluation of Version 0.1 was undertaken with 15 volunteers from the UK museum sector, comprising staff from AIM and ACE, officers from the MDN, consultants, digital archivists, and museum accreditation assessors (see Poulovassilis *et al*. 2020 for details of the conduct of the Formative evaluation). The participants' responses provided an overall endorsement of this prototype, identified several areas of possible improvement and extension, and also articulated its usefulness beyond the research objectives of the MM project.

Our analysis of participants' responses to the sixth and seventh questions of the questionnaire they were asked to complete ("Please provide comments on how the system would be useful to you in your role", "Please provide comments on how the system would be useful to others in their roles") resulted in the identification of 21 usage scenarios, listed in Appendix A. Given this potential for the system to have an impact beyond the MM project's own research aims, we then engaged with approximately 45 additional user stakeholders to elicit a broader range of research objectives and usage scenarios that would be relevant to their roles, drawn from the following sectors:

i. Museum professionals: policy, museums development, museums trusts, museum associations, museum consultants;
ii. Researchers and academics: museum studies, cultural and oral history, cultural heritage;
iii. General public;
iv. Tourism professionals.

This led to 40 additional usage scenarios, comprising 61 scenarios in total after adding the 21 scenarios from the Formative evaluation (see Appendix A). Four overarching research objectives were identified during our discussions with these external user stakeholders:

- understanding the development of the sector in order to inform government policy and regional museums development strategy;
- understanding where to focus training for museum professionals in order to improve museum accreditation rates;
- understanding the distribution of professional expertise so as to manage loans, collaborations, and disposal of collections between museums;
- identifying similar museums so as to foster networking between them.

During Iteration 1 the system was extended to support, as much as was practically feasible within the project's resourcing constraints, these additional research objectives and usage scenarios, resulting in Version 0.2. As well as making improvements and extensions to Version 0.1, this entailed the design of a website encompassing the KB, Web App, and additional resources needed to meet these additional requirements[15]. The top-level menu of the website home page contains tabs labelled About, Database, Resources, Blog, FAQ, and Contact Us:

- **About** leads to a page describing the aims and outcomes of the MM project, and additional pages listing
    - the team members and external experts who collaborated with the project;
    - a Glossary of specialist terms used throughout the website;
    - the project's primary data sources and data collection process;
    - the technical development of the system;
    - the terms and conditions of usage the MM resources.
- **Database** leads to an "about" page giving an overview of the Web App, and to pages for accessing its Browse, Search, and Visualise facilities. The "about" page includes links to an online guide and a video describing how to use these facilities. Browse, Search, and Visualise each have an online Help section as well as a tab explaining the specialist terms they use.
- **Resources** leads to, amongst others,
    - a page listing the key findings arising from the MM project's research;
    - a comprehensive report on the data analysis undertaken by the project team;
    - information collected from interviews with the founders of over 40 museums;
    - the project's publications;
    - pages from which the MM software and data can be downloaded;
    - a page for accessing films and podcasts produced by the project.
- **Blog** links to the project blog, maintained by the project team since the start of the project.
- **FAQ** leads to a list of Frequently Asked Questions, identified through the project team's interactions with museum professionals throughout the project.
- **Contact Us** leads to three pages:
    - **Get in Touch**, allowing users to contact the project team with any queries and feedback about how they have used the resource;
    - **Edit Museum Data,** allowing users to submit corrections to data relating to an existing museum;
    - **Add Museum**, allowing users to submit data about a new museum.

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[15] Similarly to the Web App, the website is implemented using HTML, Javascript, Flask, Python and related libraries. It is accessible at www.mappingmuseums.org, which redirects to web service maintained by our institution at http://museweb.dcs.bbk.ac.uk/home

3.3 Iterations 2-4

Mindful of the findings of Tan *et al.* 2009 on the benefits and limitations of different software validation methods, we used a combination of *user testing* and *heuristic evaluation* to validate the system during the next three iterations. As discussed by Tan *et al.* 2009, user testing and heuristic evaluation are different and complementary: the former relies on the experience and requirements of domain experts and is typically conducted based on a set of usage scenarios, whereas the latter relies on the technical expertise of software engineers and is typically conducted based on a set of heuristics. Heuristic evaluation is more open-ended and encourages usage of the entire breadth of a system's capabilities. User testing focusses on a specific set of usage scenarios, but encourages more detailed exploration of the system's capabilities in these settings. The former tends to uncover a larger number of less serious problems, and the latter a smaller number of more severe problems.

Iteration 2 began with *Internal validation* of Version 0.2 by the project's humanities scholars against the 61 usage scenarios. Our analysis of the internal validation outcomes led to Planning, Design, Implementation and Testing of a modest number of updates (see Section 4.1), leading to Version 0.3.

Iteration 3 began with *heuristic evaluation* of Version 0.3 by volunteers from our institution's programmes in Computer Science. We contacted all students enrolled on advanced Masters and PhD degrees and 6 students accepted to take part (1 woman/5 men; 5 Masters students/1 PhD student). Our heuristic evaluation aimed to evaluate the system against Neilsen's 10 usability heuristics (Nielsen, 1994). The system was made available to the evaluators to use for a week. They were encouraged to explore the entire system and were asked to complete a questionnaire comprising 10 questions, addressing the 10 heuristics (see Appendix B). Our analysis of the heuristic evaluation outcomes led to Planning, Design, Implementation and Testing of several corrections and improvements (see Section 4.2), leading to Version 0.4.

Iteration 4 began with *Scenario-driven user evaluation* (the Summative evaluation) of Version 0.4. This was conducted with volunteers recruited from our network of professional contacts across the UK museum sector. We publicised the evaluation event through our project blog, on social media, and we asked the major organizations with responsibility for museums to invite their staff. 10 people accepted (7 women/3 men), none of whom had any prior involvement in the design or evaluation of the system: an ACE staff member, three MDN officers, a National Museums Directors Council staff member, a policy advisor at DCMS, a policy director at the National Lottery Heritage Fund, a museum Chief Executive Officer, a museum consultant, and the director of a platform for delivery of cultural heritage content.

The ten evaluation questions (EQs) comprising the Summative evaluation are listed in Appendix C. The time availability of the volunteer professionals necessitated that a subset of the full set of usage scenarios was selected for the Summative evaluation. This subset was selected on the basis that, between them, they cover all of the major sections of the system (the Web App and underlying KB, data collection process, interview materials, Frequently Asked Questions, and the web pages on publications, films and podcasts):

- Finding the museums on a given subject, and their addresses (addressed by EQ 1)
- Where are the audio files of the interview transcripts? (addressed by EQ 2)
- Exploring the interview material and reusing it for other research (also addressed by EQ 2)
- What is the project's definition of a museum? (EQ 3)
- Identifying the museums in a given town or city, to include in tours (EQ 4)
- Museums would like to find other museums like them and see patterns of their development over time (EQ 5)
- Finding out the numbers of museums opening/closing of different governance type, subject matter, size, location (EQ 6)

- Finding out the geographical distributions of museums of different governance types e.g. local authority museums (also addressed by EQ 6)
- Finding out how the project has categorised museums that were local authority but that have outsourced their collections to other bodies i.e. "asset transfer museums". How many are there? (EQ 7)
- Finding out how the project treats museums within a museum, or museums with several branches (EQ 8)
- How was the project's data collected and checked? (EQ 9)
- What are the numbers of museums devoted to subject matter X within the UK? Within a particular region? (EQ 10)

The evaluators were also encouraged to undertake their own *ad hoc* explorations. The activities they were asked to undertake were presented in the form shown in Appendix C, which they were asked to complete.

