EULAC MUSEUMS Museums and Community: Concepts, Experiences and Sustainability in Europe, Latin America and the Caribbean

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1. Introduction

This report details and provides evidence for a series of workshops held to promote the use of 3D and spherical technologies in museums associated with the EU-LAC-MUSEUMS project.

In PART I of this report, **3D Workshops Overview**, an overview of the workshops is provided, followed by a summary of activities in each museum. This includes numbers of participants, the digital outputs created by the workshops and links to the outputs. The series of workshops have been completed, work continues on the presentation and description of the outputs. The 3D team constructed a series of workshops, which were designed to make it easy for community museums to work with 3D and spherical technologies. The goal was to enable the creation of high quality digital content using commodity hardware readily available to hosting museums and workshop participants.

In PART II, we report upon **Technology, Innovation and EU-LAC 3D**, outlining the research findings of the workshops and explaining the virtual museum framework. A virtual museum framework was developed to showcase the digital outputs of the workshops. This framework can be accessed from a bespoke Virtual Museum: **www.eu-lac.org**. And from the EU-LAC-MUSEUMS project web site: **http://www.eulacmuseums.net**

The front page provides a map interface which geo-locates all of the participatory museums, objects and tours. The galleries for digital objects are organised into museum collections together with a gallery of virtual tours. A media wiki is associated with each museum, collection and object. This enables community participation in interpretation. An archive facility enables upload of collections of photographs which can be processed by Team 3D to create 3D objects. This is open for all EU-LAC-MUSEUMS participants and will particularly help museums processing large files. The 3D toolkit available on the virtual museum website provides access to resources that will help participants to continue exploring the technologies.See Deliverable D4.1 – Manual of 3D: http://eulacmuseums.net/index.php/partnership-2/detail-3/detail-4

In PART III, we present a **SWOT analysis and suggestions for further work** for the challenges and opportunities learnt through the workshops and research.

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Figure 1. 3D Workshop, Barbados Museum and Historical Society, Barbados

PART I: 3D Workshops Overview

2. Aims and Goals of the 3D Workshops

The goals of the workshops were:

1) to introduce attendees to spherical and 3D technologies, workflows and concepts in order to develop their understanding of the potential of these technologies in their communities and museums.
2) to encourage continued learning about 3D and spherical technologies and working with the technologies after the workshops had concluded.
3) to create exemplar content and showcase it within the EU-LAC-MUSEUMS Virtual Museum.
4) to make the content available to the participating museums for use in their web sites and social media.

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3. Methodology

Stepping into a museum and exploring a culture's stories, traditions and artefacts no longer requires an expensive plane ticket. Through digital technologies, a visitor can explore remote museums, digitally handle objects and learn about a culture's distinct traditions and stories from the comfort of their home. The Virtual Museum, specifically created for the EU-LAC-MUSEUMS project, is the media hub for all content produced during 3D workshops. The site will continue hosting materials produced by museums following the instruction of the seminars, and enable contribution from community members. The new Virtual Museum also offers instruction for those eager to learn the techniques used to create the digital media seen on the site.

The workshop methodology was practice-based. Workshops started with an overview as well as a show and tell of the relevant technologies, usually in the morning. This was followed with hands on practical activities, which generated digital outputs, in the afternoons. The workshops were hosted in 9 countries and 18 museums. Participants came from a range of backgrounds, including museum professionals, photographers, students, community volunteers, school children, and academics. In total over 350 people participated in the workshops.

The museums participating in the workshops were identified by our project partners in Europe, Latin America and the Caribbean because of their long-standing relationship with them, or for their especially remote or island locations, in keeping with the aims and ethos of the EU-LAC-MUSEUMS project. Where possible, an intergenerational element was included, so that community elders were involved in the selection and communication about the "community icons" to the younger generation, thereby passing down community memory and contributing to community resilience in an age of globalisation.

During the workshops we created over 150 digital objects and have produced digital virtual tours of the museums and their surrounding areas. Work is ongoing in developing interpretation for the digital objects and the tours. Additionally an EU-LAC-MUSEUMS virtual reality app has been developed, enabling immersive mobile tours of the museums. The feedback we have received has all been positive and we have continued to work in collaboration with the participatory museums in developing the EU-LAC-MUSEUMS Virtual Museum.

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4. Workshop Format and Content

Pre-workshop advice was sent to museums, alongside the **Manual for 3D Digitisation** deliverable. It is freely available on the EU-LAC-MUSEUMS project website: http://eulacmuseums.net/index.php/partnership-2/detail-3/detail-4

The workshops went beyond the processes used for the creation of digital artefacts, and looked at how the digital content produced can be used. A link to a video showing aspects of the workshops is given below:
http://openvirtualworlds.org/cadam/eulac_promo_video.mp4

Figure 2. Photogrammetry of a knit hat and a coast guard's helmet in the Shetland Islands by Catherine Cassidy

4.1 Object Digitisation

The workshop introduced the different techniques that can be used, photogrammetry, laser scanning and structured light. Participants will have the opportunity for hands on experience of each technique and will focus on the use photogrammetry using technology that is readily available to participants (mobile phones and cameras) using freely available and open source software. They enabled both the digitisation of objects by the 3D team as well as the training of community participants at a basic to intermediate level, such that they were able by the end of the day to carry on this work.

The workshop looked at six stages of a successful digital artefact creation project:

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- **Selection of Artefacts:** Successful digitisation depends in part on selecting objects with suitable characteristics, appropriate size, matt surface, appropriate features on surfaces and lack of occlusion.

- **Selection of Equipment:** We will show how to put together a high-fidelity digitisation studio on a budget. Tripod, lights, softbox and turntable will be combined with commodity phones, tablets and cameras to create a studio capable of producing professional results.

- **Doing the Shoot**: Will look at how to set up the equipment and to take the photographs for optimum results. Whether on a camera or smartphone.

- **Creating the Model:** There are several options for creating a digital object from photos. Each will be introduced and we will step through at least one methodology. We will look at aps, open source software and commercial alternatives. Participants will get both an overview of the technologies and hands on experience.

- **Archiving:** Archiving digital artefacts will enable them to be future proofed and made easily accessible. We will provide an infrastructure which will enable source materials to be archived along with any models that are created. We will make use of open standards and freely available software to ensure outputs are not tied to proprietary standards or software that may not be available in the future.

- **Curation:** platforms like sketchpad enable digital artefacts to be made accessible over the Internet and provide opportunities for sharing. In addition, outputs can be embedded in web pages, which in turn may be developed using opensource platforms. Our approach to curation will stress the separation of technology and content, enabling domain experts and volunteers to lead in artefact curation.

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Figure 3. Workshop participants learning photogrammetry in Valdivia, Chile (See Appendix 1)

Participation in this workshop has equipped participants In the digitisation of artefacts. After the workshop participants understand the potential, limitations and commitments required for a successful community digitisation project.

Figure 4. Training in 3D and spherical technologies in Charlestown Maroon Museum, Jamaica by PhD students engaged in EU-LAC-MUSEUMS, Adeola Fabola and Kate Keohane (See Appendix 1)

4. 2 Creating Digital Scenes

Training in spherical photography has also given enabling participants to learn how to use mobile phones, tablets and cameras to create spherical photographs of the landscape and historic buildings. A workshop will be held for volunteers introducing

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spherical technologies and how they can be used. Subjects covered in the workshop included:

- **Site selection:** Selecting an appropriate location is critical as framing does not take place in spherical photography.

- **Equipment and software:** participants will be introduced to three modes of photosphere creation, using a mobile phone, a bespoke camera and a digital SLR. The software available for each method will also be introduced.

- **Executing a shoot:** Selection of scene is critical to a successful shoot. This includes location, light conditions and time of day. HDR techniques may be necessary to successfully shoot some scenes. particularly bright windows can pose a hazard for indoor shoots.

- **Processing and stitching:** we will introduce the process of creating photospheres from photographs using opensource software. We will also look at inserting appropriate XDif data.

- **Archiving spherical media:** Properly archiving photospheres and source materials provides future proofing and allows them to be optimized for appropriate use cases.

- **Sharing spherical media:** there are opportunities for widespread dissemination of photospheres through Google Street view, for creating high quality virtual tours in roundme. We will also look at how to create bespoke web and mobile applications.

The above process enables participants to create digital representations of the sites, which will enhance visits to the area and provide a platform for remote exploration. A series of photospheres form the basis of a virtual tour which will enable remote exploration of the landscape and the site. Interpretation is being collated by volunteers and included as interactive hotspots. The tour has at times been supplemented by aerial drone footage and spherical timelapse photography.

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5. Summary of Workshop locations, participation and outputs

Museum	Date	Attendees	3D Object	Virtual Tours
Unst Boat Haven	16th September 2016	18	1	Yes
Unst Heritage Centre	17th September 2016	8	6	Yes
Shetland Museum and Archive	18th September 2016	5	10	Yes
Seixal Eco Museum	3rd November 2016	16	9	Yes
National Archaeology Museum (Lisbon)	4th November 2016	42	7	Yes
Barbados National Museum and Historical Society	7/8/9th January 2017	14	13	Yes
National Museum and art Gallery of Trinidad and Tobago	11/12th January 2017	16	11	Yes
Moruga Museum	13th January 2017	42	3	Yes
National Museum of Jamaica	15th January 2017	3	5	Yes
University of West Indies (Mona Campus)	16th January 2017	8	6	Yes
Charles Town Maroons Museum	17th January 2017	16	3	Yes
Museo Comarcal de l' Horta Sud	25/26th February	8	8	Yes
Museo del Palmito d'Aldaio	26th February	N/A	N/A	Yes
Cortes de Pallas	27th February	15	N/A	Yes
San Vicente Eco Museum	20th February 2017	6	9	Yes
Community Museum of Boruca Indians	23rd February 2017	23	6	Yes
Curre Museum	24th February 2017	22	5	Yes
Sican Museum	28th February 2017	14	15	Yes
Tucume Museum	1st March 2017	5	17	Yes
Museum of the Universidad Austral de Chile	7/8th March 2017	14	14	Yes
Community Museum of Malalhue	9/10th March 2017	15	11	Yes

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Scotland, Shetland Isles
Unst Boat Haven 16th September 2016

In the northerly islands of Shetland we worked with Unst Heritage Centre and Boat Haven. Here we held a workshop, filmed intergenerational discussion based around aretfacts, created a virtual tour and digitised several artefacts. Participants included a local school group, who created their own blog about it:
http://unst.org/web/bjhs/2016/09/16/3d-artefacts-workshop/

Figure 5. Dr Alan Miller leads a workshop in progress in Unst Boat Haven

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Figures 6 and 7. Intergenerational discussions Unst Boat Haven

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Scotland
Unst Heritage Centre 17th September 2016

Figure 8. Workshop Unst Heritage Centre

A continuation workshop was held with students from Baltasound Junior High School. A virtual tour of the heritage centre was created and four objects from centre digitised. **Appendix 4** details workshops in Shetland.

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Shetland Museum and Archive 18th September 2016

Figure 9. Drop in workshop Shetland Museum and Archive
(See Appendices 4 and 5)

In Shetland Museum and Archives we ran a drop-in workshop with 5 participants as the original workshop was postponed due to flight delays. Training was provided for museum staff and a gallery of digital artefacts created along with a virtual tour of the museum.

Portugal
Seixal Eco Museum 2nd/3rd/5th November 2016

Three days were spent working with the Seixal Eco Museum. The first days activities were orientation with museum, staff and digitisation of objects. Day 2 was an open workshop, opened by Luis Raposo, ICOM Europe. During the workshop a Wiki, and virtual tour were created and objects digitised. The third day was a tour of museum sites. Virtual tours of the Gunpowder Factory and the cork factory. Digital outputs included: gallery of 3D artefacts, virtual tours of the Gunpowder and Cork Factories.

Luis Raposo (Chair of ICOM Europe) placed the following Facebook post about the workshop:

"EULAC MUSEUMS 3D Artefacts and Spaces Workshop at Ecomuseum of SeixaC The right contend in the right place ! Thanks to Alain Miller and his team. Deep acknowledge to Ecomuseu do Seixal !"

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Figure 10. Seixal Ecomuseum workshop

National Museum of Archaeology (Lisbon)

A full day workshop was held at the National Museum of Archaeology in Lisbon. This included session of 3D digitisation, 360 technologies and 3D printing. The final session was joined by archaeology students and museum staff.

Facebook Luis Raposo (Chair of ICOM Europe) posted:
https://www.facebook.com/raposo.luis/posts/1109525109166069

"On move again: the EU-LAC-MUSEUMS 3D workshop takes place today at the National Museum of Archaeology, in Lisbon. From Palaeolithic bifaces to roman bronzes several selected objects are being digitalised. It is really an enjoy to see how recent technologies can provide museums with simple, low costly ways to augment considerable their offer and better accomplish their social missions"

Figure 11. Workshop National Museum of Archaeology (Lisbon)

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Barbados

Barbados Museum and Historical Society 7/8/9th January 2017

Workshops were held in the Barbados Museum. The workshop included museum staff, students and local community members. Objects from the museum and the Primus Collection were digitised. A virtual tour of the museum and of the island were created.

Figure 12. Project Coordinator Dr Karen Brown assisting community participation in making an inventory of their objects ready for 3D scanning

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Trinidad and Tobago

National Museum and Art Gallery of Trinidad and Tobago 11/12th January 2017

Figure 13. Virtual tour of Trinidad and Tobago National Museum

Figure 14. Museum of Trinidad and Tobago

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A day of orientation and objects were digitized, followed by a full day workshop. Attendees included local professionals, students, academics, The National Trust and academic staff.

Trinidad and Tobago
Moruga Museum 13th January 2017

Figure 15. Presenting Certificate of Participation Moruga Museum

http://www.trinidadexpress.com/20170118/features/3d-technology-for-moruga-museum/

https://www.facebook.com/eulacmuseums/posts/1851998751741273

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The workshop was attended by groups from four schools and from the local community. Obects were digitised and two virtual tours created one of the museum and one of the locality.

