

# ARIADNEplus Visual Media Service 3D configurator: toward full guided publication of high-resolution 3D data

Potenziani Marco\*<sup>1</sup>, Ponchio Federico<sup>1</sup>, Callieri Marco<sup>1</sup>, Cignoni Paolo<sup>1</sup>

<sup>1</sup> ISTI-CNR – Pisa, Italy

\*Corresponding author

Correspondence: marco.potenziani@isti.cnr.it

## ABSTRACT

The use of digital visual media in everyday work is nowadays a common practice in many different domains, including Cultural Heritage (CH). Because of that, the presence of digital datasets in CH archives and repositories is becoming more and more relevant. However, the correct management of these assets, specialized and often complex, it is not always trivial, especially for communities of users lacking specific training. ~~In these cases, systems enabling assisted data publishing may be a solution.~~ In these cases, systems enabling assisted data management during the different phases of their life cycle, can be a solution.

The Visual Media Service (VMS) is a web-based platform that enables the easy publication of complex visual media assets, specifically targeting the CH domain. It allows users to upload high-resolution images, RTI (Reflectance Transformation Imaging) ~~relightable~~ images, and 3D models, transforming them into an efficient format for interactive web visualization. The VMS is an end-to-end solution able to support the entire publishing process, from data uploading to presentation customization. To expand its adoption in the CH community, the ARIADNEplus project aimed ~~at enhancing~~ to enhance its features, providing innovative services for archaeological data publication ~~management~~.

This paper introduces the VMS 3D configurator, a new tool designed to improve the visual organization of 3D archaeological datasets in the VMS. The configurator guides content creators through a multi-step wizard, offering customization options for the presentation of 3D models ~~presentations~~. The configurator consists of five different configuration stages, each providing specific customization features, such as model orientation, appearance, scene navigation, viewer interface, and annotation of points of interest.

In addition to ~~providing~~ provide a detailed description of all the configuration possibilities, the paper will also discuss uses, limitations, and potential developments of the 3D configurator, and of the entire platform too, highlighting the value of the VMS as a tool for publishing, exploring, and disseminating CH data.

**Keywords:** Visual Media Service, Web Publishing and Visualization, 3D Models, Web3D, WebGL

46 Using cutting-edge visual technologies for analyzing, documenting, preserving, and sharing artifacts is  
47 a consolidated trend in the Cultural Heritage (CH) domain (Bustillo et al., 2015). As is well established that,  
48 to become valuable resources for learning, study, and research, the digital datasets generated by these  
49 technologies should be FAIR - Findable, Accessible, Interoperable, and Reusable (Wilkinson et al., 2016).  
50 The Visual Media Service (VMS)<sup>1</sup> (Ponchio et al., 2016) is a platform designed following these principles.

51 Developed in the context of the EC Infra ARIADNE project (Meghini et al., 2017), the VMS provides easy  
52 publication and presentation on the web of complex visual media assets. It is an automatic service aimed  
53 at people working in the CH domain, that allows content creators to upload three different types of visual  
54 media (high-resolution images, RTI - Reflectance Transformation Imaging, relightable images, and 3D  
55 models) on a server and to transform them into an efficient web format, making them ready for web-based  
56 visualization.

57 To boost the penetration-adoption of the service ~~in-by~~ the CH community, possibly transforming the  
58 VMS in a solution exploitable in a more systematic and structured way, the Horizon 2020 ARIADNEplus  
59 project<sup>2</sup> aimed at expanding the VMS features, implementing innovative services for users addressed to  
60 archaeological data managementpublication.

61 In this context, one of the goals of the project was to design and develop new services for improving  
62 the visual organization of 3D archaeological datasets. Initially planned as a simple redesign of the way of  
63 linking the 3D model of an artifact or a monument to its archaeological documentation, finally the work  
64 has involved not only the 3D data enrichment stage, but also all the other configuration options already  
65 provided for customizing the VMS 3D presentation.

66 The result of this work is a brand-new configurator for 3D models, proposed as a complete multi-step  
67 wizard able to guide the content creator through the publication process. The current 3D configurator is  
68 composed of 5 different configuration steps, appropriately divided according to the type of customization  
69 they provide: Alignment, Material & Light, Navigation, Interface, and finally Annotation.

70 This paper aims at introducing-introduces the VMS 3D configurator and the key concepts behind its  
71 design. After a brief introduction of the VMS platform, useful to contextualize the application domain, the  
72 different configuration stages of the 3D setup wizard will be presented in detail and illustrated with  
73 practical examples. The paper concludes with a discussion of uses, limitations, and possible development  
74 directions of the proposed 3D data publishing approach.

## Visual Media Service

76 The current digital era of CH is characterized by large-scale, transnational, interdisciplinary and  
77 collaborative data-centric projects. Because of that, to provide access to digital data is becoming more and  
78 more important. The advent of web platforms (e.g. Europeana<sup>3</sup>, ARCHE<sup>4</sup>, Data Station Archaeology<sup>5</sup>)  
79 specifically addressed at hosting and disseminating CH datasets, allowed a wider audience access to CH  
80 digitized objects, enabling the possibility to appreciate them in previously unattainable ways.

81 Unfortunately these platforms, usually focused at storing very different digital media, result to be quite  
82 poor in visualization possibilities. This issue is particularly relevant for some complex visual media assets  
83 widely used in CH, like for instance 3D data (Wachowiak & Karas, 2009; Arnold & Kaminski, 2014), that  
84 would need peculiar visualization features. In these platforms the publication of such data often relies on  
85 external services, like SketchFab<sup>6</sup> (custom that implies a partial loss of control over the data), or is quite

---

<sup>1</sup> <http://visual.ariadne-infrastructure.eu>

<sup>2</sup> <https://ariadne-infrastructure.eu>

<sup>3</sup> <https://www.europeana.eu>

<sup>4</sup> <https://arche.acdh.oeaw.ac.at>

<sup>5</sup> <https://dans.knaw.nl/en/archaeology>

<sup>6</sup> <https://sketchfab.com>

86 minimalist, so unable of providing those data-specific visualization functions provided only by specialized  
87 tools, like Smithsonian Voyager<sup>7</sup> or Potree<sup>8</sup> (very valuable, but requiring programming skills to be used).