Our analysis of the Summative evaluation outcomes led to Planning, Design, Implementation and Testing of several functionality extensions (see Section 4.3), leading to Version 0.5.

3.4 Iteration 5

The fifth and final iteration began with Beta Testing of Version 0.5. In addition to the functionality extensions arising from the Summative evaluation (see Section 4.3), Version 0.5 encompassed new functionality allowing external users to add data about new museums and to correct mistakes in the data. These two usage scenarios had been identified at the outset of Iteration 1 (see Appendix A: Correcting a mistake in the data. Adding data about a museum that is not present in the data.) but it was not possible to complete their implementation until Version 0.5.

The Add/Edit process consists of three stages. First, a form-based web interface allows users to submit data about new museums or suggest edits to data about existing museums (see Fig. 6). Next, a member of the MM team (whose role in this context is that of a Data Curator) inspects the proposed additions/edits via a more extensive password-protected form allowing confirmation or correction of the user's input and expansion of their input to include data about additional attributes (see Fig 7). Lastly, the Curator confirms the added/edited data, leading to the execution of code passing the updates through to the KB[16].

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[16] The Add/Edit facilities are implemented using the same HTML, Javascript, Python and SPARQL technologies as the Web App.

Add Museum

You can add a museum to the database by filling in the form below.

- please give us your name and email address so we can contact you in case we need to confirm any details (name and email are required fields).
- please give us as much information as possible.
- please do not use punctuation (including commas) in any box except the email address and the extra information box, which accept all characters.
- if you are unsure of any details then leave that field blank.
- year opened and closed: if you know the year exactly, please enter the year as four digits, e.g. 1995. You can also enter a range of years. Separate the range with a colon, e.g. 1980:1989.
- please use the extra information box to tell us how you came by your information (e.g. you worked at the museum, it's in your home town).

The database curator will check the information before it is added to the database, and this process may take some time. Thank you for your help.

Your Name*	Text Input
Your Email Address*	Text Input
Name of Museum*	Text Input
Address_line_1	Text Input
Address_line_2	Text Input
Address_line_3	Text Input
Town_or_City	Text Input
Postcode	Text Input
Year_opened	Text Input
Year_closed	Text Input
Subject_Matter	Please Select ⌄
Governance	Please Select ⌄
Visitors each year	Please Select ⌄
Extra Information	

Submit

Fig. 6 Add (User's form); the User's Edit form is similar, but excluding Visitors each year, which cannot be updated

Edit and Commit Museum

['editmuseum135,"ml","m.liebenrood@gmail.com","mm.New.169"']

Get Data

Archive

Name	ml	
Email	ml	
Visitor Numbers	No Visitor Numbers Given	
Name_of_museum	Yorkshire Waterways Muse	Yorkshire Waterways Muse
Alternative_museum_name	Text Input	Text Input
Address_line_1	Text Input	The Sobriety Project
Address_line_2	Text Input	Dutch River Side
Address_line_3	Text Input	Text Input
Town_or_City	Text Input	Goole
Postcode	Text Input	DN14 5TB
Year_museum_first_documented	Text Input	Text Input
Year_museum_first_documented_source	Text Input	Text Input
Year_opened	Text Input	1980:1980
Year_opened_source	Text Input	dfoundation
Year_closed	2019	2019:2019
Year_closed_source	https://www.museumsassoc	https://www.tripadvisor.co.uk
Founder	Text Input	Text Input
Founder_source	Text Input	Text Input
Subject_Matter		Transport:Canals
Accreditation		Accredited

Accreditation_source	Text Input	mm.ace.117
Governance		Independent:Not for profit
Governance_source	Text Input	mm.ace.117
Notes	Text Input	Previously known as Water
Size		small
media	Text Input	0
Latitude (use to override autocomplete)	Do Not Fill	
Longitude (use to override autocomplete)	Do Not Fill	
Alternate Postcode (use to override autocomplete)	Do Not Fill	
Extra Information		

Modify

Add to DB

Fig. 7 Edit (Curator's form); the Curator's Add form is similar, except without showing any existing content in a second column on the right hand side

4. Results

4.1 Outcomes of Internal Validation

The internal validation identified a small number of technical errors, which were corrected during the next iteration. It also identified some functionality gaps, detailed in Supplementary Appendix D. After discussion involving the whole project team, it was decided that only one of these could be addressed within the project's time and staffing constraints. Thus, by the time of the Heuristic evaluation, 50 out of the 61 usage scenarios listed in Appendix A had been validated by the project's humanities scholars as being fully met and the remaining 11 had been judged as being infeasible to fulfil within the available time and staffing resources. The 11 unsupported usage scenarios are indicated within round brackets in Appendix A.

4.2 Outcomes of Heuristic Evaluation

Table 1 summarizes quantitatively the 6 participants' responses to the 10 heuristic evaluation questions, listed below with further details in Appendix B:
1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognize, diagnose, and recover from errors
10. Help and documentation

Q.	1:Strongly disagree	2:Disagree	3:Neutral	4:Agree	5:Strongly agree	Mean	SD	Min	Max
1			1	3	2	4.17	0.69	3	5
2			1	4	1	4	0.58	3	5
3			1	4	1	4	0.58	3	5
4	1		1	2	2	3.7	1.37	1	5
5		1	1	3	1	3.7	0.94	2	5
6			1	4	1	4	0.58	3	5
7			2	3	1	3.8	0.69	3	5
8	1	1	1	3		3	1.2	1	4
9		1		4	1	3.8	0.90	2	5
10			1	3	2	4.17	0.69	3	5

Table 1. Frequencies of the 6 participants' responses to the heuristic evaluation questions Q1-Q10 (columns 2-6); mean score, standard deviation, minimum score, maximum score (columns 7-10).

We see participants' overall positive endorsement of the system, with the highest mean score for Q1 and Q10, and the lowest for Q8. Participants complimented the system's ease of use, clarity of explanations, ease of navigation, and quality and consistency of webpage layout.

The one "Strongly disagree" for Q8 was due to the following issue articulated by one participant: "Looks like 2 sites bolted together. A lot more work needed on presentation to make the site look professional by current standards". That participant responded "Strongly disagree" to Q4 for the same reason.

The one "Disagree" for Q5 was due to one participant identifying "No validation on the format of email address. Searching on Year Exist attribute allows negative numbers". The one "Disagree" to Q8 was due to one participant objecting to the choice of font for the website and the formatting of two website pages. The one "Disagree" to Q9 was due to one participant stating that "Most of the errors I had to interpret myself".