Jamaica
National Museum of Jamaica 15th January 2017

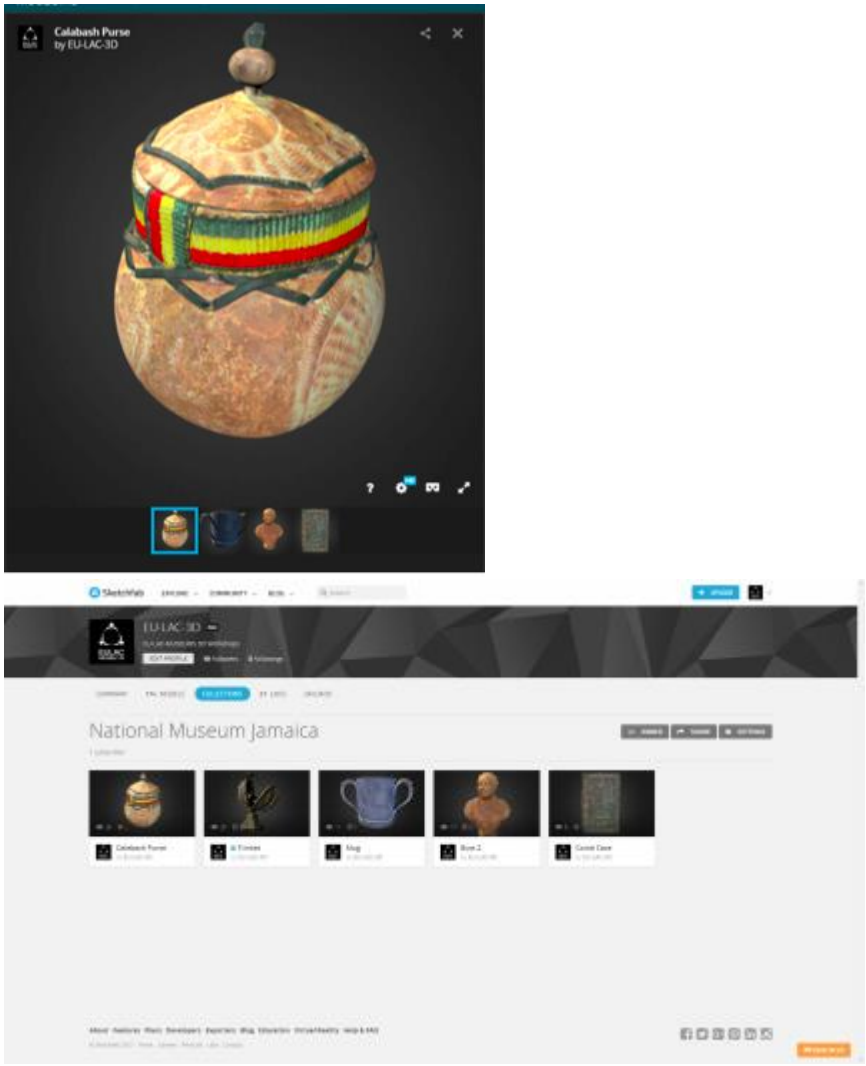

Figure 16. Digitised objects from National Museum of Jamaica

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Informal training of staff was conducted, objects were digitised and a virtual tour created.

Jamacia
University of West Indies (Mona Campus) 16th January 2017

Figure 17. Museum of University of West Indies Mona Campus

https://www.facebook.com/uwimuseum/posts/584256358434069?match=ZXVsYWMgbXVzZXVtcyxt

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The workshop was attended by academics, museum professionals, students and technicians. Objects from the museum were digitised and a virtual tour of the museum created.

Jamacia
Charles Town Maroons Museum 17th January 2017

Figure 18. Workshop in Charlestown Maroons community

A one day workshop was held. The workshop was attended by members of the Maroons community, the University of the West Indies and the Jamaica Institute. A virtual tour of the area was created together with digitisation of museum artefacts.

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Spain
Museo Comarcal de l' Horta Sud 25/26th February

On the first day orientation and training of museum staff was conducted, and digitisation of objects carried out. On the second day a workshop was held for museum staff and for representatives of three other museums in the region. A virtual tour of the local Fan museum was created.

https://www.facebook.com/museuhortasud/posts/999769280155556

Figure 19. Talking about making 360 images

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Figure 20. Digitising a figure

Spain
Cortes de Pallas 27th February 2017

Figure 21. The Valencian ESTEPA and Scottish USTAN teams in Cortes de Pallas, with the local mayor

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A virtual tour of the region and of the town was created. Dr Karen Brown addressed a Town Hall meeting recognising the colllaboration between the University of Valencia, the EU-LAC project and the local municipality in protecting their cultural heritage and historic irrigation system.

Figure 22. EU-LAC-MUSEUMS Project Coordinator signs the Cortes De Pallas Mayor's book in the town hall, together wth Jorge Hermosilla (Principal Investigator of ESTAPA, Valencia)

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Costa Rica
Rey Curre Museo Comunitario 24th February 2017

Figure 23. One stop on the virtual tour, local pottery maker

The workshop was held over two days. On the first day in the evening intergenerational conversations centred on museum artefacts were filmed. Artefacts in the museum were digitised and two virtual tours created one of the museum and one of the locality.

Figure 24. Photogrammetry of Sphere in Boruca, Costa Rica

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Costa Rica
Community Museum of the Boruca Indians 23rd February 2017

Figure 25. Young people learn new technology skills at Boruca

The workshop was attended by students from the local school and by community members associated with the museum. A virtual tour of the museum was created together with a tour of the locality. Objects from the school and museum were digitised, together with a large sphere located directly outside the museum.

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Costa Rica
Rey Curre Museo Comunitario 24th February 2017

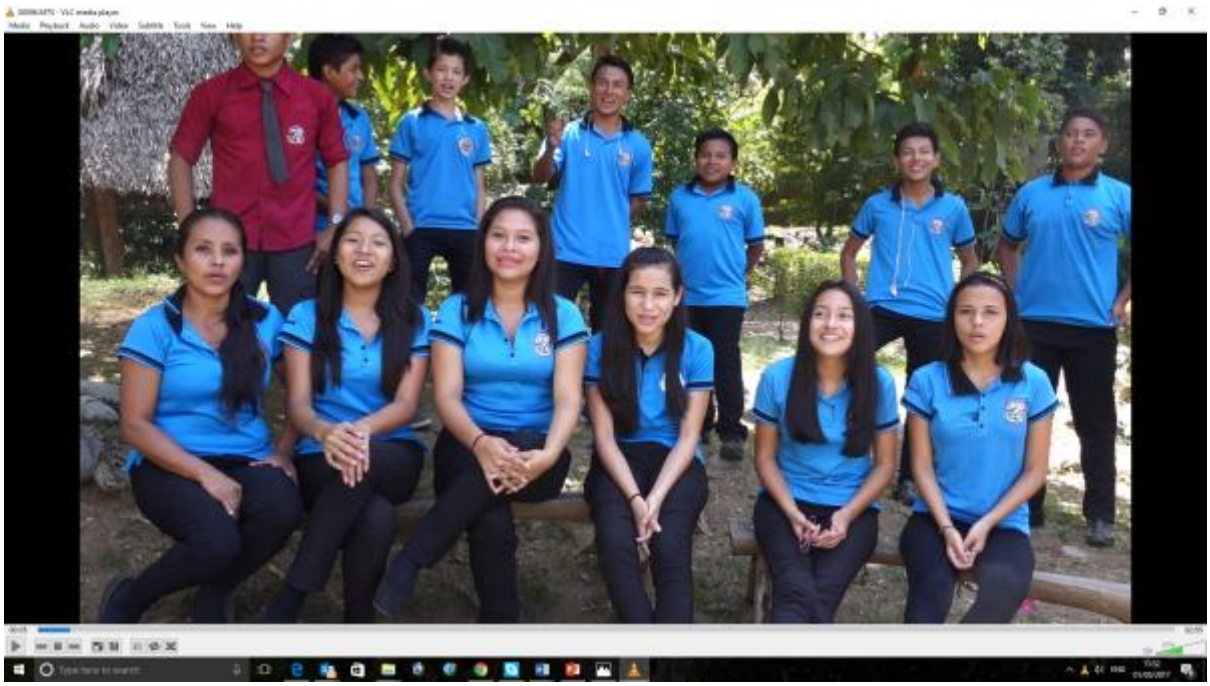

Figure 26. Young people in Rey Curre school during the workshops

A virtual tour of the museum was created and objects associated with the museum digitised. The workshop was attended by school students, teachers and community members.

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Peru
Sican Museum 28th February 2017

Figure 27. Peru Sican Museum 3D workshop set-up

Figure 28. In-house training in Sican

The workshop was attended by archaeologists, museum professionals and community members. A virtual tour of the museum was created and museum artefacts digitised.

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Peru
Tucume Museum 1st March 2017

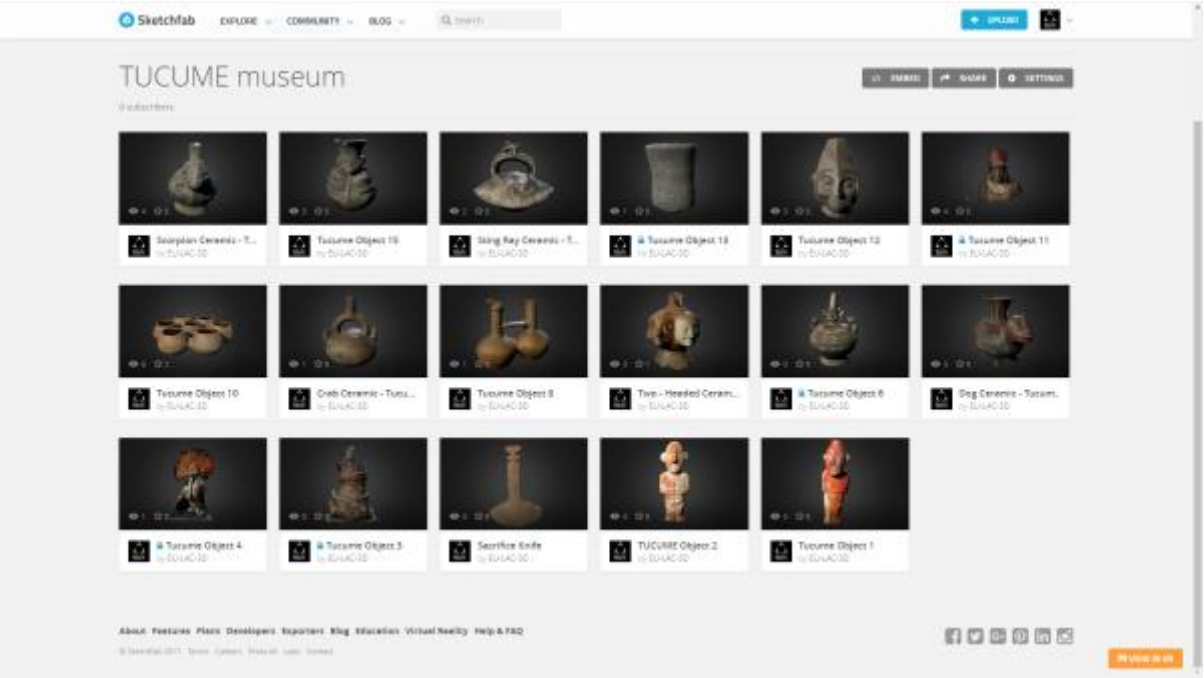

Figure 29. Gallery of 3D Models in the Virtual Museum following Peru Tucume Museum workshop

The workshop was attended by museum staff and academics. It was held informally, a tour of the museum enabled objects for digitisation to be selected and museum staff engaged in the digitisation process. Virtual tours of the museum and of the locality were created.

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Chile
Museum of the Universidad Austral de Chile 7/8th March 2017

Figure 30. 3D Workshop and photogrammetry in Chile Museum of the Universidad Austral de Chile

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Chile
Community Museum of Malalhue 9/10th March 2017

Figure 31. Community participatin in Community Museum of Malalhue

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https://www.facebook.com/Museosaustral/posts/1337560729642461
https://www.facebook.com/Museosaustral/posts/1345844898814044

http://www.museosaustral.cl/index.php/institucion/noticias/282-proyecto-realizado-en-conjunto-con-la-union-europea-acerco-la-tecnologia-3d-a-museos

The workshop was held in the museum. It was attended by students, museum professionals and academics. Objects from the museum were digitised and virtual tours created of four museums.

https://www.facebook.com/Museosaustral/posts/1312703385461529?match=ZXVsYWMsM2Q%3D

The workshop was held in the museum. It was attended by community members, council members and academics. A Matte session was held and filmed. A virtual tour of the locality was created and objects from the museum digitised.

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PART II Technology and Innovation in EU-LAC 3D

6. Virtual Museum and links to digital outputs

The front page of the Virtual Museum is at: www.eu-lac.org

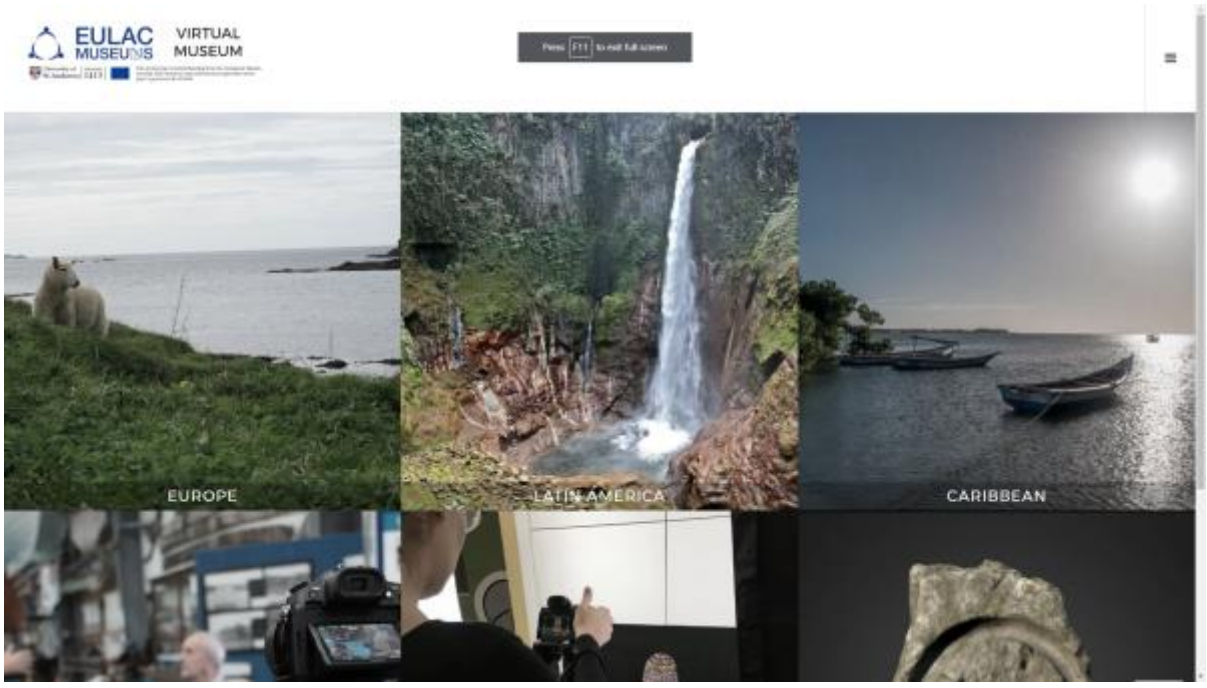

Figure 32. EU-LAC Virtual Museum front page

It is also embeded in the project website:
http://eulacmuseums.net/index.php/resources/virtual-museum-2

The Virtual Museum design features the use of web, mobile, location-aware and immersive technologies. The front-end features a location-aware map interface which uses icon-coded pins to represent different types of entities in their respective locations around the world, while the back-end is powered by the Omeka Digital Asset Management System (DAMS).