88 Finding a quick and easy way to enable visualization of digitized artifacts is therefore essential. The  
89 VMS tries to meet these needs.

90 The VMS (Figure 1) is a web service developed in the framework of the ARIADNE and ARIADNEplus  
91 projects. It is a ready-to-use platform enabling large digital datasets to be processed and displayed  
92 seamlessly and quickly.

93 The VMS provides easy publication on the web of three different types of complex visual media assets:

94 • “reality-based” 3D models, i.e. high-resolution unstructured geometries originating from  
95 the digitization of physical objects by means optical scanners or photogrammetry created with  
96 optical scanners or photogrammetry (supported input formats: high-resolution unstructured  
97 geometries PLY, OBJ, NXS, and NXZ);

98 • high resolution 2D images, (i.e., gigapixel photographs or huge planar images (supported input  
99 formats: JPG, JPEG, PNG, GIF, TIF, and TIFF);

100 • ;

101 • Reflection Transformation Imaginges (RTI) images (also known as relightable images), i.e. a 2D+  
102 images, created through computational photography, where the user can interactively change the  
103 lighting at viewing time (supported input formats: PTM and RTI).

104 The VMS allows content creators to upload these visual media on a server that automatically  
105 transforms them into an efficient web format ready for online publication. Moreover, it also creates a web-  
106 based presentation enabling content creators, but also end users, to access and interactively explore the  
107 published media. Finally, the VMS technology provides a full set of interactive tools for the displayed  
108 object(s). As such, this service can be considered a valuable tool for the publication, exploration, and  
109 dissemination of CH.

110 The VMS platform also allows users to browse through the resources uploaded by other users and set  
111 as publicly accessible. However, this option must not mislead: VMS is not to be intended as an archive or a  
112 repository. It is rather a platform to allow scholars/professionals to publish on the web large visual data  
113 and to share them with colleagues, supporting cooperative work.

114 VMS has been designed to give people working in the CH domain the opportunity to experiment with  
115 web publishing, offering them multiple possibilities, with multiple levels of access:

116 • **public vs. private publication:** content creators can decide if make their visual media accessible to  
117 anyone through the web platform, or whether to keep them private;

118 • **personal shareable link:** for sharing the uploaded media only with a selected group of end users;

119 • **iframe embedding:** for integrating the resulting presentation in the uploader’s own web page;

120 • viewer download: to further customize it by working on the source code, and allow for self-  
121 publishing or offline, local use after configuring the viewer on the platform, a content creator can  
122 download it with all its settings, to then further customize and deploy the created viewer on its  
123 own system, by working on the source code for self-publishing or local offline use.-

124 • ;

125 Therefore, the multiple levels of access are meant not just for the end-users, but also for content  
126 creators, depending on their software development skills. This democratizes the access to cutting-edge  
127 software solutions, that is one of the primary targets of the VMS. In fact, the VMS allows content  
128 creators to exploit high-performance lower-level software exposed in a shared environment through  
129 easy-to-use interfaces.

130 Particularly, the VMS is based on:

131 • **3DHOP<sup>9</sup>** (Potenziani et al., 2015), an open-3D framework for the creation of interactive web  
132 presentations of high-resolution 3D models;

133 • **Nexus<sup>10</sup>** (Ponchio & Dellepiane, 2015), a library for the creation and visualization of large 3D  
134 models online;

---

<sup>7</sup> <https://smithsonian.github.io/dpo-voyager>

<sup>8</sup> <https://potree.github.io>

<sup>9</sup> <https://3dhop.net>

<sup>10</sup> <https://vcg.isti.cnr.it/nexus>

- **Relight<sup>11</sup>/OpenLIME<sup>12</sup>** (Ponchio et al., 2018), ~~that-which~~ are libraries to create and view on the web relightable images.

These solutions, all developed by CNR-ISTI Visual Computing Lab, are low or middle-level solutions. This means that users are generally required to write source code to make them work. Conversely, using the VMS platform, even a content creator ~~without computer programming knowledge with any background in computer programming~~ can exploit them interacting with simple interfaces developed ad-hoc, without the need for coding.