These concerns were all addressed during the next iteration, in time for the Summative evaluation. Participants also identified the following issues and these too were resolved before the Summative evaluation apart from the first two, for the reasons stated:

- Back button not supported within the Web App – not changed for technical reasons, but a note about this was added to the home page of the Web App
- Font size looks quite large – not changed for accessibility reasons
- Alignment, linespacing and padding of paragraphs could be improved
- The view details section should not be all alphabetically sorted
- There is no limit to the number of filters you can add in Search
- The email address in Contact us page would benefit from making it a mailto: link
- Intentional errors in Search sometimes lead to just the message "Internal Application Error".

Participant	Statement of endorsement	Identification of a possible improvement to the User Interface	Identification of malfunctioning or unsatisfactory functionality
1	6	3	1
2	2	3	0
3	9	3	1
4	0	8	2
5	6	3	0
6	8	4	0

Table 2. Thematic analysis of participants' responses to the heuristic evaluation questions, showing the number of responses by each participant within each theme.

Table 2 gives a thematic analysis of the 6 participants' verbal responses to the evaluation questions. We discussed above participants' substantive observations relating to improvements and to malfunctioning/unsatisfactory functionality.

4.3 Outcomes of Summative Evaluation

The ten Summative evaluation questions are listed in Appendix C. Participants' responses are listed in Supplementary Appendix E. Table 3 summarizes quantitatively participants' responses to part (i) of the questions: "How easy was it to find this information?". These results indicate that they were generally able to use the system to successfully undertake most of the examined usage scenarios.

Q	Percentage of participants finding the task easy	Percentage having mixed feelings	Percentage finding the task difficult/not answering
1	70%	20%	10%
2	30%	50%	20%
3	80%	10%	10%
4	80%	10%	10%
5	70%	30%	0%
6	60%	10%	30%
7	10%	60%	30%
8	60%	20%	20%
9	80%	20%	-
10	80%	10%	10%

Table 3. Quantitative summary of the 10 participants responses' to part (i) of the 10 evaluation questions - "How easy was it to find this information?"

Table 4 gives a thematic analysis of participants' responses to part (ii) of the evaluation questions: "Any other comments"? These responses fell into five broad themes: (1) statements of positive endorsement of the system; (2) descriptions of how participants undertook the requested task; (3) instances where participants were unclear how to find the requested information; (4) statements of difficulty in undertaking the task; (5) additional functionalities incorporated into subsequent versions of the system; (6) additional functionalities that could not feasibly be incorporated or were out of the scope of the project.

Participant	Endorsement	How task was undertaken	Unclear how to find information	Difficulty in undertaking the task	Additional functionality – done	Additional functionality – infeasible or not relevant
1	1	1	1			1
2	2		1	1		6
3	3	2	1		1	2
4	1	1			2	1
5	2		2	1	3	1
6	1		1		1	2
7	4				2	2
8	1		1			1
9	4	1	1		3	
10		2		1		

Table 4. Thematic analysis of participants' responses to part (ii) of the Summative evaluation questions, showing the number of responses of each participant per theme.

Participants' concerns under themes (3) and (4) – particularly as regards scenarios 2 and 7 – were addressed in the next iteration by the production of a comprehensive Online Guide to using the Web Application and by some additions to the textual descriptions on the website.

Two major functionality additions were identified under theme (5), which were added during the next iteration: (A) to be able to choose in Browse between viewing all museums or just ones that are currently open; and (B) to support a Google-style free-text search facility on the museum data. For (A) the "Open Museums only" button can be seen at the bottom of Fig. 2, and for (B) the "Quick Search" entry field can be seen at the top left of Fig. 3. The Open Museums Only button works by automatically adding an additional filter checking that the museum's Year closed attribute has a value of "still open". The Quick Search button works by undertaking a search for occurrences of the search string within each of the attributes Name of museum; Village, Town or City; Postcode; Notes; Governance; Subject Matter; and Accreditation. The sets of museums returned by these individual queries are concatenated and duplicate entries are eliminated. The attributes shown in the results include the above plus museum Size, Year opened, Year closed.

A group discussion was held after the end of the Summative evaluation. Table 5 gives a thematic analysis of participants' oral contributions to the discussion. There were numerous statements complimenting the usefulness of the system and the appeal of the provided functionalities. Indicative quotes are:

- "Hugely useful to us (MDN) when we need to paint pictures for people. I've already used your work to help new trustees understand what the sector looks like. To give them an impression of the size of the sector, the governance types, and so on. It's also useful in tracking the hybrid museums because no-one else keeps that information." [Museums Development Officer]

- "It's just good to have all the information in one place. There isn't anything else like this – no reliable source of data." [Senior Manager, National Lottery Heritage Fund]
- "Useful for benchmarking, to know where a museum is in the scheme of things." [Museums Development Officer]
- "The data really shows the scale of the sector." [Museum Consultant]
- "The Edit Museum function is great." [Museums Development Officer]
- "Love the maps. We get a lot of questions on regionality so it's useful to be able to start with location. Then you can go into more details. Like the visualization – it's very useful for us in government – really clear." [Senior Manager, UK Government Department for Digital, Culture, Media & Sport]

There were a few requests for functionality changes or additions that were able to be undertaken by the MM team before the Beta release: functionality (A) mentioned above; providing more explanation of some specialist terms; clicking through from the Map view to the Detail view; simplifying the listing of Search results. Some requests were made that could not be undertaken due to time/resource limitations: graphical representation of Search results, a change to the Subject Matter taxonomy, a change in terminology, concurrently seeing the Detail view and the Map view, bookmarking Search results, greater orientation of the system towards the general public. A few requests were outside the project scope: inclusion of museums' financial information, tracking the collections of closed museums, extending the system to include other countries' museums.

Participant	Statement of endorsement	Requested functionality change or addition – done	Requested functionality change/addition – could not feasibly be done	Requested functionality change/addition – out of project scope	Pointers to related projects/initiatives
1	1		1	1	1
2			2		
3		1			
4	1	1			1
5		2	2		
6	3				1
7	4		1	1	
8	1				
9	1				1
10	1			1	1

Table 5. Thematic analysis of participants' contributions to the group discussion, showing the number of contributions by each participant per theme.