The combined integration of web, mobile and immersive technologies in the Virtual Museum achieves the goal of providing engaging experiences to users, for example by using virtual reality headsets to provide immersive virtual tours of remote

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locations and enable the inspection of 3D artefacts. Furthermore, several media types – audio, video (flat, spherical and stereoscopic), images (flat, spherical and stereoscopic), 3D artefacts and text – are combined to provide these compelling and informative experiences to users, thus fulfilling the multimedia integration goal. By combining a Digital Asset Management System back end with a management front end, heritage practitioners can create and update content with ease, and a presentation front end provides instant feedback, allowing heritage practitioners and community members alike to continuously manage and use the virtual museum. **http://openvirtualworlds.org/cadam/eulac_virtual_museum.mp4**

6.1 Virtual Museum Framework

A map interface indicates the location of museums participating in the network. Each museum is represented by an icon that links to the digital resources connected with the museum. These resources include: digital galleries of 3D objects held on social archive sites; virtual tours using 360 degree technology with embedded interpretation; virtual reality apps; museum web pages; museum wikis and social media. A presentation front end enables the public to engage with cultural heritage content that exists in the backend data store. This is improved upon by pairing the presentation front end with a management front end that heritage experts and community members alike can use to easily populate the back end with content. This is manifested as a web-based archive form which can be filled to supply information about a new entity, or with which content can be retrieved and edited to modify information about a new entity. The information supplied using the archive form is mapped to the Europeana Data Model (EDM, which builds on the Dublin Core schema) to leverage the literacy and familiarity of heritage practitioners with these schemas, and to improve interoperability with other cataloguing and asset management systems, towards achieving the goal of ease of management. The user experience is enriched by immersive technologies including in-built support for virtual reality headsets while undertaking virtual tours or exploring 3D artefacts. The engaging experience is not lost in the absence of virtual reality headsets, as users can still engage with the content on mobile (smartphones and tablets) and web platforms.

There are three principal ways in which our approach to the Virtual Museum is innovative:

· It is an *active* Virtual Museum in that rather than be concerned simply with presentation, it provides support for all stages of the media lifecycle.

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· The Virtual Museum is structured to support content reuse, so that the same content can be deployed easily in web, social archive, social media and mobile contexts.
· A global infrastructure is provided that enables the content from multiple museums to be accessed via the same interfaces and for comparisons to be easily made, and making it possible for museums to make their own Virtual Museum.

6.2 Virtual Museum User Interfaces

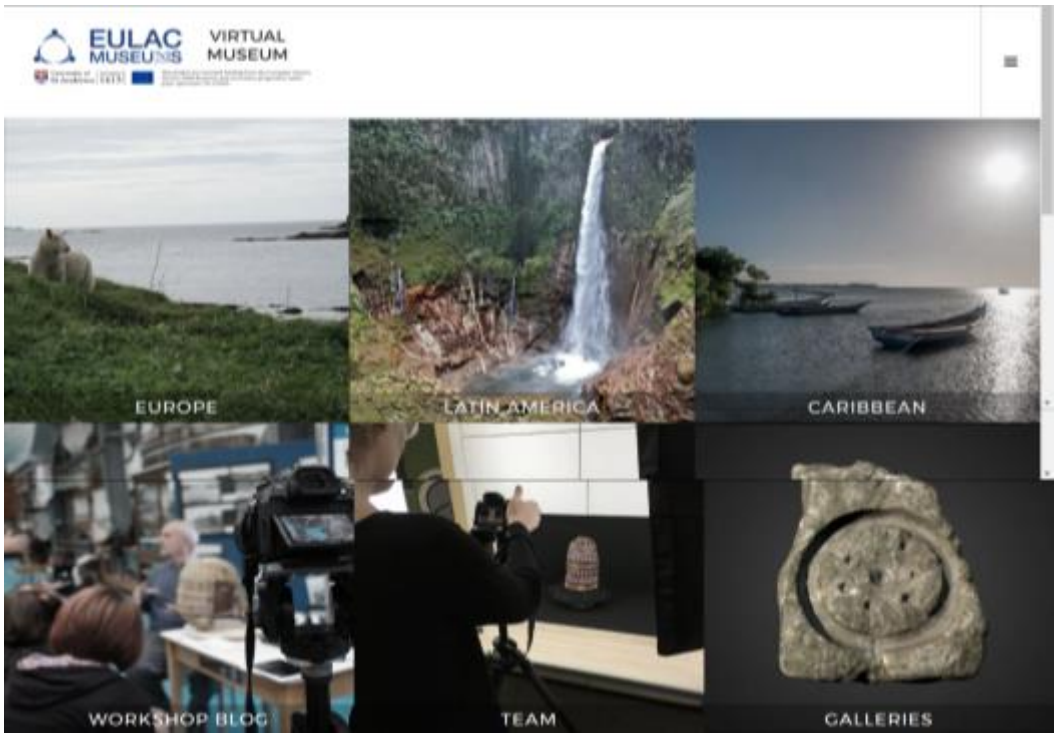

Figure 33. EU-LAC Virtual Museum front page options

The front page of the Virtual Museum provides six portals to content. The top three click through to a map interface, one for each of the regions; Europe, the Caribbean and Latin America. Each one focuses a shared world map on the museums in the region. A portal leads to the project blog with selected virtual tours, a fifth shows the people who have been involved in the project and the sixth leads to the virtual museum galleries and toolkits.
EU LAC Virtual Museum

This project has received funding from the European Union's Horizon 2020 Research and innovation programme under grant agreement No 693669.

Community Museums Map

6.3 Community Museums Map Interface

Through the map interface, you can search the world to find museums involved in the 3D EU-LAC MUSEUMS project. From each museum's marker you can explore virtual tours and 3D Galleries, contribute to a Wiki or browse the museum's social media and web presence. The map also links to virtual tours located on Roundme and 3D artefacts located on Sketchfab.

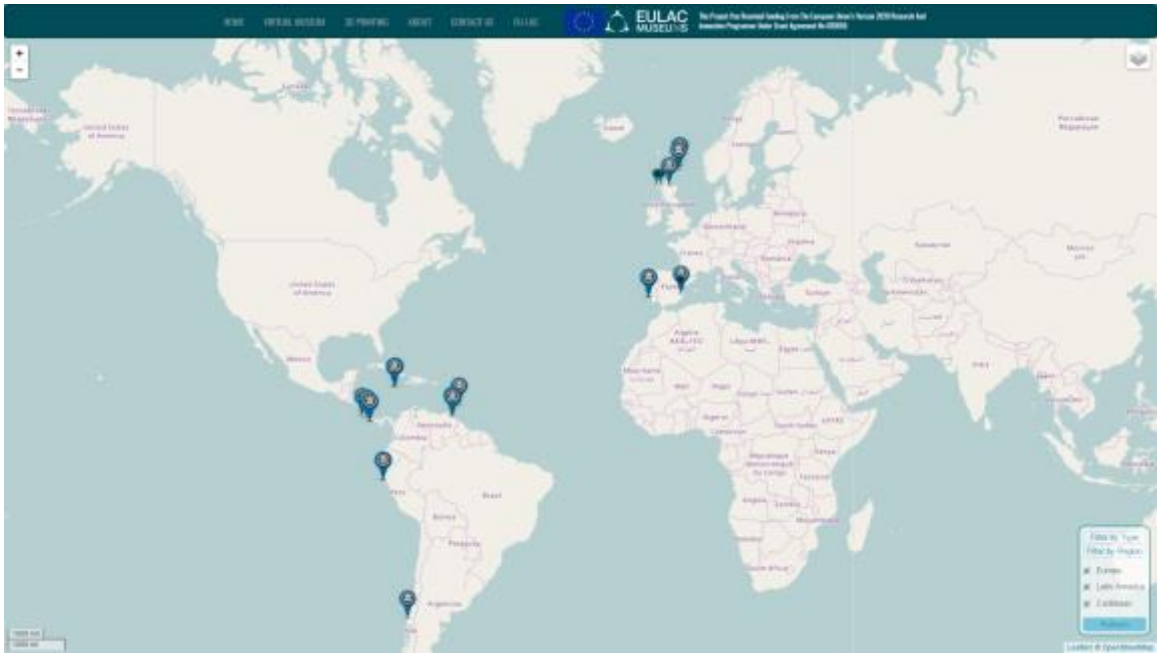

Figure 34. EU-LAC 3D Map interface

Virtual Museum Galleries
Virtual Museum Galleries and Resourceshttp://eu-lac.org/virtualmuseum/

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6.4 Virtual Artefacts

Museum objects are usually held behind glass display cases or locked away from the public eye in collection stores for their own preservation. Cultural items have stories that continue past the text panels within a museum, and often analysing the object allows for a deeper understanding of a culture. 3D digitization allows artefacts to not only be preserved digitally, but to carry on telling their culture's stories to an online audience eager to interact with them.

Social Archive of Digital Artefacts
Objects, following certain criteria, were selected by museum staff in each museum to either be 3D scanned or photogrammatised. Scanning can be done only if the necessary equipment is available, which lends photogrammetry to be the preferred affordable method in a remote community setting. Images are sent through open source software that creates a 3D file which then can be archived and uploaded to a social archiving site such as Sketchfab. As a social site, Sketchfab tracks a user's followers, views and comments. All digital objects appear in a player which can be embedded in websites easily.
Galleries of 3D Artefacts
http://eu-lac.org/virtualmuseum/digitalArtefacts.php

Figure 35. Huaco Rey Botella 3D model in Sketchfab (See Appendix 3)

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6.5 Virtual Tours

Figure 36. Virtual Tours on the EU-LAC Virtual Museum website

Imagine with just a few clicks of a mouse or through a virtual reality headset, a visitor could walk through the doors of a museum found in a lush rainforest of Costa Rica or tour a museum amidst the dramatic backdrop of the Shetland Islands in Scotland. Virtual tours of cultural museums allow first time visitors to explore new cultures as well as enabling previous residents to revisit and explore their family's past.

Gallery of 360 Tourshttp://eu-lac.org/virtualmuseum/virtualTour.php
Using the social archiving site RoundMe, 360 degree photographs taken through museums are linked together creating an immersive tour. The site allows hotspots to be added within the scenes, which can handle text, audio, images and video. The finished tour is embedded into a website or viewed through the Round.Me site. The player has the functionality for virtual reality viewing on compatible mobile phones. The archiving site also takes in analysis of views, followers and comments so basic visitor data can be quantified.
360 Tours Social Archive
https://roundme.com/@eulac3d/tours

6.6 Wiki

A wiki facilitates collaborative work and revision about a topic online. Text, images and embedded videos were added for each artefact. With every object uploaded to the Virtual Museum, a wiki page was created which then can be edited by museum staff, volunteers and community members. Cultural materials are often stories of a collective people, offering numerous and varied insights and knowledge. By generating a wiki, all members of a community add their knowledge to an object's narrative that can be discovered by anyone online.
Project Wiki

This project has received funding from the European Union's Horizon 2020 Research and innovation programme under grant agreement No 693669.

http://eu-lac.org/vmwiki/index.php/Main_Page

6.7 Active Virtual Museum

There are three ways in which the Virtual Museum provides support for content creation and use (Archive, Toolkits, Virtual Reality). Toolkits support data creation, an archive facility supports data handling and a virtual reality tool enables the creation of Virtual Reality. The framework is extensible enabling the addition of further support.