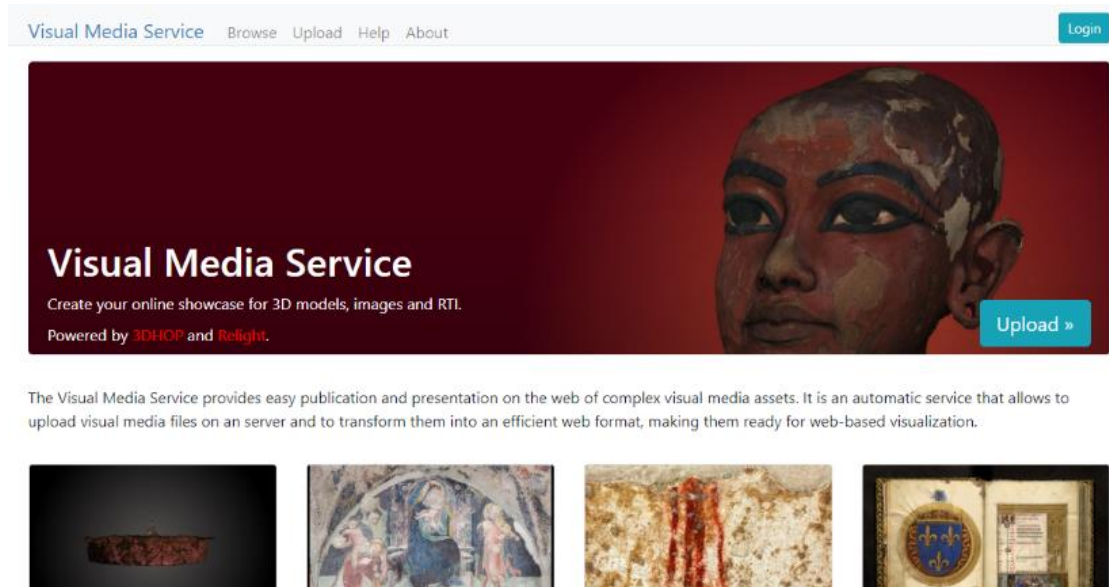


Figure 1 – The landing page of the Visual Media Service platform website.

The VMS can be considered an end-to-end solution, supporting content creators in each step of the publishing process, from login to presentation customization. ~~For each of the three supported visual media~~ The platform implements:

- **Multi-option login system:** to upload a visual media and create a presentation, a content creator has to log in to the platform. ~~The~~ VMS supports 3 different login modes. Users can log in using a Google account, a D4Science account, or simply using an email address.
- **Informative data support:** when the content creator selects the visual media to upload, simple information about that media (title, description, ~~copyright owner~~, and so on) can be provided. Since ~~the~~ VMS does not aim to be a structured archive, currently informative data support is very simple. However, it is enough to provide minimal documentation and a tag-based search system for the uploaded resources.
- **Automatic server-side data processing:** when the content creator decides to upload a resource, the VMS server processes the selected visual media creating a web-friendly multiresolution version of it, ~~exploiting the Nexus format for 3D data, and Microsoft Deep Zoom<sup>13</sup> for 2D/RTI images~~. Since data processing could take some time, it happens in ~~the~~ background (~~so, in the meanwhile, i.e.~~, the user can continue to navigate the platform). At the end of the processing the server sends to the content creator a message to notify that the processing is over.
- **Automatic creation of web presentations:** at the end of the processing, the platform also creates a basic web presentation of the chosen visual media. ~~Note that bBy default/default, the selected~~

<sup>11</sup> <https://vcg.isti.cnr.it/relight>

<sup>12</sup> <https://github.com/cnr-isti-vclab/openlime>

<sup>13</sup> [https://learn.microsoft.com/en-us/previous-versions/windows/silverlight/dotnet-windows-silverlight/cc645050\(v=vs.95\)](https://learn.microsoft.com/en-us/previous-versions/windows/silverlight/dotnet-windows-silverlight/cc645050(v=vs.95))

media is uploaded as a private resource. ~~If the owner wants to make it publicly available, he/she has to manually change the default~~ But this can manually be changed by the owner.

- **Assisted customization of web publication:** once the basic web presentation has been created, the content creator can configure it in a specific section. ~~A-The configuration wizard~~ process introduces to the user all the customization possibilities.

This last point represents the core of this work. Particularly, we focused on the configuration section for 3D models, which has been completely renewed, changing from a single-page simple editor with very few functionalities aimed at customizing the viewer interface (backgrounds, skins, buttons) to a complete multi-step wizard able to thoroughly edit the 3D scene, guiding the content creator through the whole publishing process. ~~able to guide the content creator through the publication process.~~

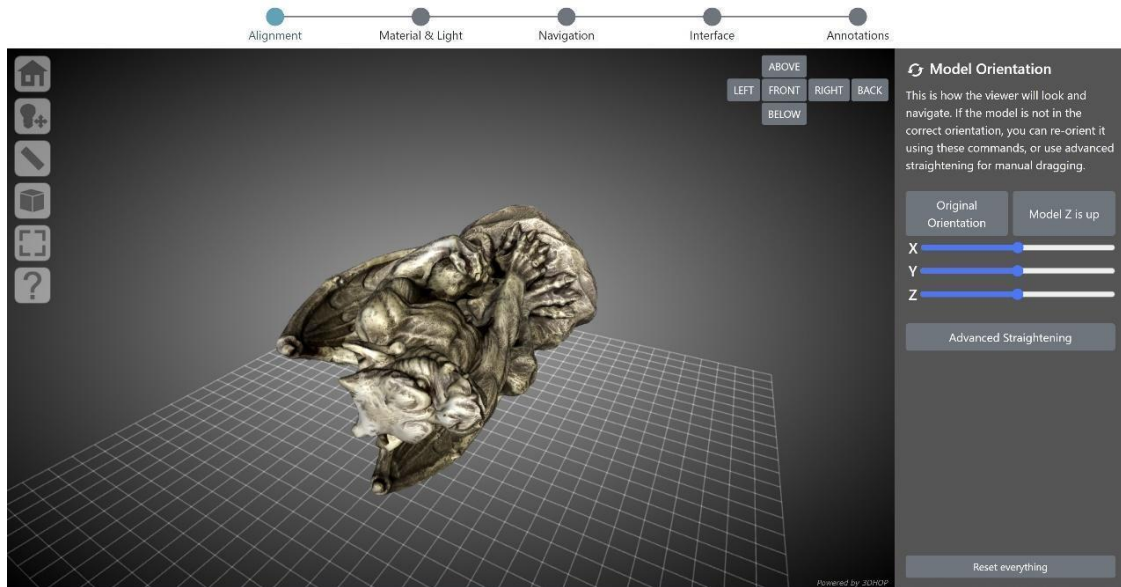
### 3D Configurator

~~The advent of modern 3D visualization technologies allows a wider audience access to digitized objects, enabling the possibility to appreciate these objects in previously unattainable ways. This is particularly valuable for objects that are fragile, have limited visibility, or restricted access, as it often happens with Cultural Heritage (Wachowiak & Karas, 2009; Arnold & Kaminski, 2014). Finding a quick and easy way to enable 3D visualization of digitized artifacts is therefore essential. The configuration section for 3D models provided by the VMS tries to meet these needs.~~

The current 3D configurator is composed of 5 different configuration steps, ~~appropriately divided according to the type of customization they provide:~~ Alignment, Material & Light, Navigation, Interface, and ~~finally~~ Annotation.