4.4 Outcomes of Beta Testing

The Beta release of the system was made public on 17 March 2020, although the launch event planned for that date had to be cancelled due to the Covid-19 pandemic (over 120 professionals from the UK museum sector had booked to attend). The were no error reports or requests for additional functionality by external users following the Beta release and the project team received much positive feedback. Indicative quotes are:
- "Love the maps. So sorry to hear that you are having to cancel your launch event next week. It would have been an opportunity for everyone, including me, to congratulate you and the team on a job very well done and the development of a resource that will be of great use for the future" [Museum Consultant]

- "The utterly fascinating Mapping Museums report has been published" [Trustee of an alliance of over 100 UK cultural heritage organizations]
- "The research project will be extremely valuable for AIM and its members […] informing our work, enabling us to better advocate for the sector's needs and improving our overall efficacy" [Senior Staff Member, AIM]
- "It is really valuable in terms of the long-term view and the breadth of view. It also captures information about a layer of museums which we know little about - those that are at the very early stages of their development. The trends and thematic information that comes through along with correlations will be able to help to bust myths and inform our strategic role for museum development in England" [Senior Staffmember, ACE]
- "It's the only resource that could offer a rigorous answer to the question 'Should I start a museum of X or Y in this place' " [Museum Consultant]
- "An invaluable resource for volunteers and staff who have learnt cataloguing and digitisation skills while working with the MM Archive" [Digital Archivist]

5. Discussion

We have devised and applied an iterative methodology allowing the incorporation of requirements and feedback of user stakeholders drawn from across the UK museum sector within the resourcing constraints of a single publicly-funded research project. Employing Rapid Application Development methods (which are detailed in Poulovassilis *et al.*, 2020) allowed a fully functional first prototype of the KB and Web App to be delivered within the available time and staffing (21 months' of an experienced software developer over two years) that could then be presented to external users for Formative evaluation, leading to the identification of additional research objectives and usage scenarios to meet their requirements. A subsequent phase of development and internal validation of the system allowed a much-improved and extended version to be presented first for Heuristic evaluation and then for Summative evaluation by another group of external experts. This phase, too, was able to be accomplished within the available time and staffing (25 months' of a Postdoctoral Researcher/Developer over a further two years).

Conducting the Heuristic evaluation allowed discovery of several technical issues that had not previously been identified by the project's internal users or participants in the Formative evaluation. These problems could then be addressed ahead of the Summative evaluation, thereby improving the experience of these external experts and making optimal use of their time. We note that *no technical errors* were identified by the external experts during the Summative evaluation.

Conducting the Summative evaluation firstly gave an overall endorsement of the system and affirmed its usefulness to the broader user stakeholder community; and secondly provided feedback that could be used to make final improvements before the first public release of the system. Since that release, despite significant use of all parts of the system (see Supplementary Appendix F for usage statistics), there have been *no error reports or requests for help* via the Contact Us tab.

6. Conclusions

This paper has presented the iterative methodology we devised and applied to deliver the Mapping Museums system. The system fills a gap in data and knowledge of the UK museum sector and is enabling new research by museum studies scholars and museum professionals into the history, status and long-term development of the sector. Our methodology has enabled the elicitation of requirements and feedback from a broad range of user stakeholders from across the UK museum sector within the resourcing constraints of a single publicly-funded research project.

The effectiveness of our methodology is evidenced by the positive feedback received during the evaluation studies and following the Beta release, the considerable usage of the system, and the fact that no error reports or requests for help in using the system have been received from the community since the Beta release. Our methodology can be followed for developing systems of similar scope requiring the active participation of a broad range of user stakeholders and operating within constrained time and staffing.

Our system has been called a "game changer" by a Senior Manager at the UK Government Department for Digital, Culture, Media & Sport (DCMS). It is now routinely used by the national organizations with responsibility for museums, including by DCMS for induction and training of new staff; by Arts Council England for informing decisions on museum development strategy and funding allocations; by the Museums Development Network for tracking the museums in their region and supporting their development; and by the Association of Independent museums for obtaining data to support their advocacy activities.

The system will continue to be maintained for free public use by our institution for the foreseeable future at http://museweb.dcs.bbk.ac.uk/home. The data continues to be updated through the Add and Edit facilities described earlier.

This new resource is particularly important at the present moment. All UK museums closed during the COVID-19 pandemic, it is possible that some will struggle to continue operating, and the museum landscape may change more rapidly than would have otherwise been the case. The MM system is now underpinning ongoing research on the impact of COVID-19 on the sector[17] , aiming to provide museum professionals with authoritative evidence for planning strategy and formulating policy going forwards.

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[17] "Museums in the Pandemic" project, funded by AHRC grant AH/V015028/1, 2021-22. See www.museumsinthepandemic.org

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Appendix A. User stakeholders' 61 Usage Scenarios

We indicate within square brackets at the end of each scenario the part of the MM website addressing it. *Italic font* indicates the 21 scenarios identified in the Formative evaluation. **Bold font** indicates the subset of scenarios selected for the Summative evaluation. The 11 scenarios determined by the internal validation to be unsupported are shown within round brackets (…).

Researchers and Academics	Finding out the meaning of key terms appearing in the website [Glossary]
	Finding out what the MM project is all about [About, Films & podcasts]
	Finding out what parts of the information accessible on the website can be downloaded and/or reused, and under what licensing terms [Access & Copyright]
	Finding the museums in a given location [Database]
	What is the project's definition of a museum? [FAQ, Glossary, Publications, Films & podcasts] **Evaluation Question 3**
	Contacting the research team with a question about the data or the materials on the website [Contact us->Get in touch]
	Finding out who has worked on the project – both core team members, and others [About->Research Team, About->Acknowledgements]
	Exploring the interview material and reusing it for other research [Interviews] **Evaluation Question 2**
	Where are the audio files of the interview transcripts? [Interviews] **Evaluation Question 2**
	Finding out about the project's data and software and how it can be accessed [Data, Software, Access & Copyright]
	Finding out how the Browse, Search and Visualise facilities have been designed and implemented [Software]
	Finding museums focussed on specific subject matter [Database]
	Exploring museums in a given area, including accreditation status [Database]
	Finding the dates of closure of specific museums [Database]
Museum Professionals	Finding the museums in a given region or local authority [Database]
	(Finding out the proportions of accredited/unaccredited museums in a given location. [Database])
	Finding out the numbers of museums opening/closing of different governance type, subject matter, size, location [Database] **Evaluation Question 6**
	Finding out the geographical distributions of museums of different governance types e.g. local authority museums [Database] **Evaluation Question 6**
	(Finding out the proportion of museums in a given location that relate to a given subject area [Database])
	Finding a complete list of museums in a selected location, including their addresses [Database]
	Finding out the key findings of the project [Key Findings]
	(Finding out the proportion of museums in a given location of different sizes [Database])
	Finding out how the project treats museums within a museum, or museums with several branches [FAQ] **Evaluation Question 8**
	Finding out the geographical distribution of museums across the English regions [Database]

Finding out how the project has categorised museums that were local authority but that have outsourced their collections to other bodies i.e. "asset transfer museums". How many are there? [Database] **Evaluation Question 7**

Finding out how many museums have either Arts or Mixed subject matter [Database]

(Finding out the proportion of museums that relate to different subject areas [Database])

How does the project categorise large national museums in terms of their subject matter? [Glossary]

Where did the project get its funding? [About]

How was the project's data collected and checked? [Data Collection] **Evaluation Question 9**

Correcting a mistake in the data [Contact us->Edit museum data]

Adding data about a museum that is not present in the data [Contact us->Add museum]

Finding out how to access the database [Database ->About]

Finding out how current the data in the database is [FAQ]

Finding out about the numbers of museums of different governance type over time, cross-referenced with geographical location [Database]

(Finding out the proportion of museums according to subject matter cross-referenced with governance type [Database])

Finding out what parts of the information accessible on the website can be downloaded and/or reused, and under what licensing terms [Data, Software, Access & Copyright]

Finding out how the project team has classified Subject Matter and Governance [Glossary]

What are the numbers of museums devoted to subject matter X within the UK? Within a particular region? [Database] **Evaluation Question 10**

What are the numbers of museums on subject matter X that have closed? What are the numbers that have closed within a particular region? [Database]

(*What are the numbers of closures of accredited vs unaccredited museums?* [Database])

(*Which museums are more or less likely to be accredited according to their size/ governance/location?* [Database])

What is the project's definition of a museum? [FAQ, Glossary, Publications, Films & podcasts] **Evaluation Question 3**

Has the number of museums that are opening/closing changed over time? [Database, Visualise]

(*How have closure rates in a given region changed over time?* [Database, Visualise])

Looking at closure trends of different types of museum, in different subject matters, and different locations [Database]

Looking at governance changes for a specific museum [Database - through the full list of Details].