Archive

When a digital object's files have been uploaded to the Virtual Museum, the object was archived within the server and all original files were run through their respective software to create a 3D digital object. Even though software is widely available to convert digital files to 3D objects, the computer used needs to have enough processing power. All artefacts are accessible online to other museums, researchers and to the general online community. When an object was added, all information provided including the metadata follows the object through each process. This ensures a detailed description when the digital object was added to a collection within a social archiving site or the corresponding wiki.
Use this page to upload to the galleries and archives
http://eu-lac.org/virtualmuseum/memberpage.php

Toolkits

The Virtual Museum acts as a digital centre for all media that was produced by the workshops and by the museums and communities thereafter. In order to provide instruction after the workshops, toolkits researched and designed for community used by the USTAN 3D team are available on the website for self-guidance through every aspect of the Virtual Museum. The relevant software and app guides are also available through links that will take a user to the programmes home page.
3D Digitisation Toolkit
http://eu-lac.org/virtualmuseum/tutorial.php

Virtual Reality

Through the use of a mobile phone and a cardboard headset users are transported into the middle of a museum gallery, historic building or landscape. This resource supports the creation of virtual reality mobile applications. Users choose or upload photospheres and interpretation and arrange their sequence. With the app design completed the mobile app can then be generated and quickly made available for download.to users phones.
Build your own 360 App

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7. Virtual Museum Architecture

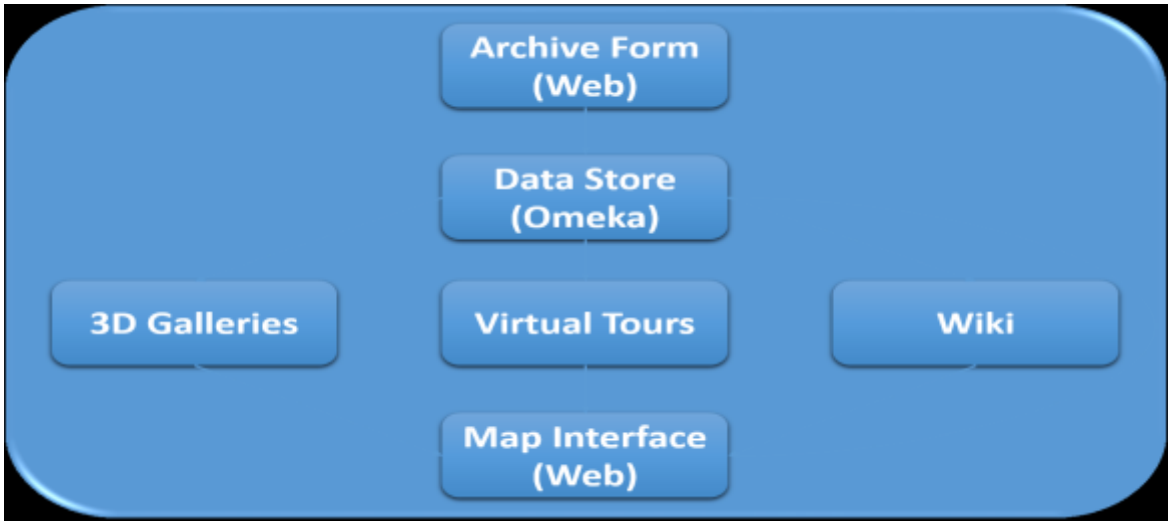

Figure 37. Virtual Museum Architecture

The Virtual Museum architecture is shown in the above Figure. A web-based archive form enables files upload supply metadata which together represent and describe entities that are presented to users on a map-based interface. Data supplied using the archive form are stored in a back-end Digital Asset Management System, implemented using Omeka, and the data are categorised by entity type. For clarity, Figure Architecture shows only the 3D galleries, virtual tours and wikis as entities which are stored in the Omeka data store and presented on the map interface. However, the 3D galleries are made up of 3D artefacts, and virtual tours are made up of photospheres, and other entity types include audio, flat (2D and 3D video), flat (2D and 3D) images, and museums which represent the top level entity of the Virtual Museum.

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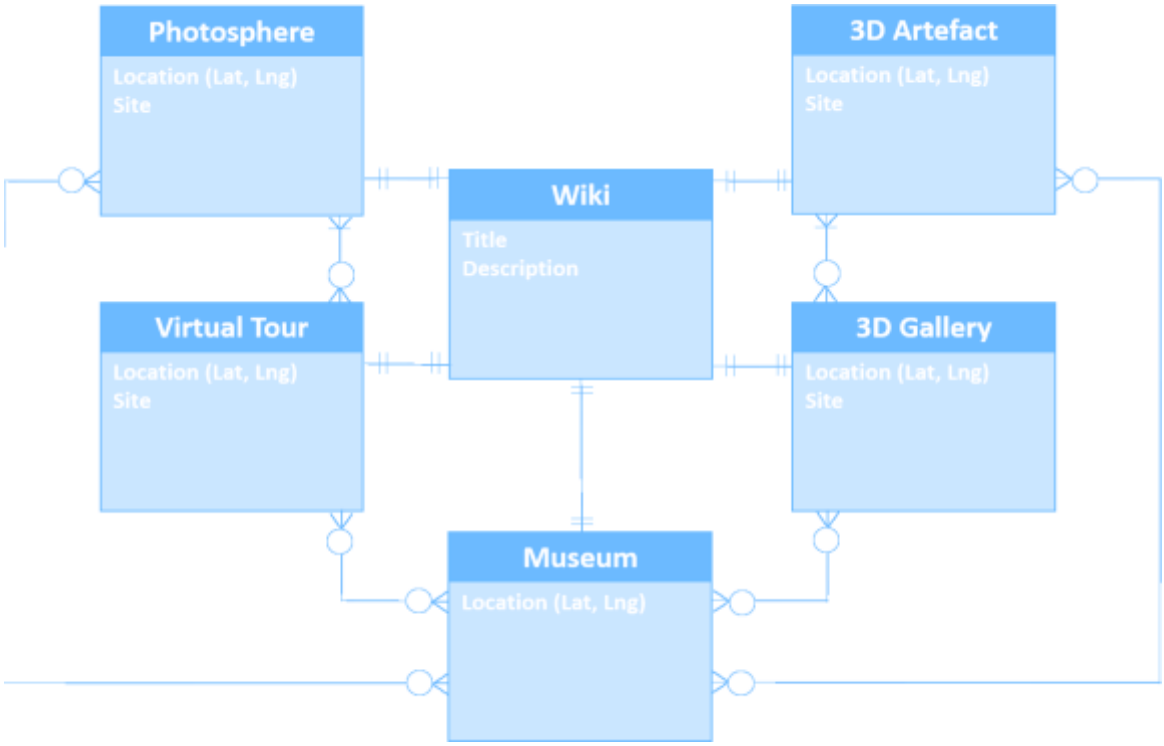

Figure 38. Entity Relationship

An entity relationship diagram which depicts how the content of the Virtual Museum fit together is shown in the above Figure.

Photospheres are used to depict locations to enable users to undertake remote tours of places that they plan to visit (in anticipation), or places that they have visited (in reminiscence or recollection) or places that they are unable to visit (in substitution). One or more photospheres grouped together by a common theme (such as location or likeness) make a virtual tour, and each photosphere can belong to more than one virtual tour or none at all, hence this relationship is represented as a “many to many” association (one to many [photospheres] and zero to many [virtual tours]). Zero or more virtual tours may be associated with a museum (or other organisation) which represents the top level entity of the Virtual Museum. This implies that each virtual tour may be associated with one or more museums or none at all hence this relationship is represented as a “many to many” association (zero to many [virtual tours] and zero to many [museums]). In addition, photospheres (whether they are

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part of virtual tours or otherwise) can also be associated with museums in a “many to many” manner (zero to many [photospheres] and zero to many [museums]). 3D artefacts are used to depict digital representations of physical artefacts or objects of interest.

One or more of these 3D artefacts, grouped together (by location, provenance or composition) make a 3D gallery and each 3D artefact can belong to more than one 3D gallery or none at all, hence this relationship is represented as a “many to many” association (one to many [3D artefacts] and zero to many [3D galleries]). Zero or more 3D galleries may be associated with a museum. This implies that each 3D gallery may be associated with one or more museums or none at all hence this relationship is represented as a “many to many” association (zero to many [3D galleries] and zero to many [museums]). In addition, 3D artefacts (whether they are part of 3D galleries or otherwise) can also be associated with museums in a “many to many” manner (zero to many [3D artefacts] and zero to many [museums]).

Each entity in the Virtual Museum has an associated Wiki entry which describes the entity with the text and metadata supplied using the archive form. Irrespective of type, each entity has one and only one Wiki entry, however, the Wiki entry of an entity may refer (or link) to the Wiki entry of another entity (for example, a museum’s Wiki entry may refer to the Wiki entry of a 3D gallery associated with the museum, or a 3D gallery’s Wiki entry may refer to the Wiki entry of a 3D artefact associated with the 3D gallery). This implies a one to one relationship between an entity instance and a Wiki entry (one and only one [entity instance] and one and only one [Wiki entry].

8. Virtual Museum Implementation

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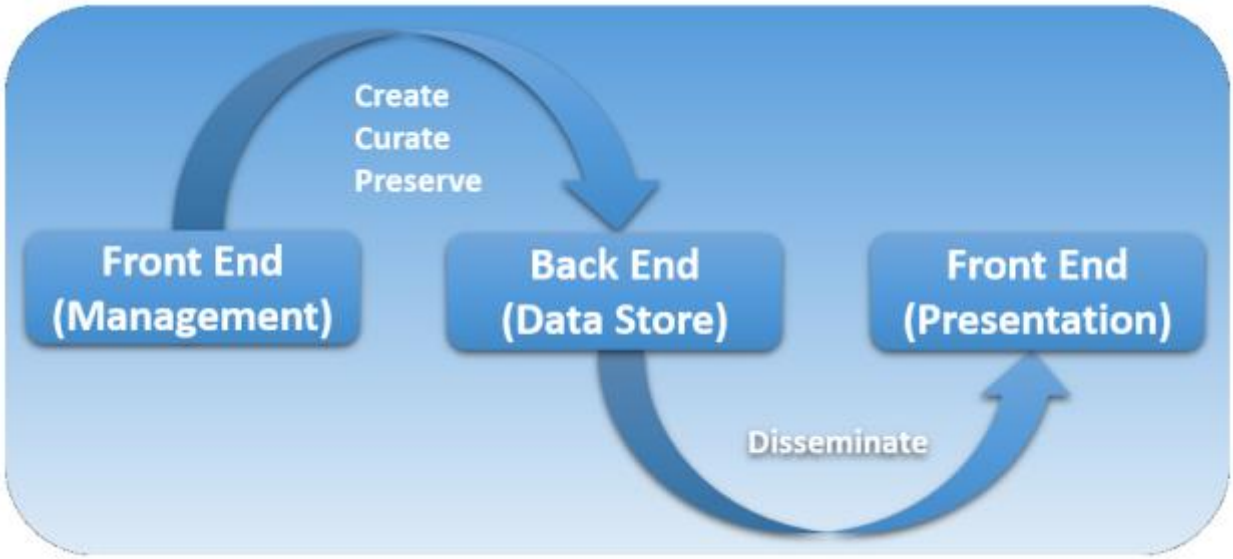

Figure 39. Virtual Museum Components

The Virtual Museum has been implemented using a variety of technologies – web platforms, mobile platforms, virtual reality headsets, and a Digital Asset Management System (DAMS). The Virtual Museum features a back end which stores and organises data, a management front end which enables updating the data, a presentation front end which enables interacting with the data, and an integrated workflow by which the system components communicate.

Back End

The Virtual Museum back end is implemented as a free and open source Digital Asset Management System (DAMS) using Omeka. The DAMS provides interoperability with popular web-based system and frameworks, and is supported by a Relational Database Management System (RDBMS) which stores the data, and a Representational State Transfer (ReST) Application Programmable Interface (API) which facilitates retrieving, modifying and adding to the data. Within the Virtual Museum, calls to the Omeka API are made using Javascript (from the presentation front end) and Python (from the management front end). The code snippet above shows a Javascript function that can be used to retrieve the items in the Omeka repository using an AJAX call. Upon successful completion of the call, a "json_response" object is received, which contains the result of the call in JSON

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format, and is then parsed as required by the “parse_data” function. If the AJAX call fails or time outs, an error is thrown instead.

The Virtual Museum *front end* has a presentation interface which is implemented as a map-based interface and a management front end which is implemented as a web-based form.

The presentation front end – implemented as a map interface – features icon-coded pins which represent entities in the VM, such that users can click on a pin to reveal a popup for viewing or interacting with the item. The map interface logic is implemented in Javascript and uses “GET” Asynchronous Javascript and XML (AJAX) requests to the Omeka. API to retrieve data in Javascript Object Notation (JSON) format.

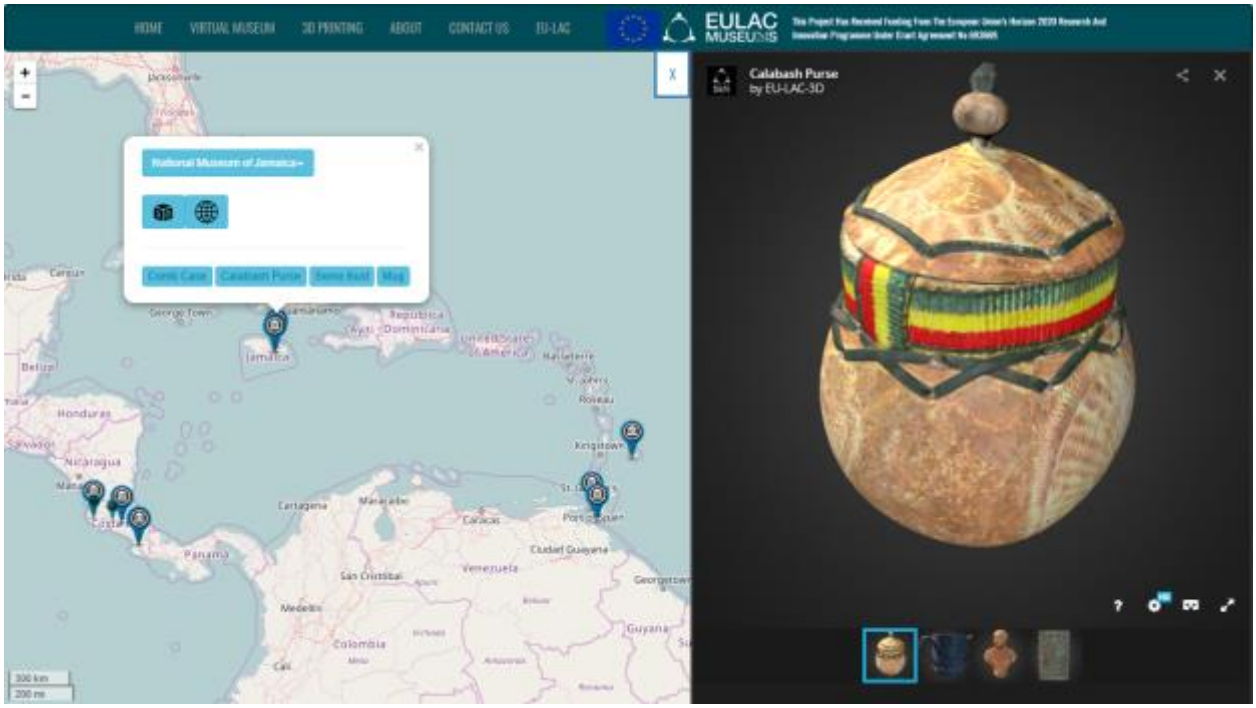

Figure 40. Map pop up

The JSON data is then parsed, which involves identifying distinct entities, categorising them by type and applying type-specific rendering. It is pertinent to note that the rendering of items depends on the information available. For instance,

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items without any location specific information are not rendered on the map because of the requirement of latitude and longitude coordinates.