**Alignment:** the first step allows the content creator to fix the model orientation (Figure 2). One of the more common issues ~~that happens arising from~~ working with 3D models is that the model is often visualized with the wrong orientation. This happens because the 3D model has not been oriented ~~when it has been created~~ correctly at the time of creation, or because the different tools composing the 3D working pipeline (data acquisition, editing, publication) use different reference systems. In any case, if the model is not in the correct orientation, in the alignment wizard the content creator can re-orient it using different commands:

- First of all, one can correct the model orientation rotating the model along an axis; there are 3 different sliders, one for each axis, and one can use them to independently rotate your model on a selected axis;
- Then, one can define the UP of the model, meant as its upward side; this is another ~~very annoying~~ issue that happens very often, since software used for creating 3D models follow different notations; so, UP vector can be defined in 2 different way (Y-vertical, used mostly by Computer Graphics tools, and Z-vertical, used mostly by engineering and geographical tools), and this led to weird behavior in visualization; since is not possible knowing in advance what is the notation used for the given 3D model, in this panel ~~with a simple button~~ one can switch from a notation to the other;
- Finally, one can use the “advanced straightening” function to orient the model to match predefined views while directly interacting with the model in the 3D scene using a spherical trackball.



205

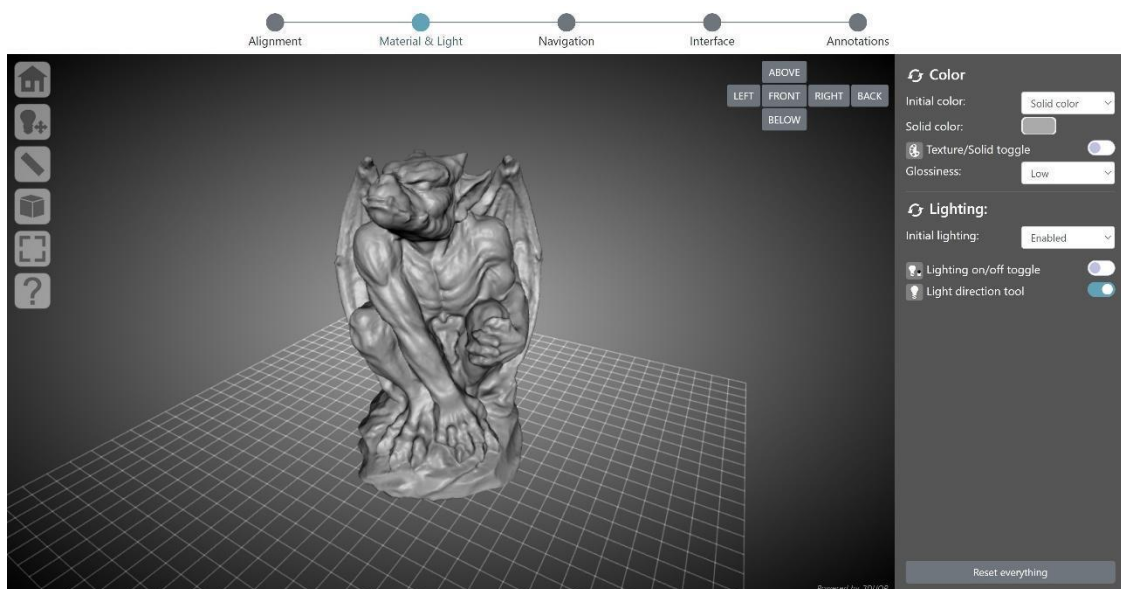
206  
207  
208  
209

**Figure 2** – The Alignment setup in the 3D configurator wizard. The panel on the right contains the controls for rotating the model along an axis, recalling the original orientation, setting the UP vector, accessing the dedicated panel for enabling advanced straightening. The 3D viewer on the left is updated in real time according to the customization in the right panel.

210  
211  
212  
213  
214  
215  
216  
217

**Material & Light:** the second step allows the content creator to set up the 3D model appearance (Figure 3). More specifically:

- the material wizard provides a set of tools to select the startup color of the 3D model (texture or solid color), define the solid color used, add or remove a toolbar button for switching between texture and solid color, and finally customize the glossiness level (dull, low, medium or shiny).
- the lighting setup provides a set of tools to define the startup lighting of the scene, add or remove a toolbar button for switching between enabled and disabled lighting, and finally add or remove a toolbar button for enabling the interactive control of light direction.