Looking at asset transfer museums' information [Database]

Finding how many museums there are in a specific region according to governance [Database, Key Findings]

(*What percentage of museums have closed according to governance and/or size and/or local authority area within a given region?* [Database])

Updating the data in the future [FAQ]

	How has the independent museums sector developed over time? [Database, Key Findings] (*Which parts of the UK have largest number of unaccredited museums?* [Database]) (*Which are the accredited museums in a given subject area? And in a given location?* [Database]) ***Museums would like to find other museums like them and see patterns of their development over time*** [Database] **Evaluation Question 5** *How has the museums sector developed over time?* [Database, Key Findings]
General Public	**What is the project's definition of a museum?** [FAQ, Glossary, Publications, Films & podcasts] **Evaluation Question 3** Finding the museums in a given location [Database] **Finding the museums on a given subject, and their addresses** [Database] **Evaluation Question 1** Finding out about specific museums and their curators [Interviews, Films & podcasts]
Tourism Professionals	**Identifying the museums in a given town or city, to include in tours** [Database] **Evaluation Question 4**

Appendix B. Heuristic Evaluation Questionnaire

Name:…………   **Date:**…………

---

1. Visibility of system status
• It should be clear to the user what the system is doing at any time

Please enter your observations about the degree to which this Heuristic is satisfied:

In summary, my view is that this heuristic is satisfied:

Strongly disagree □	Disagree □	Neutral □	Agree □	Strongly agree □

---

2. Match between system and the real world
• The user interface should use terms that relate to its intended users and real-world application (e.g. not technical computing terminology)

Please enter your observations about the degree to which this Heuristic is satisfied:

In summary, my view is that this heuristic is satisfied:

Strongly disagree □	Disagree □	Neutral □	Agree □	Strongly agree □

---

3. User control and freedom
• Users should be able to move freely between different parts of the system
• If they make a mistake, it should be easy for them to go back and correct it

Please enter your observations about the degree to which this Heuristic is satisfied:

In summary, my view is that this heuristic is satisfied:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

4. Consistency and standards
- The user interface should be consistent in its presentation, wording and terminology
- It should follow accepted conventions found in similar systems

Please enter your observations about the degree to which this Heuristic is satisfied:

In summary, my view is that this heuristic is satisfied:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

---

5. Error prevention
- The system should be designed to be as error-proof as possible
- If an error is detected in the user's input, the system should display a helpful message

Please enter your observations about the degree to which this Heuristic is satisfied:

In summary, my view is that this heuristic is satisfied:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

6. Recognition rather than recall
- Users should be presented with clear options to choose from at any time, rather than having to remember or guess what might be possible
- Users should not have to remember their actions or inputs from one part of their dialogue with the system to another part
- Instructions for using the system should be visible or easily retrievable as necessary

Please enter your observations about the degree to which this Heuristic is satisfied:

In summary, my view is that this heuristic is satisfied:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

7. Flexibility and efficiency of use
- The system's design should be flexible so that it can be used effectively by both new and experienced users

Please enter your observations about the degree to which this is satisfied:

In summary, my view is that this heuristic is satisfied:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
☐	☐	☐	☐	☐

8. Aesthetic and minimalist design
- Everything that the user sees should be necessary and useful – there should not be any irrelevant or rarely needed information
- The user interface should present the system's functions in a visibly pleasing way

Please enter your observations about the degree to which this Heuristic is satisfied:

In summary, in my view is that this heuristic is satisfied:

Strongly disagree ☐	Disagree ☐	Neutral ☐	Agree ☐	Strongly agree ☐

---

9. Help users recognize, diagnose, and recover from errors
- Error messages should be clear and free from jargon.
- They should help the user to understand the problem and to find a solution

Please enter your observations about the degree to which this Heuristic is satisfied:

In summary, my view is that this heuristic is satisfied:

Strongly disagree ☐	Disagree ☐	Neutral ☐	Agree ☐	Strongly agree ☐

---

10. Help and documentation
- When the user requires help in using the system, it should be easy to find the relevant information, so that the user can carry out their intended task

Please enter your observations about the degree to which this is satisfied:

In summary, my view is that this heuristic is satisfied:

Strongly disagree ☐	Disagree ☐	Neutral ☐	Agree ☐	Strongly agree ☐

Appendix C. Summative Evaluation Activity Sheet

Please take a few minutes to explore the Mapping Museums website at XXXXXXXXXXXX, particularly the Home, About, Database, Resources and FAQ tabs (you won't need to use the Blog or the Contact Us tabs today).
Then, work through each of the following information search scenarios and briefly answer questions (i) and (ii) in each case. It doesn't matter if you don't finish all the scenarios. Please ask a member of the research team for help if you get stuck. If you do finish all of them and want to carry out some other information searches, please do so!

---

1. You are a member of the general public and want to find museums about railways. You would like to know their names and addresses, so that you can plan some visits.

(i) How easy was it to find this information?

(ii) Any other comments?

---

2. You are a researcher in Museum Studies and want to find out which museums the Mapping Museums project team visited and what materials they have compiled about these museums.

(i) How easy was it to find this information?

(ii) Any other comments?

---

3. You are a researcher in Museum Studies and want to find out what is the definition of a "museum" that the Mapping Museums project had adopted for their research.

(i) How easy was it to find this information?

(ii) Any other comments?

---

4. You are a tourism professional and want to find museums in Oxford, including their addresses, so that you can plan a tour in the near future.

(i) How easy was it to find this information?

(ii) Any other comments?

---

5. You are a curator of The Belfast Barge museum. You would like to find other museums in your area that are similar in size and governance, to see how these museums have developed over time.

(i) How easy was it to find this information?

(ii) Any other comments?

---

6. You are a museum professional and are interested in the number of museums opening/closing of different governance types. You would also like to know the geographical distributions of museums of different governance types.

(i) How easy was it to find this information?

(ii) Any other comments?

---

7. You are a museum professional and want to find out how the project has categorised museums that were local authority but that have outsourced their collections to other bodies (i.e. asset transfer museums). How many are there?

(i) How easy was it to find this information?

(ii) Any other comments?

---

8. You are a museum professional and want to find out how the Mapping Museums project treats museums within a museum, or museums with several branches.

(i) How easy was it to find this information?

(ii) Any other comments?

9. You are a museum professional and want to find out how the Mapping Museums team collected their data. What sources did they use?

(i) How easy was it to find this information?

(ii) Any other comments?

10. You are a museum professional and want to find out the number of transport museums in the UK, and within a particular region.