An interactive map of the world enables the visualisation of the spatial and geographical relationships between entities. It also enables users to view entities by region. For example, users can view entities associated with the Caribbean only, or entities only found in Europe, or Latin America only, or a combination of these regions. This selective geographical visualisation is implemented using a bounding box model. For each identified region, four pairs of latitude and longitude coordinates are used to represent the four corners of an imaginary box. Users can select or deselect regions using checkboxes on the map interface. When data is requested from the back end and before the entities are rendered on the map interface, an algorithm checks if each entity's coordinates fit into the bounding box defined by any selected regions. An entity will only be rendered on the map if it is found to be within a selected region. In addition to a region selector, the map interface features a panel that enables users to view content by type by selecting or deselecting checkboxes. This facilitates the categorical visualisation of data, such that users can choose to view only museums, 3D artefacts.

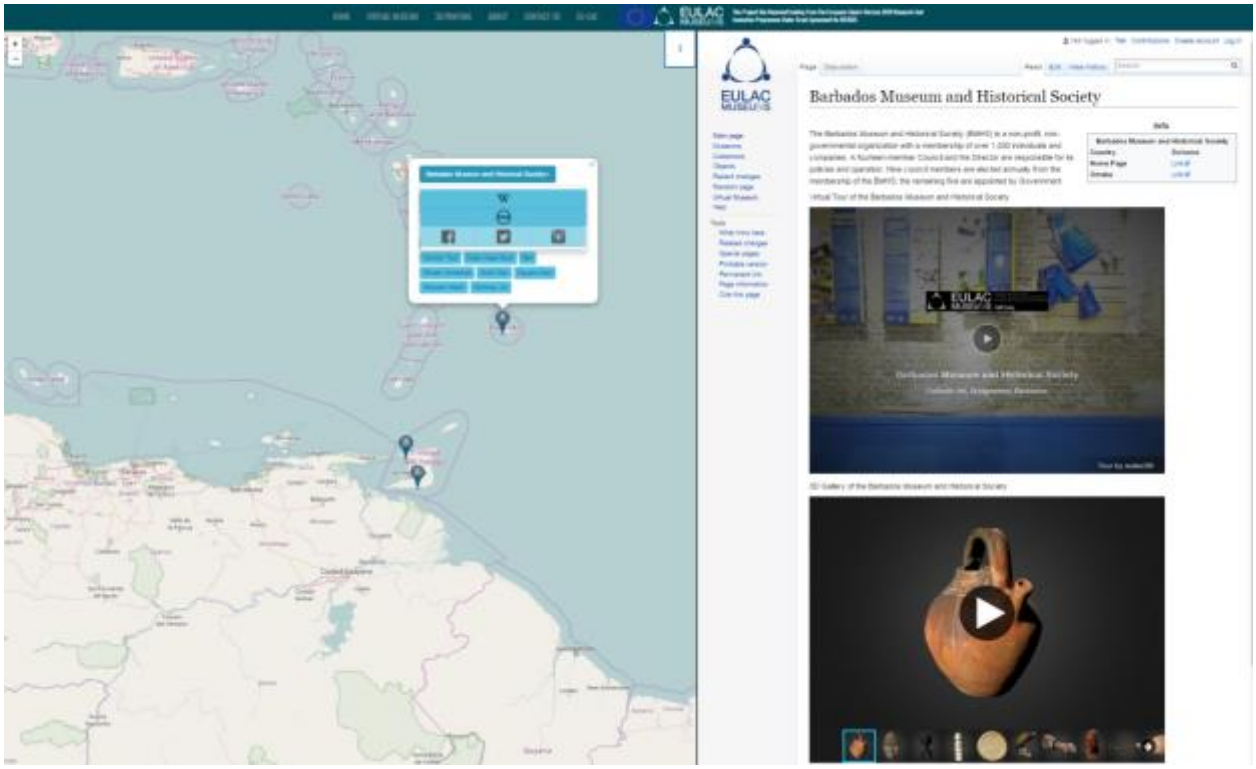

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Figure 41. Viewing Wiki Content on the VM map interface

Tours, images, or any of the other entity types become available, and any combination of these types. In addition to the geographical and categorical visualisation of content, the Virtual Museum supports descriptive visualisation of content using a Wiki which collates the metadata that has been provided for each entity using the management interface. The Wiki is displayed in a panel alongside the map interface and it features any descriptive text and data that has been provided, as well as any associated multimedia in form of 3D artefacts, virtual tours, images or video. A fourth type of visualisation supported by the Virtual Museum is exploratory visualisation, which is facilitated using an instant search feature that enables users to query the data store for entities that match a given search string. The search type implemented is a “contains search” (as opposed to a “starts with search”) to increase the relevance of the results obtained, and the search is performed instantly on the title and description fields of entities, such that the results are updated after every keypress that modifies the query string. The instant search is facilitated by locally storing representations of the entities contained in the data store so as to preclude the need to repeatedly access the server while searching for entities. The exploratory search feature also integrates with the other visualisation paradigms in the system so that users can visualise the results geographically by viewing an entity’s location on the map, descriptively by viewing the Wiki content for the entity and categorically by viewing type-specific information for the entity.

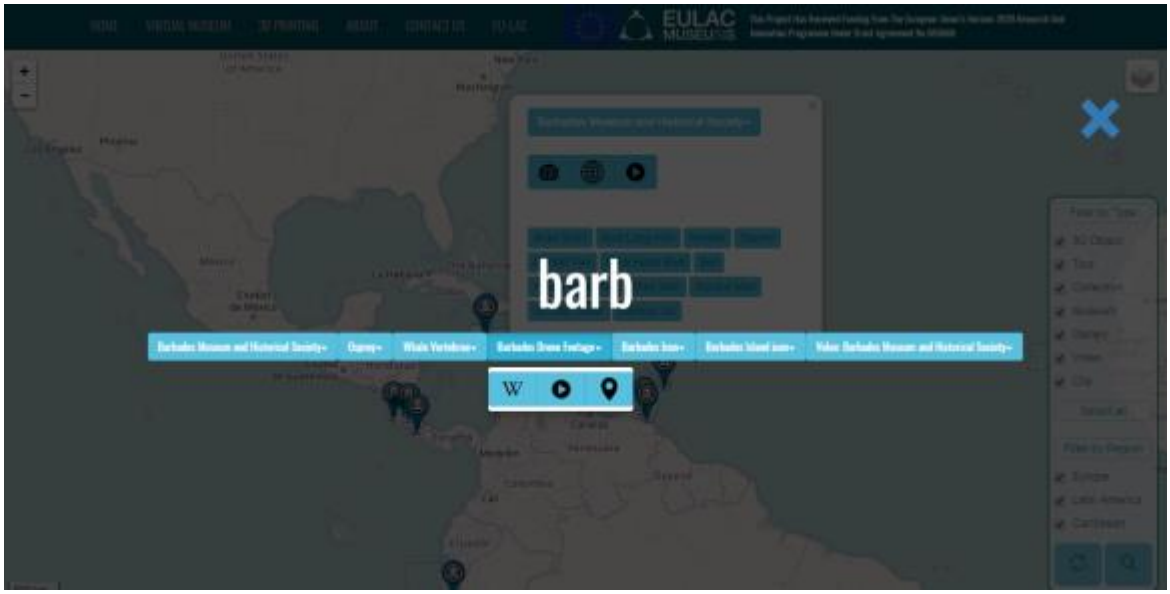

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Figure 42. Searching on the map interface

These features work together to facilitate the visualisation of heritage content in four ways: geographical, categorical, descriptive and exploratory, thus providing breadth and depth in the dissemination of, and engagement with heritage content, as well as satisfying the information-seeking needs of virtual museum users.

The management front end is implemented as a web-based form which contributors fill to supply metadata about entities. It uses “POST” calls to the Omeka API to update the information in the database. The form is implemented using HTML5 (with Javascript for client-side data validation), and posts submitted data to Python scripts which call the Omeka API.

The exploratory search feature also integrates with the other visualisation paradigms in the system so that users can visualise the results geographically by viewing an entity’s location on the map, descriptively by viewing the Wiki content for the entity and categorically by viewing type-specific information for the entity. These features work together to facilitate the visualisation of heritage content in four ways: geographical, categorical, descriptive and exploratory, thus providing breadth and depth in the dissemination of, and engagement with heritage content, as well as satisfying the information-seeking needs of virtual museum users. The management front end is implemented as a web-based form which contributors fill to supply meta data about entities. It uses “POST” calls to the Omeka API to update the information in the database. The form is implemented using HTML5 (with Javascript for client-side data validation), and posts submitted data to Python scripts which call the Omeka API.

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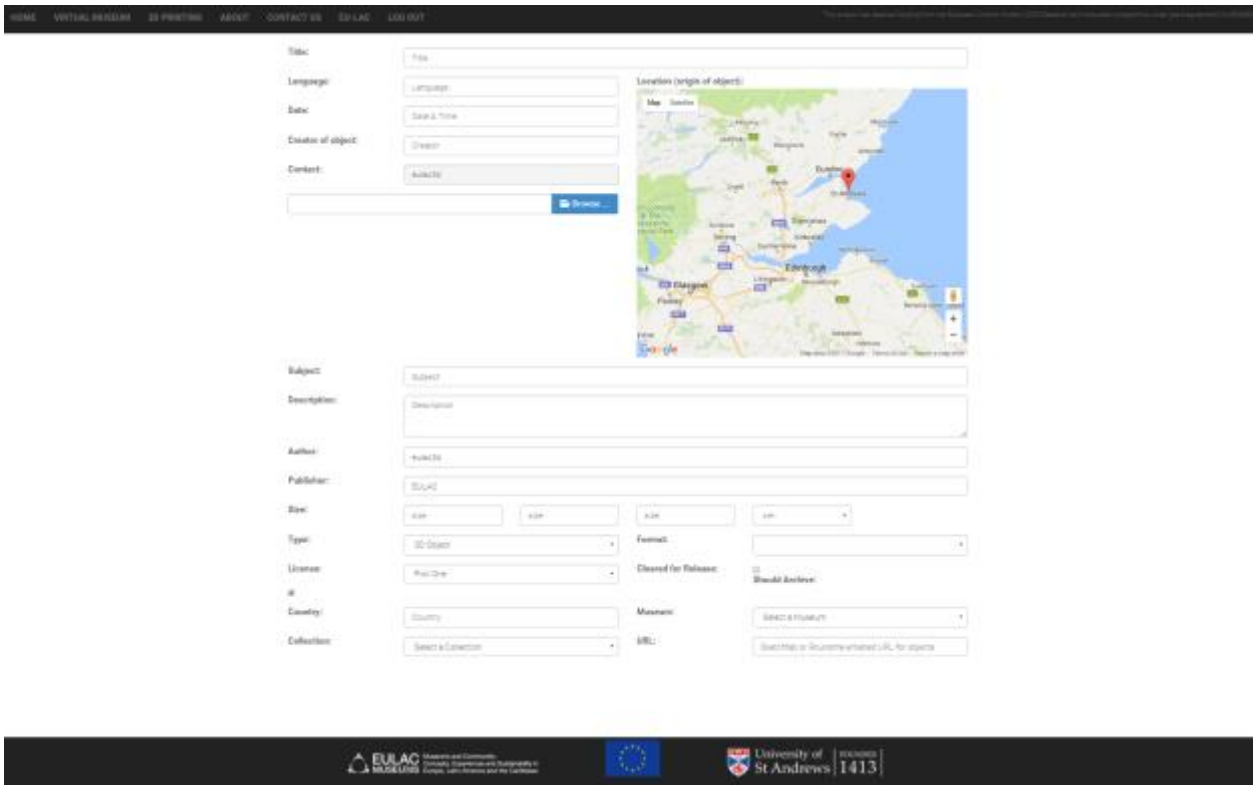

Figure 43. Upload and Metadata form

Data Management

To our knowledge, there is no ubiquetous industry schema or language for categorising and labelling meta data in the cultural heritage domain. Many schemas exist, but no one of these (or any other) schema has been universally adopted by all stakeholders in the field. This has resulted in problems with interoperability (or none at all in extreme cases) between systems for cataloguing, archiving, managing and/or disseminating heritage. The Dublin Core schema was proposed as a solution to this challenge to describe digital resources based on a set of terms, and the vocabulary applies to digital resources, irrespective of domain. The Europeana Data Model (EDM) builds on the Dublin Core schema and is widely adopted across (Europe) hence it boasts a high level of familiarity with heritage practitioners. For this reason, information provided using the management front end is mapped to Europeana types (which are in turn described based on Dublin Core terms) so as to utilise the existing literacies and improve interoperability with existing systems.

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EU-LAC-MUSEUMS
DELIVERABLE D.4.2

PART III Reflections
SWOT Analysis and suggestions for future work

9. Reflections, SWOT Analysis and suggestions for future work

A community museum represents social history of a community often based in a locality. It connects the objects in its collections with the history and life of the community that is part of. In doing so there is the potential for active community participation in the creation of the museum, creation of its collections and curation of its exhibits.

Community museums vary significantly in size and resource. However, their location is often remote and resources modest, meaning that they tend to be more vulnerable to the effects of climate change than large subject based museums. The connection to the Internet may be absent, unreliable or slow often ruling out direct use of Internet based digital resources in museum exhibits and exhibitions.

The close engagement between the museum and the community means they have the potential to both develop and leverage the digital resources and literacies of community members in taking forward the life of the community museum. A focus on defining the cultural heritage of a particular community brings with it the possibility of sharing and connecting with other communities thereby creating direct linkages and mutual understandings that would not be possible through traditional media communications.

An important challenge associated with community museums is a variation in the availability of resources and infrastructure required to support the day-to-day operations of the museum. This may range from the presence of adequate infrastructure to a paucity or altogether absence of infrastructure in the worst case. The latter may be attributed to the nature of community museums, which are set-up and run by closely-knit teams of trustees and local members who volunteer their time and resources in the day-to-day operations of the museum. These resources include the digital literacies of the local members; specifically the ownership of smartphones and tablets as well as a concomitant proficiency in utilising these devices to perform day-to-day tasks. This represents an opportunity in the sense that a virtual museum infrastructure can be designed to leverage these digital literacies thus overcoming the aforementioned infrastructural challenge.

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9.1 SWOT Analysis

Strengths
The workshops were able to create learning spaces which both enabled the facilitators to share their understanding, and the participants to share their expertise with each other. This approach in turn encouraged the developments of connections and community between workshop participants.