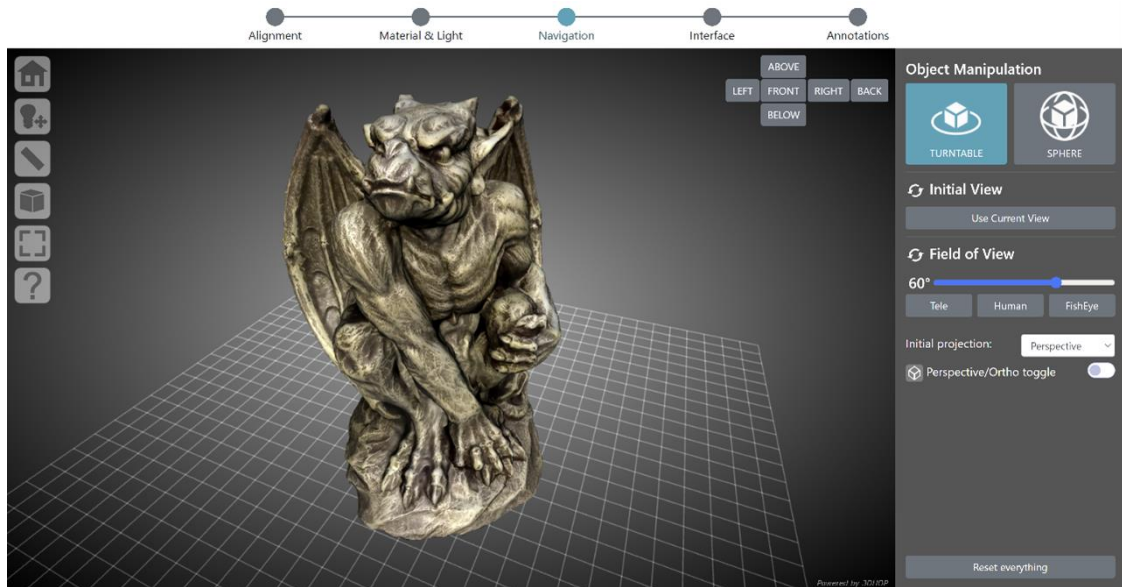


218

219  
220  
221  
222  
223

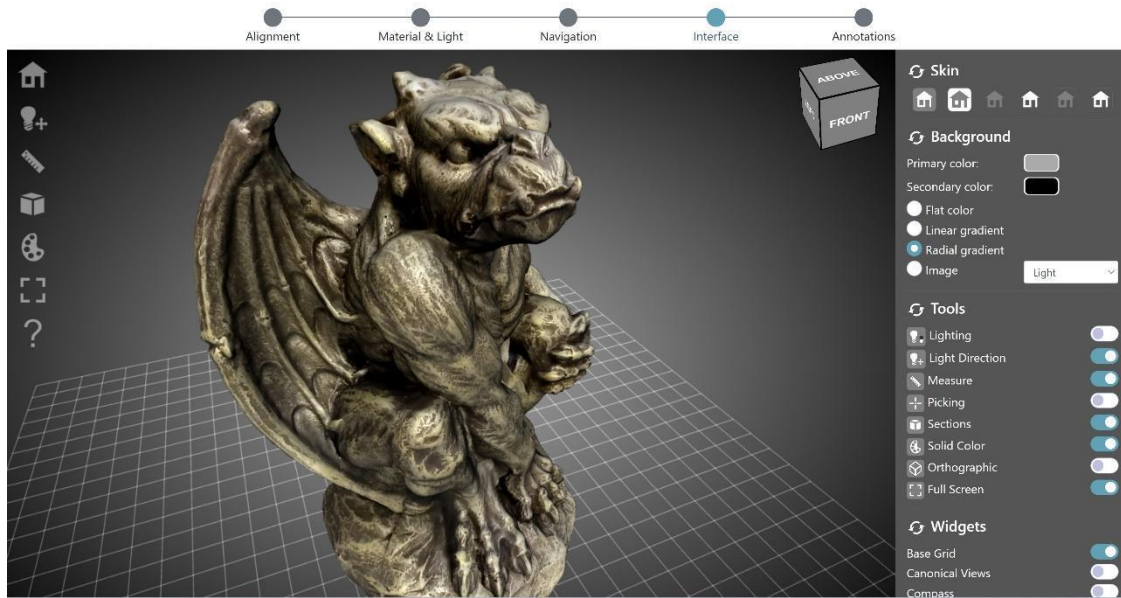
**Figure 3** – The Material & Light setup in the 3D configurator wizard. The panel on the right contains the controls to set the initial appearance of the model, modify the solid color, add/remove the texture/solid color toggle button in the toolbar, define the level of model’s glossiness, set the initial lighting of the scene, add/remove the lighting control button in the toolbar. The 3D viewer on the left is updated in real time according to the customization in the right panel.

224 **Navigation:** the third step allows the content creator to define the scene navigation setup (Figure 4).  
 225 In particular, this wizard provides a set of tools to select the trackball paradigm used in the scene for  
 226 manipulating the 3D model (turntable, that just allows a 2-axis manipulation, with vertical tilting and  
 227 horizontal rotation of the model, preserving the vertical axis; or sphere, that enables full and free rotation  
 228 on all axes), define the initial trackball position, customize the field of view angle of the virtual camera  
 229 (using a slider or three different buttons with predefined values), specify the type of projection used by the  
 230 camera at the startup (perspective or orthographic), and finally add or remove a toolbar button for  
 231 switching between perspective and orthographic projection.



232  
 233 **Figure 4** – The navigation setup in the 3D configurator wizard. The panel on the right contains the  
 234 controls for changing the trackball, setting the initial view, modifying the FOV, defining the type of  
 235 camera projection, adding/removing the camera projection button in the toolbar. The 3D viewer on  
 236 the left is updated in real time according to the customization in the right panel.

237 **Interface:** the fourth step allows the content creator to customize the viewer interface (Figure 5). This  
 238 specific wizard provides a set of tools to customize the toolbar skin (6 different themes are available: light,  
 239 dark, minimal light, minimal dark, transparent light, transparent dark), add or remove tool buttons from  
 240 the toolbar (lighting, light direction, measurement, point picking, sections, solid color, projection, full  
 241 screen), define the viewer background (flat color, linear gradient, radial gradient, predefined images), and  
 242 finally select which widget provide to the end user (base grid, compass, canonical views, navigation cube).