 (i) How easy was it to find this information?

(ii) Any other comments?

Any other searches that you carried out, and your comments on these:

Your name:………

Supplementary Appendix D. Functionality gaps identified by Internal Validation

- Usage scenario: Finding out how the Browse, Search and Visualise facilities have been designed and implemented.
  Validator's comment: We don't have a description of technical development on the website. There is some information about the software the data but not anything about iterative process.
  Action: an additional section on Technical Development was added to the website under the About tab.

- Usage scenarios: Finding out the proportions of accredited/unaccredited museums in a given location; Finding out the proportion of museums in a given location that relate to a given subject area; Finding out the proportion of museums in a given location of different sizes; Finding out the proportion of museums that relate to different subject areas; Finding out the proportion of museums according to subject matter cross-referenced with governance type; What percentage of museums have closed according to governance and/or size and/or local authority area within a given region?
  Validator's comment: This isn't possible because it would involve the calculation of percentages [rather than just counts]. If we were ever to develop the system then such a facility would be very useful.
  Action: not implemented due to project's time and staffing constraints.

- Usage scenarios: What are the numbers of closures of accredited vs unaccredited museums? Which museums are more or less likely to be accredited according to their size/governance/location?
  Validator's comment: These are questions that can be worked out using the database but the DB doesn't do it for you … This is partly because accreditation isn't factored into the tables [heat maps] which is because we don't have data on when museums were accredited.
  Action: not implemented due to project's time and staffing constraints and the lack of data on museums' dates of accreditation.

- Usage scenarios: Which parts of the UK have largest number of unaccredited museums? Which are the accredited museums in a given subject area? And in a given location?
  Validator's comment: That can be worked out but only manually ... Not supported in Heatmap.
  Action: not implemented due to project's time and staffing constraints and the lack of data on museums' dates of accreditation.

- Usage scenario: How have closure rates in a given region changed over time?
  Validator's comment: We haven't got information on rates of closure only on numbers of closure. Being able to calculate rates would be useful.
  Action: not implemented due to project's time and staffing constraints.

Supplementary Appendix E. Users 1-10 responses in the Summative Evaluation

Note, the text between square brackets indicates response by the project team.

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1. You are a member of the general public and want to find museums about railways. You would like to know their names and addresses, so that you can plan some visits.

(i) How easy was it to find this information?
User 1: 3/5
User 2: Very easy
User 3: Having read about how you organise subject matter it was quite straight-forward. 131 results. Intuitively name of museum. To find address scroll through with Next button. Kept trying to use arrow at top of the page.
User 4: Searches are hierarchical
User 5: It was very easy apart from initially not clear that some museums could be closed. Once aware adding another filter was very simple
User 6: Easy when realise it isn't a Google search approach
User 7: Search very easy. Great to have Next arrows. Postcodes all there.
User 8: I got muddled – was trying to use default output attributes. It would be useful to have ability to print the list – looks as though that will happen with CSV [CORRECT]
User 9: Simple enough to Browse and click to Transport/Railway
User 10: Very. I went in through the map but quickly found the list.

(ii) Any other comments?
User 1: Need to establish that Browse rather than Search is the key step
User 2: Search page could be more visual with categories such as : Trains and railways, Cricket etc. [NOT FEASIBLE TO IMPLEMENT IN TIME AVAILABLE]
User 3: Explored tabs to find quickest way of locating specific organisation. Then got harder to use – filters etc.
User 4: Searches refine to seek. Info required
Although not intuitive remember to ensure they are open in 2019 (which is relevant to this question). [WE HAVE IMPLEMENTED CHOICE BETWEEN JUST OPEN AND ALL MUSEUMS IN BROWSE]
Picking admin areas allows tight geographical searches to be refined.
Not a tool for the general public.
User 6: Maybe add something to the word Value (not everyone will realise they should put a search term in there). Also clarify it is a structured search based on a structured terminology
User 7: A lazy general public member may expect a link to the museum itself to find opening hours
Would automatically assume all the museums were open unless thought to do second filter [THIS FEATURE WAS ADDED TO BROWSE]
User 9: Would be useful to have a simple prompt as to whether museum is open or closed rather than expecting to carry on filtering [NOW ADDED TO BROWSE]
User 10: Then realised that closed museums are on list. Can you filter by open and subject? And print list? Had to ask to find Search. Can only filter by 2 search terms? No – can add filters

---

2. You are a researcher in Museum Studies and want to find out which museums the Mapping Museums project team visited and what materials they have compiled about these museums.

(i) How easy was it to find this information?
User 1: 3/5

User 2: Could not find

User 3: About -> Data Collection doesn't mention visit. Only phone calls, emails, MDN. Resources->Interviews implies a visit: full entry.

User 4: OK although it would be good to see list of sources and explanation. [IT IS THERE]

User 5: By Visited, is that each of the 4K in total? Easy to find dataset from which to find data collected [MISUNDERSTOOD THE QUESTION]

User 6: Resources/Interviews/individual museum entries

User 7: Harder – found info on compiling under Blog 'Getting Started' entry [MISUNDERSTOOD THE QUESTION]

User 8: Data collection page is useful but I can't find how to identify which museums the team visited. The interview page list 57 people interviewed but did they visit? [WE DO ACTUALLY STATE THAT WE DID]

User 9: Not clear that I got all data but used Resources + Blog but doubt that I had a comprehensive list. List of visited museums on the website with click through info [THAT IS INDEED CORRECT]

User 10: Found places visited. The blog, interviews – all interesting but I'm not sure if I found the data requested [YES]

(ii) Any other comments?

User 2: I found the total number but not the rest of the information.

User 3: Description of what they compiled is clear e.g. full transcript/summary/contextual/photos etc.

Get into quite dense info quickly

Fairly easy – found it on 2nd attempt – useful to have date of interview alongside title as it is a snapshot in time and things change [WE DO STATE BETWEEN 2018/2019 AT TOP OF PAGE]

User 4: Toby Bulter interview 57 people + over(?) 40 museums. What is the significance of this 40 did the project visit others (?) find on the site

Couldn't we have glossary offer primary provenance data search. [NO]

User 6: Wasn't very obvious and I wonder if I found the correct place! [YES]

User 7: Would be great to move under About, Project [IT IS INDEED THERE]

---

3. You are a researcher in Museum Studies and want to find out what is the definition of a "museum" that the Mapping Museums project had adopted for their research.

(i) How easy was it to find this information?

User 1: 5/5

User 2: Easy

User 3: Easy

User 4: FAQ + link to blog

User 5: Easy – in glossary and blogs

User 6: Easy – found under FAQs

User 7: Very easy via the glossary

User 8: Quite easy – via FAQs

User 9: Very easily on FAQ but required click through to definition [ACTUALLY IT DOESN'T]

User 10: Not easy – I looked in the project pages and assumed it would be explained as part of the project overview. Was eventually told it was in the FAQ page.

(ii) Any other comments?

User 3: Blog really useful to find out more about how project has developed and the thinking behind it. Definitions are essential for research purposes.