We found that it was possible to create an effective photography studio for photogrammetry on a budget and that the processes of object selection and capture of images were easy to learn. The hands-on approach to learning was central to the process and was made possible by holding full day workshops. Local content was used to illustrate the processes being taught. The relevance of the objects, locations and stories made it easier for participants to play an active role, it led to their engagement in the process, and developed their collective understanding of local heritage.

During the workshops, participants and instructors worked together to create digital outputs of value to the museum and community. These were agreed locally to ensure relevance and value. This in turn lead to both a commitment by participants to engagement in the workshop, and to the creation of high-quality digital outputs representing local heritage on the global stage. This generated enthusiastic engagement in the workshop process, leading to more transfer of knowledge and skills. It ultimately contributed to an overall satisfaction with the 3D workshops, as expressed generally from the participants and in recorded feedback.

The workshops themselves were highly adaptable and catered to the skillset and interest of the attendees. For each museum, time was spent with staff and participants introducing the technologies and assessing their interest and technical skill sets. In certain cases, after learning a certain direction the participants wished to take the workshop, the schedule for the morning and afternoon programmes were reversed. The development and use of a virtual museum framework provided support for all stages of the media lifecycle, It enabled content to be automatically disseminated to multiple contexts of web, wiki, mobile and installations extending the reach and depth of impact. It also providedes a platform to support ongoing engagement and dissemination. Due to the overall satisfaction and enthusiasm received after the workshops concluded, there was an increase in cooperation and commitment to the project by partners across continents. The workshops facilitated bi-regional integration by allowing other museums to collaborate to generate and share digital content online.

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There was a consistently high level of satisfaction with the workshops by participants and stakeholders. Engagement and participation were high throughout and feedback positive. Creating models from content captured within the workshops has enabled a significant library of EU-LAC digital artefacts to be created.

Weaknesses
This section contains some reflections on challenges encountered and lessons learnt during the workshops.

1) There was wide variation in digital infrastructure and skills of participants.
2) Some artefacts that communities requested to have digitised were difficult to successfully apply photogrammetric processes to.
3) The creation of meta data to provide context and description was challenging.
4) The duration of the workshops made it challenging to reach all learning goals.

The wide variation in Internet connectivity meant that it was often difficult to use the virtual museum within the community museum. The Virtual Museum acted as a platform for the dissemination of outputs. However, in some museums its full potential in supporting the workshops, in providing local exhibitions and supporting ongoing local was not always realised.

It was difficult to set up local participants to be confident in continuing to museum-grade digital models after the workshops had finished. More time was required to fully train participants in the software side of the processes. This was often aggravated by the absence of local computers appropriate for photogrammetry as well as the weakness and inaccessibility of cloud based solutions.

The timescales required to process models made it impractical to go through the full lifecycle of model creation live within the workshops. To become proficient in photogrammetry it is necessary to go through this lifecycle a number of times. Thus it was not possible to complete this learning process during the workshop and local resources were not always available to participants after the workshop.

Learning to use the photogrammetry software in itself posed a challenge for the workshops. We aimed to provide enough of an overview for participants to understand what needed to be done and equip them to continue the learning process after the workshop.

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None of these challenges are insurmountable and are likely to become less severe as computer systems become cheaper and more powerful and network infrastructure develops. They can be seen as a consequence of pushing the enveloppe of what can be achieved within community museums. Furthermore, These challenges are addressed in part by the Virtual Museum infrastructure, which enables the upload of photographs as well as the automatic creation and dissemination of models.

Figure 44. EU-LAC-MUSEUMS Postdoctoral Research Fellow, Dr Iain Oliver processes a digital model into 3D software

Opportunities
Opportunities arise from the development and spread of technologies combined with their accompanying digital literacies. The workshops have revealed both a hunger and an eagerness to engage with emergent technologies for the

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preservations and communication of heritage. This presents the following opportunities:

1) The widespread dissemination of inaccessible heritage through its digitisation, and communication.
2) Putting communities and their museums in control of the digital curation of their heritage, whilst opening new possibilities for its communication.
3) Through community heritage being part of a global virtual museum framework, direct communication is made possible with other museums participating in the Virtual Museum.
4) Connection between communities and their museums can be strengthened and enriched by making use of and developing existing digital literacies and digital infrastructures.
5) Increasing intergenerational communication, through parallel and integrated engagement with technology and heritage.

These opportunities can be addressed through two areas for future work, which will enable the potential of emergent technologies to be properly realised.

Two areas should be addressed further:

- The development of skills in transforming sets of photographs into models through software processes.

- The further development of a Virtual Museum infrastructure, which provides both global access over the Internet and a low cost local Virtual Museum node to support local work.

Threats
We identify three types of threats to realisation of the potential of the work described in this deliverable:

1) The threats of climate change, war and environmental degradation to cultural heritage mean that the subjects of the digitisation process are themselves under threat. Digitisation provides protection in the form of recording the current state of artefacts, buildings and landscapes.
2) The unevenness of digital infrastructures and digital literacies means that in the absence of intervention the opportunities identified above are unlikely to be fully realised. Resource is required in order to provide further training and equipment. In the absence of follow help it may seem that the workshops

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provided helped develop potential but there long term impact on the day to day activities of community museums is limited.

3) Lack of awareness raising of the capabilities of digital heritage and bi-regional cooperation would threaten the impact that it can have.

Each of these threats can be addressed. Digitisation of heritage resources can be carried out, the case for further funds to follow up and develop the work of the workshops can be made secured and the digital work integrated into the wider project work.

Progress is already being made in each of these directions. Workshop participants and facilitators are continuing their digitisation work, the University of st Andrews has awarded a PhD studentship to develop the Virtual Museum work, which can run parallel with the project and the development of a Virtual Museum of the Caribbean will feature in future project work.

9.2 Suggestions for Future Work

Here we propose three areas for future work. For the potential of emergent technologies to be properly realised three areas should be addressed further:

1) The development of skills in transforming sets of photographs into models through software processes.
2) The further development of a virtual museum infrastructure, which provides both global access over the Internet and a low cost local virtual museum node to support local work.
3) Promotion of the achievements of this work will enable others to take a similar approach with similar benefits, integration of the digital with other areas of work will enable the benefits to be rrealised throughout the project.

Design for Development of Virtual Museum Infrastructure

The vulnerabilities of community museums, the participation of community and potential for developing understanding through sharing are important factors in deciding on design priorities. Based upon the experience of working with community museums and preliminary research we suggest the need for a design which enables the following requirements to be met:

1. Digital preservation of the state of natural and cultural heritage.
2. Provision of engaging immersive exhibits, accessible locally and globally.

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3. Support community participation in the creation and curation of digital heritage.
4. Be affordable through the efficient use of commodity devices.
5. Integrate with existing museum and community digital infrastructures.
6. Connect communities through enabling digital sharing of heritage.

These requirements are in part motivated by the observation that a digital museum for preservation should integrate explicit preservation activities with a system that supports the day to day activities of a museum. This fits with the conception of an active Virtual Museum, which encourages participation and contribution by different stakeholders.

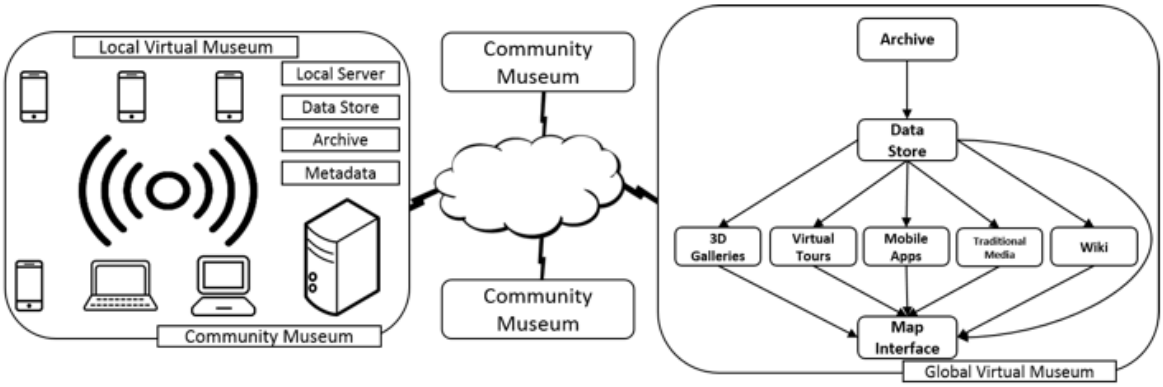

Figure 45. Museum Infrastructure Graph: The Virtual Museum and the Community Museum

Figure 45 illustrates in the left hand side a local museum setting, into which can be inserted a device which overcomes the weakness of the local digital infrastructure and reliability of internet connectivity in a remote setting. The middle of the diagram illustrates the internet connecting to the right hand side illustrating the Virtual Museum created in the global EU-LAC-MUSEUMS project.

These goals can be achieved through a virtual museum infrastructure that connects community museums, provides archive facilities and enables access to immersive exhibits and exhibitions.

Based on the experience of research developed through the EU-LAC-MUSEUMS Virtual Museum project in remote areas of Europe, Latin America and the Caribbean, we have developed a prototype for an architecture which consists of a

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local virtual museum in each community museum and a global component they connect via the Internet.

Within this architecture, each community museum would in theory have a local system that provides responsive services and connection to the Internet. The local system would be accessible through its own WiFi access point that will enable mobile phones and computers to connect to its resources. It will have local storage that will contain an archive of media and interpretation, described through metadata. Web and app services will support both management of the archive and the presentation of exhibits. A synchronization, upload and download service will support connection to the Internet based global virtual museum. If and when developed, it would enable the reliable exchange of data even when the Community Museum has slow, unreliable or even non-existent Internet connections.

The internet Virtual Museum will consist of the following components: a digital archive that holds resources from all the community museums that are associated with it; metadata provides context for the media, enable semantic searches and integration with aggregators such as Europeana. Support for global exhibits and connections with mapping solutions and social archive sites such as Sketchfab for 3D objects and RoundMe for 360 degree media will contribute to preservation through promotion.

A local virtual museum will be physically located within each community museum in the network. Local servers will enable resources in the data store to be accessed within the museum and its environs. It will provide the following functionality:

1. Local access to immersive and 3D exhibits on mobile phones or laptops.
2. Support for community engagement in digitization processes.
3. Support that makes it easy for communities to create interpretation and meta data.
4. A searchable archive that holds and organises digital media locally.
5. An integrated WiFi access point to enable access from existing digital infrastructure.
6. Connection with a global archive and peer community museums.

The Virtual Museum combines media types through local web interfaces which create a rich and varied experience for users. Users can listen to oral histories (such as folk tales and ancient stories) or be guided around a site using audio narratives, users can undertake virtual tours of remote sites or compare the present and past states of a local site using spherical photos and videos. Curators and conservators can combine digital representations of artefacts with interpretation, enabling users

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to explore and inspect these 3D artefacts remotely using their mobile devices, text snippets can be collectively added by community members to describe entities using an integrated wiki, and the resulting wiki articles are available to consumers to add information and context to their experiences while interacting with said entities.

What would be involved in the digitisation and how would the heritage be digitised? We propose digitising physical museum artefacts using technology already in people's pockets and inexpensive technologies such as smartphones and digital cameras. Using cameras and free software, 3D replicas of objects can be created using photogrammetry, and these 3D artefacts can be disseminated over the Internet, making them accessible on websites and on mobile apps.

Smartphones can be used to capture spherical photos which can be used to make virtual tours. These virtual tours can facilitate remote exploration of sites, and coupled with cheap virtual reality headsets (such as the Google Cardboard), immersive experiences can be provided to users. Audio recordings can be used for preserving oral histories such as stories, folklores and tales, while video recordings can be used for guided tours or as part of remote virtual tours. This digital content will be described and curated using a crowdsourcing approach to metadata creation, such that community members and heritage practitioners alike can contribute to the description of digital entities. A web-based archive form will make it easy to upload metadata which, together represent and describe entities that are presented to users. Data supplied using the archive form are stored locally in a back-end Digital Asset Management System, and the data are categorised by entity type.

The local system provides a data store to the community museum digital media archive and a selection of resources from other community museums. Holding resources locally will enable provision of a high-quality web service with bespoke web and mobile applications to address digitization, description, archives and exhibitions. The 3D galleries are made up of 3D artefacts, and virtual tours are made up of photospheres, and in addition to these, other entity types include audio, flat (2D and 3D video), flat (2D and 3D) images, and museums which represent the top level entity. Web and app services will enable museums and their communities to use the phones and computers they already have and are familiar with to communicate with digital museum. An interface also connects the museum to the Internet and enables museums to upload and download resources to a global data store. Synchronization between local and global archives will enable global reach to be achieved, but not require high speed wide area connectivity.

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Workshops and Skill Development

A lot of progress has been made in one and two day workshops. However, follow on workshops which developed self sustaining centres for photogrammetry would be of great benefit. It is desirable to have training over a longer period of time. This could take several forms, for example distance learning or support for self learning. However, we suggest that an intensive course lasting a week would equip the participants to take their skills back into the communities and museums. Run well, these courses could create a layer of facilitators who would be able to make a long term difference in the network of museums that they are based. These workshops could be run on a regional or national basis and be based in locations connected with networks of community museums.

These workshops should be combined with the provision of equipment suitable for carrying out photogrammetry work locally, including computers of sufficient power to process complex models.

10. Conclusion

This report has outlined the activities and outputs which meets WP4 D4.2 Report on 3D Workshops.

St Andrews has facilitated and lead workshops in community museums in all the countries participating in the project with the exception of France (ICOM International being the Legal Entity Beneficiary whose task is primarily dissemination). In each of the workshops family and community members learned how to create digital 3D artefacts and spherical photographs. This work was supported through the creation of a Virtual Museum infrastructure, which both showcases the content created in the workshops and supports the creation of more content for by community members.

By virtue of the 3D workshops conducted, the community members are now equipped with the skills required to digitise artefacts (via photogrammetry), capture spherical media (via photospheres) and document intangible heritage (via audio and video recordings) using commodity devices. These museums can now digitally curate, preserve and disseminate their heritage. The provision of the new and improved virtual museum infrastructure will ensure that the content produced by these museums can be consumed in-house and dispersed globally, thus interconnecting geographically-distant communities.

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We found that it was possible to create an effective photography studio for photogrammetry on a budget and that the processes of object selection and capture of images were easy to learn. The hands-on approach to learning was central to the process and was made possible by holding full day workshops.