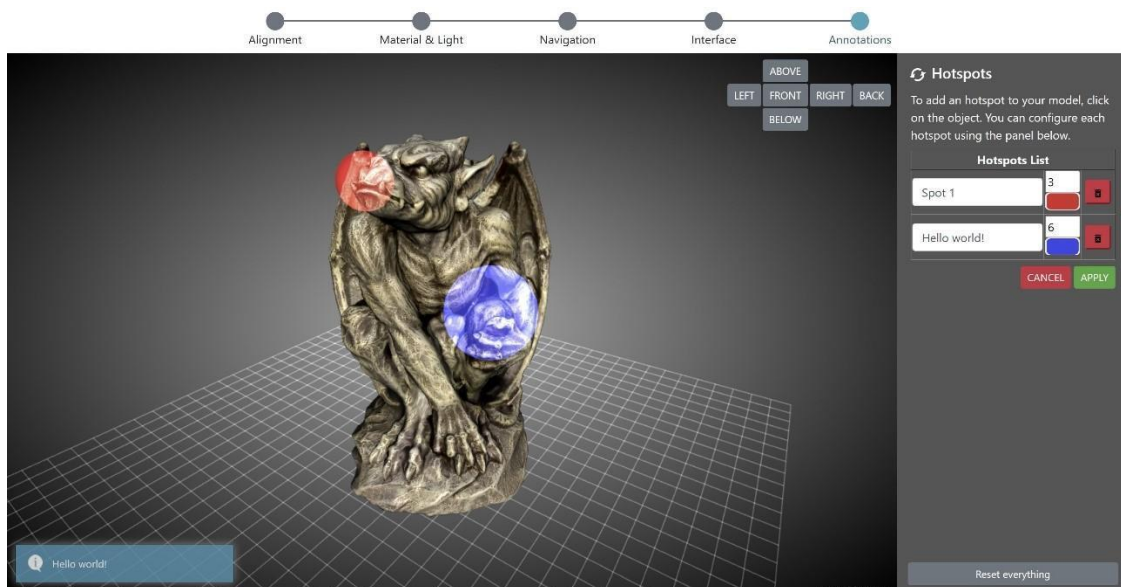
243

244  
245  
246  
247  
248

**Figure 5** – The Interface setup in the 3D configurator wizard. The panel on the right contains the controls for changing the toolbar skin, setting the viewer background, selecting the tools to enable adding/removing the related buttons in the toolbar, choosing the navigation/orientation widget to add to the 3D scene. The 3D viewer on the left is updated in real time according to the customization in the right panel.

249  
250  
251  
252  
253  
254  
255

**Annotation:** the fifth step allows the content creator to add hotspots (points of interest highlighted by clickable geometries) to the 3D model and link them to some basic annotation (Figure 6). The annotation wizard provides a set of tools to add or remove custom hotspots to the 3D model, define the size and color of each hotspot, and finally edit the text information linked to the hotspot. Once at least one hotspot is defined, the wizard automatically adds a toolbar button to enable or disable the hotspot visibility. If hotspots are visible, moving the mouse cursor over their geometry triggers a panel (in the bottom left of the viewer) showing the text associated with that specific hotspot.



256

257  
258  
259  
260  
261

**Figure 6** – The Annotation setup in the 3D configurator wizard. The panel on the right contains the controls for adding/removing spherical hotspots (in red and blue) to the 3D model, modifying the hotspots setup (radius, color), and editing the information linked to each hotspot. Moving the mouse cursor over one of the hotspots in the 3D scene recalls the linked information through a panel visible on the bottom left of the viewer.



Released in early 2015 and integrated in the ARIADNE portal shortly after, to date the VMS counts around 1500 visual media resources uploaded, processed, and visualized. Among these, around 1000 are still online, while the remaining have been removed. The number of content creators exploiting the platform over the years counts 460 unique users.

As mentioned before, in the VMS data owners can select between restricted or open access, which is an important option when data of ongoing, not yet published research is being managed and processed. The usefulness of this option is visible in the fact that, currently, only a subset of the material (around 30%) is publicly accessible. A similar deduction can also be drawn from the difference between the total object processed and the current number of available objects: users have exploited this service to put online, temporarily, restricted-access data, and then they removed it after having used it, or have used the VMS just to create and configure the viewer, that has then been downloaded for private, local use.

These two types of use, are quite different from what is offered ~~in~~ by other online services, have certainly contributed to the good results obtained so far, and to the ~~penetration~~ adoption of the VMS ~~in~~ by its target community. Indeed, currently the VMS is used by a number of cultural institutions. Among these, there are several universities (Florence, Milan, Turin, Rome, New York, Lincoln, Zacatecas, and many others) plus some research centers (INRAP, CNRS, CNR). Also, there is widespread use of the service in education, ~~from especially at the~~ university ~~courses level~~ (from master's degrees, ~~courses and to~~ Ph.D. courses). Finally, a few 3D scanning/processing companies use the VMS as a tool to test the 3DHOP library functionalities and its potential, to develop the interface, and (rarely) to preview or present 3D and RTI material to clients.

These examples of use, together with the figures mentioned above, show there is good interest in and appreciation for the VMS. Nevertheless, so far we have not received any news about a more systematic or structured use of the platform. The new configurator system aims at filling this gap, providing content creators with a set of customization options that have never been so extensive and easy to use. These new possibilities shouldn't just impact the mere publishing of content, but they also should be able to stimulate a discussion concerning the reproducibility/applicability of the proposed data publishing approach to different media (~~imagining e.g.~~ applying the same configurator settings to other data), or even contexts (~~for instance e.g. pfiguring the orting the configuration wizard in similar data publishing infrastructures, or even in archives and repositories where the content configurator can be exploited for media asset ingestion, or to re-configure the data already stored in these platforms~~ porting of the configuration wizard in similar data infrastructure).