User 4: The definition of a museum is not a clear (i.e. lots of definitions) [WE ADDED ONE MORE SENTENCE]
User 6: Perhaps could put the definition on the Home page too as this does impact on all the data included on the website
User 7: Big fan of the glossary. Like the Further Info links on how to define a museum […] – really like that there is a Terms tab along the way too.
User 8: Liked the link to the Blog

4. You are a tourism professional and want to find museums in Oxford, including their addresses, so that you can plan a tour in the near future.

(i) How easy was it to find this information?
User 1: 5/5
User 2: Difficult (Browse)
User 3: Less easy – you need to know which region to search initially, but get there eventually [JUST NEED TO TYPE OXFORD INTO NAME OF TOWN]
User 4: Relatively easy
User 5: Easy by screening with the two filters.
User 6: Easy to find the list of Oxford museums + addresses
User 7: Via Browse and Search into the map for details – very easy
User 8: Via the search menu – seemed relatively easy
User 9: Simple using the search term
User 10: Fairly easy – found through map rather than searching "Oxford"

(ii) Any other comments?
User 2: I didn't know where Oxford was (part of which district). I had to click to click all the regions to find Oxfordshire. Easy ([using] Search)
User 3: Easier to find this sort of info using Google (Sorry!) [WE HAVE NOW IMPLEMENTED A FREE-TEXT SEARCH AS WELL] Map does work well click on blue tags
User 5: Until aware that a second filter to find which museums are open, it would be unclear from the search that some were closed
User 7: Map allows me to visually see how close the sites are and plan a day of visits. Also shows me museums in nearby area that I wouldn't get if I filters via Search for Oxford only
User 8: Would a drop-down menu on Values help? Some place names may be difficult to spell for world-wise users [NOT FEASIBLE – WOULD BE A VERY LONG LIST!]
User 9: Needed to remember to filter on Year Exists

5. You are a curator of The Belfast Barge museum. You would like to find other museums in your area that are similar in size and governance, to see how these museums have developed over time.

(i) How easy was it to find this information?
User 1: 2/5
User 2: Easy
User 3: First found Belfast Barge using Location/List. Give Governance – clear
User 4: Once I found Belfast Barge it was hard to find the size field ["SEE ALL" HAS BEEN REMOVED. SIZE BROUGHT HIGHER UP]
User 5: Easy to apply across filters in search.
User 6: It was easy when I understood how to build the search components using the filters. However my inclination was either to build the search from the Belfast Barge museum page, or use the Browse button and search on the map [THE FORMER IS CORRECT]

User 7: Easy for filtering for governance. Difficult for size.
User 8: If you enter 'The Belfast Barge museum' no results show
Fairly easy but first time I was confused by the Value box – I hadn't realised it was drop-down menu to begin with.
User 9: Relatively easy but a bit subjective. However like that I decide whether to choose small/medium etc. and could expand beyond Belfast
User 10: In search found other small independent museums in Belfast

(ii) Any other comments?
User 1: Not apparent how you cross-ref on Browse then[?] search[?] [NO SUCH CROSS-REFERENCING IS SUPPORTED]
User 2: Some users may not find "Add Filter" but was easy to understand
User 3: 'Size' is not listed and who have to look at the Glossary to remind myself what the project definition might be e.g. physical size of collection/building/visitor figs/employees.
Comparative question harder – you need to know which museums you are looking for already? And be familiar with geography
User 5: The curator would perhaps already know size, but it took a while to find the See All which revealed the whole dataset. Not easy to flick between browse and search when you go back for a piece of information [INDEED, YOU CAN'T USE THE BACK BUTTON]
User 7: Used filter for just Belfast museums and saw what governance Belfast Barge museum was and added second filter. Couldn't see size of museum when on list [NEEDED TO ASK TO SEE FULL LIST OF ATTRIBUTES – NOW RECTIFIED]. Had to add third filter and guess what size of Belfast Barge museum is by trial and error
User 10: Then browsed map and realised it was much more flexible

6. You are a museum professional and are interested in the number of museums opening/closing of different governance types. You would also like to know the geographical distributions of museums of different governance types.

(i) How easy was it to find this information?
User 1: Not too easy
User 2: Easy
User 3: Governance – easy to find: click on gov./map. Visual overview.
User 4: ---
User 5: Visualise tool displayed this clearly using the slide bar at the bottom. Easy to see change over time.
User 6: Difficult – presumably it is using the Visualisations table, but at the moment I can't see how to do it [TWO DIFFERENT CHARTS ARE REQUIRED]
User 7: Easy once I realised I should go via Visualise not Search
User 8: Applying more than one filter to analyse data works well.
User 9: Very easy for geographical distribution. Relatively easy once you decide on your search parameters
User 10: --

(ii) Any other comments?

User 3: Less sure how to approach open/close with governance – filters ? [YES]
User 5: Would be good to see all types on one graph (though large)
Easy to browse geographical spread across map of governance types.
User 7: Loved the graphs over time!

User 8: Can you get to info via map – better for geographical visuals [YES YOU CAN, IN SEARCH/MAP VIEW]
User 9: Could have spent ages on this one playing around with types of governance and closures. Really useful tool.

7. You are a museum professional and want to find out how the project has categorised museums that were local authority but that have outsourced their collections to other bodies (i.e. asset transfer museums). How many are there?

(i) How easy was it to find this information?
User 1: 2/5
User 2: Could not find
User 3: Not easy : clicked governance – then?
User 4: Hidden in FAQs
User 5: Answered in a FAQ. Firstly looked in Glossary.
User 6: Not easy – ok when FAQ section found
User 7: Took me a little while after searching via About/Glossary but found under FAQs [FIXED THIS]
User 8: Notes -> asset transfer – took a bit of doing and doesn't quite match the question?
User 9: Prompted to search in Notes
Actual transfer / closed / pending transfer
User 10: ?

(ii) Any other comments?
User 1: OK once I had accessed FAQs to find out
User 2: I could filter local authority museums but I could not find the right filter for the second question [WE HAVE ADDED ANOTHER ENTRY TO THE GLOSSARY]
User 4: Useful search function
User 5: Once I'd found the FAQ it was simple to search and view.
N.B. Can users add tags, save searches? [NO]
Select and add to map [YES, THROUGH EDIT]
User 6: Very useful data.
User 7: Great explanation and tip for search via 'Hybrid'
Took a bit of fiddling with, but managed to search via Hybrid and Notes
User 9: Probably needs to have better Glossary for Notes. Should have looked at FAQ [WE EXTENDED THE GLOSSARY WITH SOME MORE INFORMATION]
User 10: No idea – subsequently a fellow attendee search on "asset transfer" as a term [INCORRECT – we use Hybrid in the notes. ADDITIONAL ADDED TO GLOSSARY]

8. You are a museum professional and want to find out how the Mapping Museums project treats museums within a museum, or museums with several branches.

(i) How easy was it to find this information?
User 1: 5/5 (FAQS)
User 2: Could not find [DIDN'T SPOT FAQS TAB ?]
User 3: Quite easy
User 4: ---
User 5: Yes answered within FAQs
User 6: Easy now realise how useful FAQ system is.
User 7: Both under FAQ – very easy

User 8: Needed help to get to answer in FAQs
User 9: Easy – in FAQs
User 10: Easy – I went straight to FAQs

(ii) Any other comments?