One measure of the success of the workshops is the degree of engagement that occurred in the process and the participants perception of whether they benefited from participation. Throughout the workshops there was active engagement with questions contribution and participants were eager to engage in hands on activity. Feedback formal and informal has been positive. The first workshop was so well received that the program was expanded because of demand from partners not wanting to be left out.

However, there were several barriers for this process to continue after the workshops. These included the lack of an appropriate cloud based solution and infrastructure to support cloud applications. The absence of local computers and software to process photographs is also a barrier. The timescales required to process models made it impractical to create models during the workshops themselves, with much of the processing carried out after they had finished.

Teaching the use the photogrammetry software in itself posed a challenge for the workshops. We aimed to provide enough of an overview for participants to understand what needed to be done and equip them to continue the learning process after the workshop.

These challenging learning outcomes are addressed by the proposed future work. The development of Virtual Museum infrastructure, which connects a low-cost local nodes situated in community museums to the existing Virtual Museum infrastructure. Follow-on workshops could create self-sustaining centres for digital interpretation and enable the opportunities offered by new technologies and digital literacies to be realised.

The stakes are high. As we have demonstrated through the 3D Workshops and reflexive analysis, it is possible for community museums to engage with their communities in new and exciting ways, to tap into existing skills, and to develop new ones. The potential to promote heritage to new and expanding audiences exists, therefore creating a greater understanding of EU-LAC relations in an increasingly globalised and connected world.

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APPENDIX 1

Detailed accounts of three 3D Workshops

Three workshops are discussed in more detail to communicate better the workshop process.

a) An Account of the Charlestown, Jamaica 3D Workshops

3D workshops took place in the Maroons community in the Blue Mountains of Charlestown, Jamaica on the 17th of January 2017. The community museum was selected by the University of the West Indies for its remote location and its significance to the country's heritage. The community forms part of a UNESCO World Heritage Site.

Digitising artefacts: Several artefacts held in the community museum were selected and digitised to result in 3D representations of the artefacts and consequently 3D galleries. These artefacts were digitised using laser scanning and photogrammetry techniques.

Capturing spherical media: 360 degree images of both indoor and outdoor locations were captured for the purpose of making virtual tours of these locations. The locations included rooms in the community museum as well as the outdoor landscapes.

Capturing aerial footage: Aerial footage of the community was captured using a drone flown over the Asafu yard around the museum, the Blue Mountains and the community river. The process of capturing this footage was driven and directed by the locals.

Traditional dance: A dance session took place during which traditional beats were played using drums while the locals put on a display of their ancient festive dance techniques. Audio and video recordings of the dance techniques and traditional beats were captured as a means of digitising and preserving intangible heritage.

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APPENDIX 1 (CONTINUED)

Figure: School pupils participated in storytelling activities with local elders, and were recorded for inclusion in the Virtual Museum.

The workshops were designed to leverage the existing infrastructure and the community members' skillset. The community is equipped with an indoor museum which houses ancient artefacts. The indoor museum is surrounded by an outdoor yard with a shed and podium that is ideal for public/community events.

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APPENDIX 1 (CONTINUED)

It was observed that the community members possessed the skills and technical know-how required for photography. A significant number of community members had smartphones and/or tablets with which they could capture photos and videos. In addition, some community members possessed cameras and had experience with high-end photography equipment and media production. These skills in photography and media production were serendipitous in facilitating the workshop activities, namely the 3D digitisation of artefacts by shooting multiple overlapping images, the preservation of intangible heritage by recording footage of folk dances and the documentation of natural heritage by capturing aerial footage of the community mountains and rivers.

The Maroon Museum workshop conducted resulted in the following digital outputs:

3D galleries: Digital representations of the physical objects in the museum as a means of preserving and disseminating tangible heritage. The collection of the digitised artefacts resulted in the creation of novel 3D galleries. These 3D galleries are available online via SketchFab as well as through the EU-LAC MUSEUMS Virtual Museum, thus facilitating global access and (literally) putting the Maroons community heritage on the map.

Spherical media: 360 degree images and videos of the indoor museum and outdoor surroundings were captured, thus facilitating the creation and deployment of a virtual tour of the Maroons Community museum. This virtual tour is available online via SketchFab as well as through the EU-LAC MUSEUMS Virtual Museum, thus enabling the general public to partake in remote, virtual tours of the Maroons community without having to undertake physical travel.

Traditional multimedia: In addition to the spherical media, flat images and video were captured during the workshops. These included footage of folk dances, audio narratives and aerial footage of the community, all of which contribute to the preservation of intangible and natural heritage. Traditional multimedia is also available online via the virtual museum interface.

Conclusions: During the USTAN 3D workshops in the Maroons community of Charlestown, Jamaica, physical objects were digitised through photogrammetry and laser scanning, locations were captured for virtual tours, folk practices were

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APPENDIX 1 (CONTINUED)

preserved and intangible as well as natural heritage was documented. In the face of minimal physical infrastructure, the USTAN 3D workshop leveraged digital literacies

of community members hence equipping them with the skills required to digitise, preserve and disseminate local heritage on a global scale.

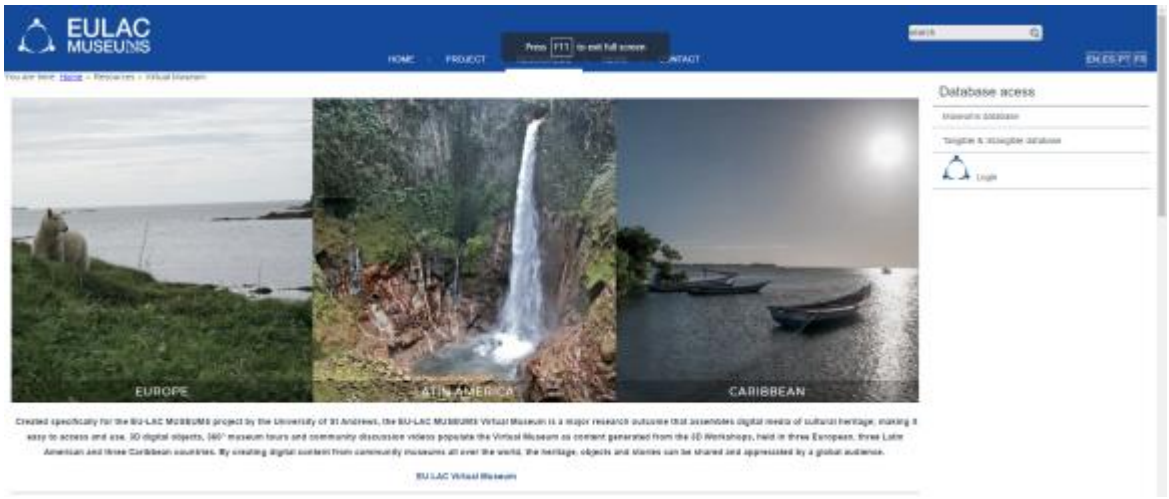

Figure: Project Website with Virtual Museum links.

http://www.eulacmuseums.net/index.php/resources/virtual-museum-2

The Social Archive of 22 Collections is hosted on Sketchfab here:

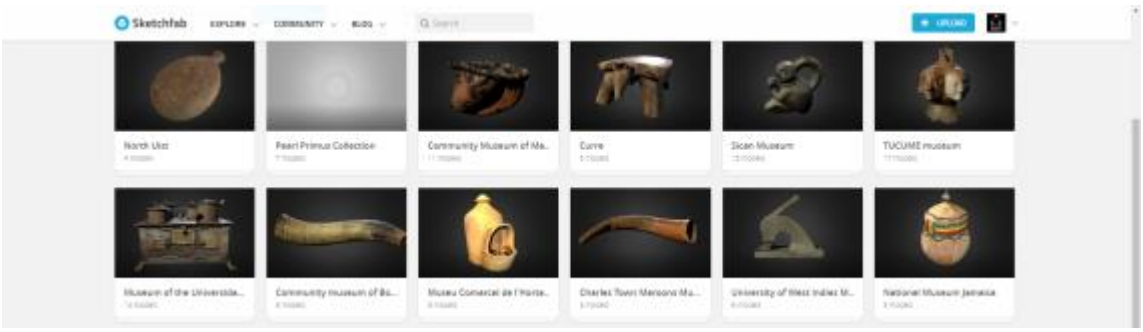

Figure: Collections of digital artefacts created in the workshops.

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https://sketchfab.com/eu-lac-3D/collections

APPENDIX 1 (CONTINUED)

The Social Archive of 27 Virtual Tours is hosted on Roundme.com here:

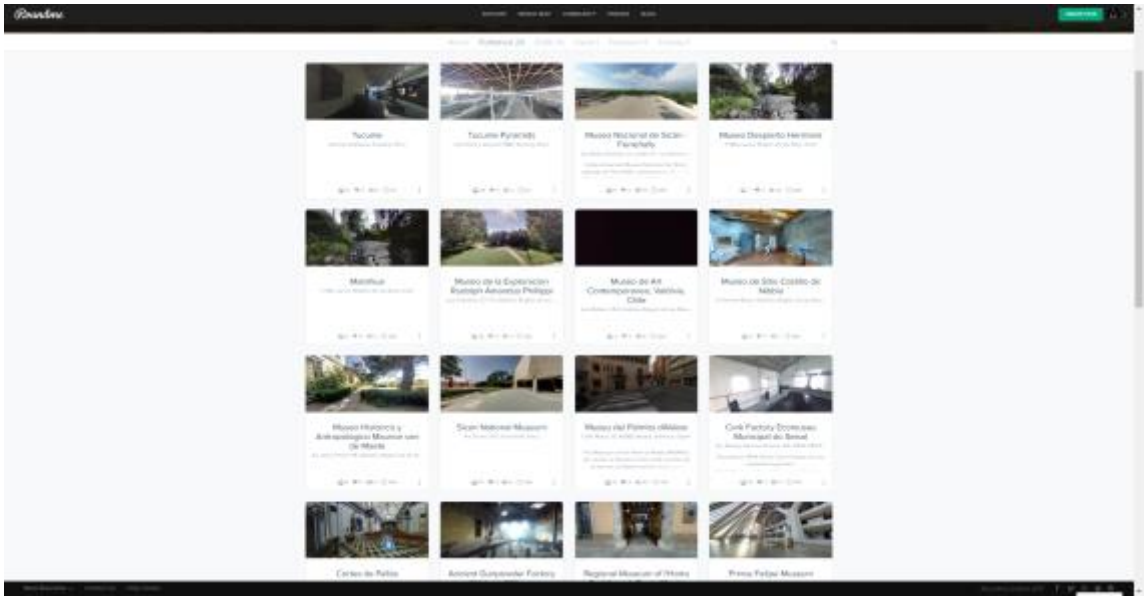

Figure: Collections of digital artefacts created in the workshops.

https://roundme.com/@eulac3d/tours

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APPENDIX 2

Figure: Example poster used to advertise workshops in Chile.

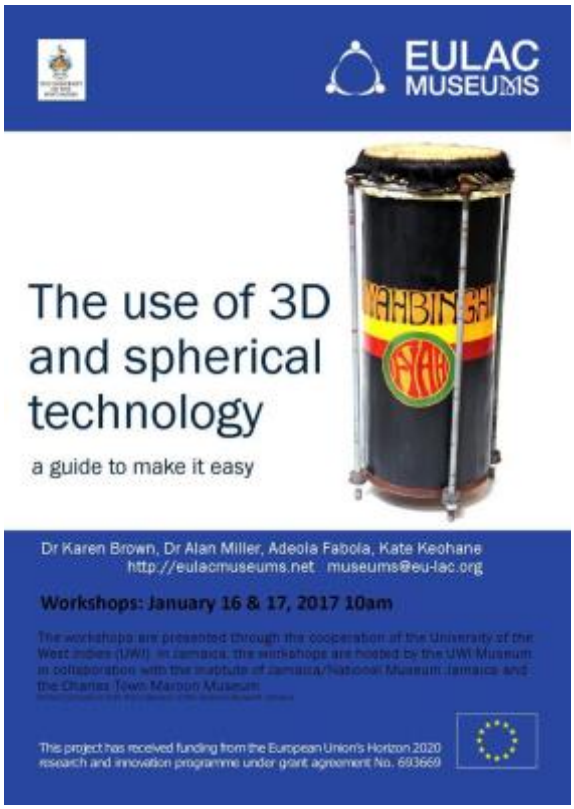

Figure: Example poster used to advertise workshops in Carribean.

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APPENDIX 3

Object Curation

Digitisation of an object makes it easy to edit, copy and share. It may be lit in different ways and be associated with interpretation. The digital artefact may add a new dimension to a physical exhibition, be presented in an online gallery, be embedded on a blog or shared through social media.

Sketchfab is a free site for hosting and sharing digital models. At the time of writing, museums that set up a Sketchfab account can apply for a free upgrade to a professional or business account. This increases the detail allowed in models and gives more control over how embedding works.

After uploading, there is a multitude of controls that enable professional presentation of the models. Most of the defaults are satisfactory, however we recommend choosing a black background for the model. If the model is too large it will may take a long time to load. Sketchfab recommend using less than a million faces, for big models this can be achieved by decimating the model in Meshlab.

https://help.sketchfab.com/hc/en-us/articles/205852789-MeshLab-Decimate-a-model

Once a model is uploaded it has been placed in one or more collections. There may already be models uploaded you would like to add to a collection as well. Models on Sketchfab can be easily shared on social media.

Figure: Huaco Rey Botella 3D model in Sketchfab

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APPENDIX 3 (CONTINUED)

Object Selection: The clay bottle is an example of a Huaco Rey which is typical to the Andean region of Peru, most commonly found in formal funerary burials. The object was a complete example of this pottery type, with little blemishes and was quite robust. The object was selected to digitise through the process of photogrammetry. The object was not reflective, had great details for reference points, some occlusion that could be covered through strategic photography angles, and could hold its shape and not roll when places on its side.

Equipment Selection: As photogrammetry was the chosen method of digitising for this object, the table top setup was needed. This included a lightbox with a single colour as a backdrop (black) and a matching turntable. Also required was a lighting setup that lit the object evenly with white light. A tripod was used along with a remote to reduce shake. A digital mirrorless SLR camera with manual settings along with 28-70mm full frame lens was used for digitising all objects for photogrammetry for the EU-LAC MUSEUMS project.