Obviously, although the 3D configurator is 100% up and running, we are aware that, to date, for some aspects, it is still a demonstrator. And because of that, independently of the current limitations, due to its specialization, it cannot be considered a solution good-suitable for all eventualities.

For instance, since this 3D wizard is tailored to the specificity of 3D models, the same five configuration steps might not make sense with the other visual media supported by VMS (RTI & high-resolution 2D ~~images~~ images). On the other hand, some specific customization features (interface, some inspection tools, and mostly annotations) would fit very well also with two-dimensional data. So the same approach could also be replicated for these media, which would certainly benefit from the potential provided by a more structured configuration process. On the other hand, since the same approach could also be replicated for these media, moving the RTI & high-resolution 2D Images configurators from single-page editors to multi-step wizard is on the road map of future developments. For this reason, moving the RTI & high-resolution 2D Images configurators from the current single-page editors (similar to the old single-page 3D configurator) to a multi-step wizard is on the road map of future developments.

Future developments that are not limited to ~~overcome~~ overcoming the configurator limitations, but also aiming at increasing and diversifying the publication possibilities provided to content creators.

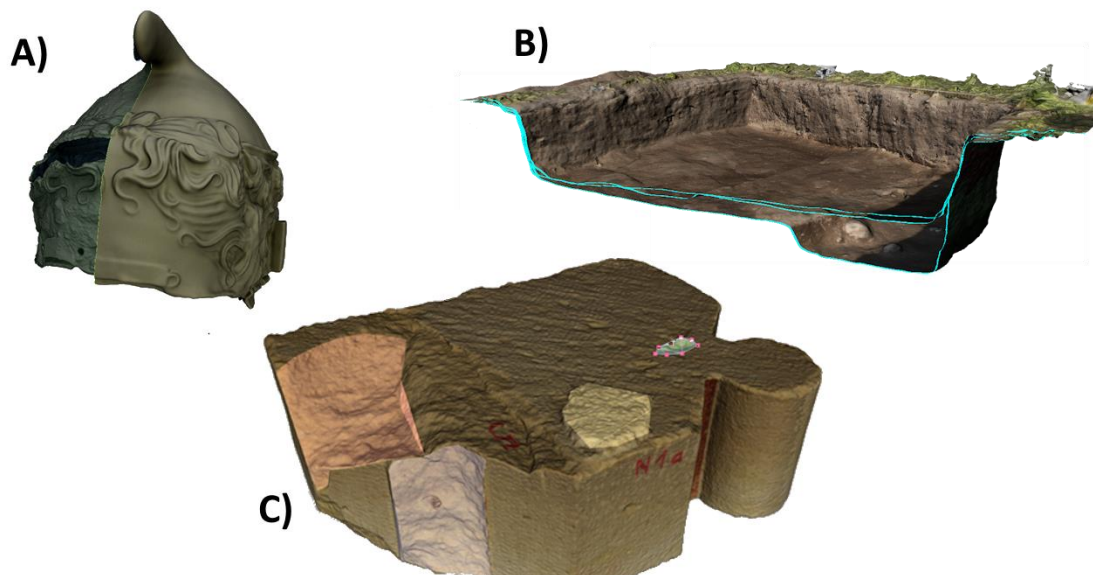
The first step of this process is trying to go beyond the current single object visualization, for instance allowing content creators to upload objects as a collection of items, so as to visually organize their exploration in a dedicated section, but also to apply one specific configuration setup to the whole collection. This makes sense if one is publishing a collection of similar items, and could save the content creator a lot of time. A beta version of the tool for creating 3D collections has already been tested for a

314 large set of lithic artifacts (Ardelean et al., 2022), and it is currently in the evaluation stage to be publicly  
315 released.

316 With collections you have multiple items grouped together, but each one ~~with~~ will typically have its  
317 own viewer. However, one may want to have multiple objects in the same viewer. Actually, the VMS  
318 already supports this particular data organization, but currently this feature is restricted just to high-  
319 resolution 2D images. These particular collections of images are called **Image Sets**, and are already online  
320 (it is possible to browse them ~~in~~ on the platform website). Image Sets are very useful, for instance to keep  
321 all the pages of one book together, but they are a quite trivial example of multiple objects in the same  
322 viewer (because the final user can just visualize one item per time, jumping from a visualization of an item  
323 to the other).

324 For this reason, we are exploring the possibility to develop something more for 3D objects, designing a  
325 viewer able to load and display multiple objects together. Having more than one object in the same scene  
326 opens up various use scenarios: as a basic interaction, it would be possible to toggle the visibility of each  
327 component. However, to fully exploit the multiple objects, it will be necessary to add some more  
328 interaction with the objects. For this reason, the road map includes the release of various multi-object  
329 publication templates, each one with a specific built-in interaction, easily configurable. Examples ~~of these~~  
330 could include a two objects comparison template, in which a content creator uploads two objects, and the  
331 viewer lets the user toggle between the two models, apply cross-transparencies, or use a slider to switch  
332 from one to the other (Figure 67-A). Use scenarios: before/after restoration, display variants, artist's  
333 concept vs. actual statue. Another possible template is a sequence explorer, in which a content creator  
334 uploads multiple objects, each one depicting a "stage" of the same entity, and the user can follow the time  
335 sequence, see an "exploded" view, or display multiple stages with transparencies/sections (Figure 67-B).  
336 Use scenarios: archaeological excavations, evolution of a building/site).

337 Other development directions ~~might~~ aim at a more technical approach. Although usable in a technical  
338 environment, the VMS viewer is still more ~~suitable as~~ a tool for the general public dissemination ~~rather~~  
339 than ~~as~~ a technical instrument. For this reason the introduction of more advanced features, able to help  
340 professionals, is in the development road map. For instance, the current ~~feature of~~ hotspots authoring is  
341 useful, but still limited. Technical extensions could include: points/polylines/areas annotations, groups and  
342 layers of annotations, exporting functionality (Figure 67-C). Also, the introduction of more technical tools  
343 would give the possibility of exploiting the metric quality of the high-resolution visual media in the VMS.  
344 Advances in this regard could include: new measurement tools (e.g., angles), dimensioning, functionalities  
345 to export annotations/measurements.