User 6: Last sentence on the FAQ para is ambiguous. Which is the 'first' museum? (We have an example where the first museum in historic terms has been amalgamated with the later museum (i.e. the second) and it is the second museum that exists not the first). Or have I got the wrong end of the stick?   [WE HAVE REWRITTEN THAT SENTENCE]

9. You are a museum professional and want to find out how the Mapping Museums team collected their data. What sources did they use?

(i) How easy was it to find this information?
User 1: 5/5
User 2: Easy
User 3: Quite easy
User 4: ok
User 5: Available in Data Collection, easy to find but perhaps could be listed concisely in an FAQ [HAS NOW BEEN ADDED TO ABOUT -> DATA COLLECTION]
User 6: Easy
User 7: Easy – all under About and Data Collection
User 8: Easy to find on the Data Collection page
User 9: Easy to find under 'About'
User 10: Easy – I went straight to the About pages

(ii) Any other comments?

User 8: Information is clear
User 9: Might be useful to have link in that section for museums to contact you if they dispute data and have a process/protocol for it [WE HAVE THESE – UNDER CONTACT US TAB]

10. You are a museum professional and want to find out the number of transport museums in the UK, and within a particular region.

 (i) How easy was it to find this information?
User 1: 5/5
User 2: Easy
User 3: Quite easy
User 4: ---
User 5: Easy to filter search through subject matter and then location.
User 6: Easy
User 7: Easy
User 8: Seem to be two transport museums in Manchester – easy to determine from the database
User 9: Easy to find subject matter but then realised that I needed to filter on location and then subject. [IN FACT YOU CAN DO IT EITHER WAY ROUND] Wasn't as intuitive as I would expect
User 10: Easy – played around with the map to find the data

(ii) Any other comments?

User 2: Map can be used more effectively for regional/location-based search query (Similar to Righmove, Zoopla) [BEYOND SCOPE OF PROJECT]
User 5: Would it be possible to filter the list? Could make it simpler to identify different regions, though this could easily be done in an exported CSV [YES, CORRECT]
User 7: Can filter for Transport but can't for region other than 'Village, Town, City' [YOU CAN, THROUGH ADMIN AREA] so then looked at map

---

Any other searches that you carried out, and your comments on these:

User 1:
Archaeology (106)
Not showing up by collections e.g. Lewes, Guildford, Exeter, Plymouth .. [COLLECTIONS WERE OUT OF SCOPE OF THE PROJEC T]
User 2:
Visualisations -> results should be clickable
-> totals and subtotals could be added to cohort tables
Website URLs -> At least a Google search link can be added
Website is not usable on mobile browsers
User 3:
Query : it's collections level information but did you consider including designated collections (149) in any way? Update post-panel (about 2 a year) on ACE list.
Accreditation stats. post-panel ?
ACE website – DesignatedCollections.pdf
NB includes libraries and archives
[WE COULD INCLUDE THIS INFORMATION WITHIN NOTES, TIME PERMITTING]
NB 'The Collection' = art + archaeology
Usher gallery next to The Collection [UNCLEAR]
How tracking Governance changes [NOT PRESENT IN OUR DATA]
Nuances of closure: Accreditation Scheme has stats for "removed" and "excluded" and explains what it means
But Accreditation data is not mapped against non-accredited [UNCLEAR]
User 4:
Corrections:
Fordham museum is a hybrid?
Gosport museum address is incorrect
Issue about addresses – are they governance addresses or venue? [SHOULD BE THE LATTER BUT THERE ARE A FEW MISTAKES IN THE DATA – NOW CORRECTED USING THE 'EDIT' FUNCTION]
User 5:
- When searching on map, it would be useful if you could click through the pin to the record [ADD TO SEARCH, TIME PERMITTING]
- 'See All' do you need this? It would be good to see the full dataset if you are not already aware what has been collected [CORRECT – NOW REMOVED]
User 6:
How do you search for all open or all closed museums in a region?
User 7:
Searched:
- Browse – government via map
- Search – nationals – then looked via map. Noticed that Royal Observatory Greenwich isn't listed [CORRECT]

- Tried to search for 'free entry' [WE DON'T RECORD THAT]
- Did some general browsing via demographic subgroup
- General browse on Channel Island museums. Currently seems to put a lot in the sea [POSTCODE PROBLEM – CORRECTED]
- General browse – England – by region, really helpful as the subheadings themselves indicate areas with numbers showing high concentrations
- Nationals – museum of Mankind and British Theatre Museum, wouldn't classify as nationals. As far as gvmnt concernced, have to have central gvmnt money to be a national [A CONTESTED ISSUE GENERALLY]
- Would be useful to have split DCMS/MOD/Scottish Government/Welsh Government/HO/NI government museum split [GOOD IDEA, BUT WE'VE DONE IT DIFFERENTLY; CAN GET THIS INFO THROUGH SEARCH]
- Trying to search for way to see seasonal/tour only opening (with tax relief checking in mind!) [USEFUL BUT OUT OF PROJECT SCOPE]
- Loved the interviews and all the extra info e.g. podcast
- Love that you have a micromuseums archive and collecting on independents
- Love that can download the data
- Would be great if data record of museum had all the data showing initially without having to click View All icon at bottom [CORRECTED]

User 8: ---
User 9: ---
User 10: ---

Supplementary Appendix F – Mapping Museums Usage Statistics

No. of views/ accesses	Mar 2020	Apr 2020	May 2020	June 2020	July 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020
Report	166	139	98	67	47	45	77	45	60	48
Online Guide	19	22	24	21	13	17	14	6	7	11
Video	41	21	26	5	4	5	6	5	16	1
Browse	351	344	215	205	556	300	168	217	193	160
Search	305	278	301	185	255	249	146	128	179	240
Visualise	336	147	164	212	108	301	176	109	216	329
Interview transcript files	6	17	63	17	4	3	5	1	2	3
RDF/XML data file	not available	36	16	11	21	16	14	15	15	22
All other accesses to the MM website	20752	18613	13960	11503	14165	15172	10349	11013	10152	9958

Supplementary Table 6. Usage Statistics 17th March – 31st December 2020.

No. of views/ accesses	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	June 2021	July 2021	Aug 2021	Sept 2021	Oct 2021	Nov 2021	Dec 2021
Report	53	58	60	63	59	50	33	27	65	70	61	63
Online Guide	7	8	5	11	6	6	5	7	8	2	6	6
Video	3	3	4	1	1	1	1	1	1	1	1	1
Browse	233	163	341	241	214	139	116	129	185	150	167	116
Search	295	257	314	200	197	147	98	103	255	164	188	117
Visualise	185	204	384	162	181	154	100	50	161	221	144	101
Interview transcript files	44	52	9	6	6	1	1	1	15	0	14	14
RDF/XML data file	10	11	38	27	19	19	17	23	8	14	11	10
All other accesses to the MM website	25549	23725	40749	30879	29792	14750	25949	18452	26572	38551	30477	35119

Supplementary Table 7. Usage Statistics January – December 2021.