Process of Capture: As this object had a steady base that held it upright with a limited amount of shake, it was determined to begin photography with the object vertical. As the object has a barrel with an underside difficult to view, the first angle taken was low, projecting upwards under the object. The turntable was rotated 13 degrees, generating 25-30 images for the low angle. The tripod and camera was adjusted to the object's midline, taking another set of photos. The camera and tripod were adjusted again for a higher angle, adjusted to ensure the top surfaces of the object were in view. Another set of 25-30 images were taken at the higher angle. The object was then gently turned on its side, using the handle of the bottle to help balance it. The camera and tripod were adjusted again to a midline angle as to evenly photograph the bottom surface and very top that were hidden from view of the previous angles. Another set of photos were taken at this angle. It was then decided as a section of the barrel still had not been seen in the photograph, the object was turned to lean on the other side of the handle, still it's on it's side. The extra set of photographs of it turned on its side would ensure all surfaces were photographed. This concluded with over 150 images taken for the single object, but ensured a complete digital object.

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APPENDIX 3 (CONTINUED)

Model Creation: After returning from Latin America, all files for the object were evaluated for any pre-processing editing, such as colour correction, masking or omitting of duplicate images. After the images were approved, the files were uploaded in VisualSFM software and processed into a sparse cloud of points. At this

point, bad angles can be removed if the sparse cloud of the objects doesn't appear like the object. Once all angles have been approved, the object is processed into a dense cloud of points. The model file is then uploaded to Meshlab software for editing. At this stage, unwanted points are deleted to create a mesh of the object. The mesh was cleaned of any more points that had carried through the previous editing stages. After the mesh was approved, the colour textures were applied back to the object and saved as an .obj file type.

Archiving: The object files were archived locally on a server, including the original photographs, mesh files and final .obj file. All files are saved in an identifiable location under obvious file names, as for future research. The .obj was uploaded through the EU-LAC Virtual Museum Archive page, automatically uploading it to SketchFab with its associated metadata and generating a Wiki page. The object was saved in the Sicán National Museum collection in SketchFab and is searchable to the public.

Curation: After the object was uploaded to Sketchfab, the 3D settings were adjusted to best reflect the original likeness of the object. Lighting, alignment and object rendering were adjusted within the 3D settings. The metadata automatically uploaded was checked for its accuracy and was saved as a "Cultural Heritage" object and given the "eu-lac" hashtag to make the object searchable within SketchFab.

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APPENDIX 3 (CONTINUED)

Figure: Huaco Rey Botella in SketchFab 3D Settings

Huaco Rey Botella 3D object found here:
https://sketchfab.com/models/2fcda09f327e43ffa6aa3245655a2913

A video of exemplar objects digitised during 3D Workshops:
http://openvirtualworlds.org/cadam/eulac_objects.mp4

The link for the entire 3D Collections on SketchFab:
https://sketchfab.com/eu-lac-3D/collections

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APPENDIX 3 (CONTINUED)

Digital Tours

Figure: Photosphere of Unst Boat Haven, Shetland

The digital scenes section of the workshop provided training in spherical photography and its creation. Participants learned how to use mobile phones, tablets and cameras to create spherical photographs of landscapes, historic buildings and museum galleries.

Digital scenes provide digital context for artefacts turned into 3D objects. Subjects covered in the workshop included:

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APPENDIX 3 (CONTINUED)

A. **Site selection:** The importance of selecting an appropriate location was discussed as framing does not take place in spherical photography and optimal lighting from artificial lighting is difficult to achieve.

B. **Equipment and software:** Participants were introduced to three modes of photosphere creation, using mobile phones, bespoke cameras and a digital SLR camera. The software available for each method was also introduced.

C. **Executing a shoot:** After site selection, preparing to take the photo is paramount. The use of a tripod for steadiness and taking into account moving objects will affect the photograph. People must either be cleared away for the photograph or taken while remaining still; a choice needing to be made depending on the relevance of the people in the photograph.

D. **Processing and stitching:** The process of creating photospheres from photographs using open source software was introduced to participants. Inserting appropriate xdiff data to enable geolocation within supporting applications was discussed due to importance for location referencing photographs.

E. **Archiving spherical media:** The proper methods for archiving photospheres and source materials provides future proofing and is similar to archiving other digital media.

F. **Sharing spherical media:** Using sites such as Google Street view, participants can achieve high volume visits to their uploaded photospheres or can create virtual tours in social sharing sites such as RoundMe.

Virtual tours enable participants to create digital representations of their museums and community sites, which provides a platform for remote exploration and has the potential in turn to increase actual visits by tourists. A series of photospheres form the basis of a virtual tour interlinked by portals which jump the viewer to the next photosphere. Interpretation is collated by volunteers and included as interactive hotspots. Tours are supplemented by aerial drone footage, spherical timelapse photography, historical photography, audio and text.

The link to the project's RoundMe virtual tour collections:
https://roundme.com/@eulac3d/tours

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APPENDIX 4

Exemplar Interpretation: output from Shetland Museum and Archive workshop and provided to workshop hosts.

Shetland Museum and Archives 3D Objects - EU-LAC-MUSEUMS Project

Prehistoric cup
Whales are common in the North Atlantic, and since ancient times people have used their meat and oil. In regions with no trees, bones were fashioned into household items that would usully be made from timber; this handled cup is made from a backbone. It is unfinished, and you can see the inside isn't fully hollowed-out.
Early People gallery
ARC 85130

Byre lantern
Tradional Shetland farmsteads had outbuildings connected to the house, so people could go through to the byre to tend to the cattle, even in the strongest winter gale. For centuries light came from fish-oil lamps. Once imported glass became common around 1800, people used candle lanterns because they protected the flame from draughts.
Home & the Land gallery
FPL 65678

A cure for jaundice
Jaundice is a symptom, rather than a disease. Shetlanders used folk-remedies to try to cure the condition. One way was to drink water from a stream where three landlords' estates met. The water was scooped with the big bowl, called a kapp, and the patient sipped it with the little dish. This dish is made from whalebone.
Customs & Folklore gallery
FPL 2012.480

Burn the witch!
Three hundred years ago, people were obsessed with witches. An allegation of witchcraft could be fatal to the accused. Discovering if a suspect was guilty wasn't easy. One way a suspect could be identified involved fire; if she came to the door, the householder met her with a burning peat held in tongs. If the person was a witch, she ran away, and if innocent, she'd just be confused!
Customs & Folklore gallery
FPL 1992.974

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APPENDIX 4 (CONTINUED)

Fisherman's hat
Shetlanders wore knitted hats when off fishing, and the the multicoloured patterns contrasted with the brown oilskins and boots they wore. Visitors to the islands two hundred years ago were much taken with these vivid caps, and bartered them from the fishermen – hence why they survive.
Harvest from the Sea gallery
TEX 7738

Fishing sinker
Traditional fishing gear had two main parts – a baited hook to catch the fish, and a weight to sink the line into the sea. This is a specialised sinker that people used where there was a very strong tide, where big fish could be caught. The pointed shape and concave face allowed it to be pulled through the current, but sometimes stones were lost if the line broke.
Harvest from the Sea gallery
FIS 7479

Box for a voyage
When off on a boat trip, people used this kind of box, known in Shetland as a bøst, to carry food or fishing flies. These boxes were made around Hordaland province, and imported in the 18th century as part of the islands' trading links with coastal Norway.
Boats gallery
CON 8153

Emigrant's doll
Around 1900 hundreds of Shetlanders left their native home. It was a time of hardship but also opportunity. People settled elsewhere in Britain, or further afield in the world. This doll belonged to a girl in a seaport where islanders settled as mariners and domestic servants.
On the Move gallery
SPO 1990.427

Beating crime
Criminals who were guilty of minor offences were dealt with locally up to the 19th century. They could be locked in the cells, or – for lesser bad deeds - held in the stocks. Youngsters could be thrashed with a switch, of birch twigs tied together. It was an official tool, and has a Royal seal attached.
Power & State gallery. IMP 2001.104

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APPENDIX 4 (CONTINUED)

Gone for good
The top predator was the sea eagle. Its only enemy was people, and it was persecuted because farmers thought it attacked lambs. Numbers dwindled in the late 19th century, once guns and poison became easily available, and by the 1910s this magnificent bird had been exterminated in Shetland.
Trade & Industry gallery
NAT 2007.23

The bird has flown
Corncrake birds lived in Shetland for thousands of years, nesting in cornfields. However, they disappered over only thirty years. People had come to use imported food and animal fodder, so farmers stopped growing oats and barley, and the corncrake's habitat vanished.
Trade & Industry gallery
NAT 2007.22

Tourist tackle
From the 1880s to 1930s Shetland was a favourite destination for better-off tourists. They stayed in rural hotels, and angling was the ideal pastime on the local lochs. Tourism has grown to be a major part of the local economy in the 21st century.
Trade & Industry gallery
SPO 1993.127

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APPENDIX 5

Example briefing document provided for hosts on the Shetland Isles

The use of 3D technologies in Museums: a workshop to make it easy.
These intergenerational 3D workshops are kindly funded through the European Commission Horizon2020 project "EU-LAC-MUSEUMS: Museums and Community: Concepts, Experiences, and Sustainability in Europe, Latin America and the Caribbean".

Lead Facilitators:
(Day 1) Dr Alan Miller (School of Computer Science), Dr Karen Brown (School of Art History), and assistants from the University of St Andrews
(Days 2 and 3) UNST Heritage Trust and local school and community representatives.

Program:

-Day 1 (Shetland Museum): Digitisation and Workshop Purposes/activities
1) Create local exemplar content for use in the workshop, digitize selected artefacts and capture photospheres of museum;
2) Meet and train museum/staff/volunteers/activists from community museums in the toolkit so that they can make use of technology in community museum network.
3) Workshop with invitees from community museum network

-Day 2 (UNST)
1) Workshop in Unst Heritage Trust
2) Digitisation of artefacts and capture of photospheres, for use in workshops

-Day 3 (UNST)
1) Digital capture and processing.
2) Interpretation and dissemination.
Obs. It would be good if participants were familiar with interested in photography and/or digital interpretations.

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APPENDIX 5 (CONTINUED)

General aims of the workshops:

-To learn how to use mobile phones and cameras to enhance the communication of community heritage.

-To engage enthusiasts who have an interest in photography or digital interpretation and would like to learn more

-The main outcomes of the workshops will be to:
1) Create and disseminate exemplar digital content
2) Train enthusiasts in digital 3D technologies and interpretation
3) Equip museums to run further workshops and dissemination activities.
4) Exemplar digital outputs fit for use by participants and eulac.

The workshops will introduce participants to using mobile phones and other available digital technologies to create, archive and present 3D and spherical representations of artefacts and their context. Six stages of the process will be addressed:

1) The selection of subjects for digitisation.
2) The process of digital capture.
3) Post-processing and enhancement.
4) Digital archiving in a connected world.
5) Providing appropriate interpretation.
6) Dissemination through social media, the web and 3D printing

Equipment:

A digital toolkit including software, equipment and user guides will be provided for the workshop. It will enable museum and community use of spherical and 3D technologies.

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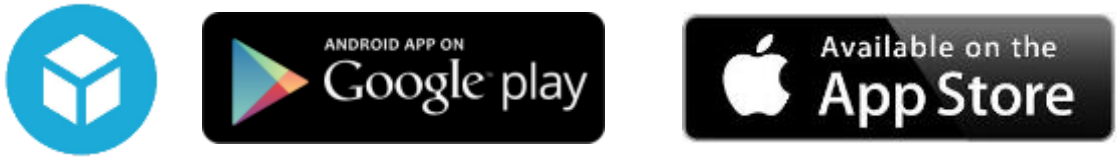
APPENDIX 5 (CONTINUED)

Software:

Google Street View:
Can be used with a phone to create photospheres. These can then be downloaded to a computer and uploaded to roundme.

Roundme:
Description: Round.me enables Photospheres to be uploaded and viewed. They can then be organised into sequences and tours, and act as a backdrop for interpretation.

Sketchfab:
An accessible site for hosting and viewing 3D models.



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APPENDIX 6

TEAM 3D

Dr Karen E. Brown: Project Coordinator

Karen is Coordinator of the EU-LAC-MUSEUMS project, working closely with Project Administrator and Youth Programme Worker, Jamie Brown. She is a member of the Board of the European Regional Alliance of ICOM, Lecturer in Museum & Gallery Studies, and Director of the St Andrews Museums, Galleries and Collections Institute. Karen provides strategic direction and vision to the Virtual Museum design and workshop delivery. Karen brings her world class expertise in curation and interpretation to the new challenges that the digital domain offers.

Dr Alan Miller: Lead on 3D and Immersive Technologies

Alan has extensive experience in applying immersive technologies to create Smart Tourism and Heritage applications. He has worked with museums and galleries in developing award winning digital visitor facing exhibits including an installation of the St Kilda digital world heritage site for the Taigh Chearsabhagh Museum. Alan leads in 3D design, delivery of the workshops and overseas digital development of the virtual museum.

Dr Iain Oliver: Research Fellow

Iain leads our systems engineering work and in developing the Virtual Museum toolkits. His Ph.D was in traffic engineering for virtual environments. Since then he has developed immersive systems for museums and the Virtual Time Binocular framework. Iain has also expertise in laser scanning, structured light and photogrammetry. He has produces high quality 3D models and makes them available through the web and mobile apps.

Catherine Cassidy: Research Fellow

Catherine brings her background in Museum and Galleries Studies to the mix. She recently curated the successful SKYWARD exhibition, which won critical acclaim for its innovative use of technology. Catherine brings expertise in curation and digital design. She specialises in the promotion of 360 scenes and digital artefacts through Social Media campaigns.

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APPENDIX 6 (CONTINUED)

Adeola Fabola: PhD Candidate

Adeola is a PhD candidate with the Open Virtual Worlds project at St Andrews, he is working with digital artefacts, 3D Scanning as well as live and immersive technologies. Google cardboard for groups, live drone tours and accessing remote locations from your desktop all feature in Adeola's research. Adeola is currently on an Internship at the Timespan museum creating and archiving digital artefacts.

Jamie Allan Brown: Project Youth Programme Worker and Project Administrator

Jamie is the Project Youth Programme Worker and Project Administrator for EU-LAC-MUSEUMS. Jamie has extensive experience in youth work and community development, internationaly and in Scotland. Jamie leads in the project's youth programme, delivery of our social media posts and professional administion of the overall project.

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