346  
347 **Figure 7** – Illustrative examples of possible future developments: A) two objects comparison  
348 template, in which a content creator uploads two objects, and the viewer lets the user use a slider to  
349 switch from one to the other; B) sequence template, in which a content creator uploads multiple

350 objects, and the user can display multiple stages with transparencies/sections; C) technical viewer,  
351 providing more advanced features, such as points/polylines/areas annotations, able to help  
352 professional users.

353

354

## Conclusions

355 We presented a multi-step wizard for customizing 3D model web presentations and for guiding the  
356 content creator through the publication process.

357 Composed of 5 different configuration steps (Alignment, Material & Light, Navigation, Interface, and  
358 Annotation), this 3D configurator system represents a significant step toward the assisted integration of  
359 complex visual media assets in the context of the archeological domain.

360 Initial testing started on selected datasets provided by ARIADNEplus project partners led to positive  
361 feedback, ~~foreshadowing that~~ indicating the proposed publishing approach may have a substantial impact  
362 on future research practices, as well as on data reuse.

363 All the planned developments, together with the continuous update and maintenance of all the  
364 software components of the VMS (3DHOP, Nexus, Relight/OpenLIME), aim at improving the already good  
365 results obtained by the service so far.

366

## Data, scripts, code, and supplementary information availability

367 Link to the Visual Media Service website: <http://visual.ariadne-infrastructure.eu>

368 Link to the ARIADNEplus website: <https://ariadne-infrastructure.eu>

369 Link to the 3DHOP website: <https://3dhop.net>

370 Link to the Nexus website: <https://vcg.isti.cnr.it/nexus>

371 Link to the Relight website: <https://vcg.isti.cnr.it/relight>

372 Link to the OpenLIME website: <https://github.com/cnr-isti-vclab/openlime>

373

## Conflict of interest disclosure

374 The authors declare that they comply with the PCI rule of having no financial conflicts of interest in  
375 relation to the content of the article.

376

## Funding

377 The research leading to these results has received funding from the European Union Horizon 2020  
378 Programme (H2020-INFRAIA-2018-2020) under the Grant Agreement n. 823914 (H2020-INFRAIA-2018-1  
379 "ARIADNEplus" project) and under the COST Action n. 18128 (CA18128 "SEADDA" Saving European  
380 Archaeology from the Digital Dark Age).

381

## References

382 Ardelean C F, Mitrani A, Ruvalcaba-Sil J L, Williams T J, Velchoff N, Ponchio F, Callieri M (2022). 3D models  
383 of seventy-seven representative stone tools from Chiquihuite Cave, Zacatecas, *Universidad Autónoma  
384 de Zacatecas*. <https://doi.org/10.48779/d2nq-f182>

385 Arnold D, Kaminski J (2014). 3D Scanning and Presentation of Ethnographic Collections: Potentials and  
386 Challenges. *Journal of Museum Ethnography*. **27**, 78-97. <http://www.jstor.org/stable/43915864>

387 Bustillo A, Alaguero M, Miguel I, Saiz J M, Iglesias L S (2015). A Flexible Platform for the Creation of 3D  
388 Semi-Immersive Environments to Teach Cultural Heritage. *Digital Applications in Archaeology and*  
389 *Cultural Heritage*, **2**, 4, 248-269. <https://doi.org/10.1016/j.daach.2015.11.002>

390 Meghini C, Scopigno R, Richards J, Wright H, Geser G, Cuy S, Fihn J, Fanini B, Hollander H, Niccolucci F,  
391 Felicetti A, Ronzino P, Nurra F, Papatheodorou C, Gavrilis D, Theodoridou M, Doerr M, Tudhope D,  
392 Binding C, Vlachidis A (2017). ARIADNE: A Research Infrastructure for Archaeology *Journal on*  
393 *Computing and Cultural Heritage*, **10**, 3, 27. <https://doi.org/10.1145/3064527>

394 Ponchio F, Corsini M, Scopigno R (2018). A Compact Representation of Relightable Images for the Web *In*  
395 *Proceedings of the 23rd International Conference on 3D Web Technology (Web3D 2018)*, 10.  
396 <https://doi.org/10.1145/3208806.3208820>

397 Ponchio, F, Dellepiane, M (2015). Fast decompression for web-based view-dependent 3D rendering. *In*  
398 *Proceedings of the 20th International Conference on 3D Web Technology (Web3D 2015)*, 199-207.  
399 <https://doi.org/10.1145/2775292.2775308>

400 Ponchio F, Potenziani M, Dellepiane M, Callieri M, Scopigno R (2016). ARIADNE Visual Media Service: easy  
401 web publishing of advanced visual media. *In Proceedings of the 43rd Annual Conference on Computer*  
402 *Applications and Quantitative Methods (CAA 2015)*, 433-442.

403 Potenziani M, Callieri M, Dellepiane M, Corsini M, Scopigno R (2015). 3DHOP: 3D Heritage Online Presenter.  
404 *Computer & Graphics*, **52**, 129-141. <https://doi.org/10.1016/j.cag.2015.07.001>

405 Wachowiak M. J, Karas B V (2009). 3D Scanning and Replication for Museum and Cultural Heritage  
406 Applications. *Journal of the American Institute of Conservation*, **48**, 2, 141-158.  
407 <https://doi.org/10.1179/019713609804516992>

408 Wilkinson M D, Dumontier M, Aalbersberg I J, Appleton G, Axton M, Baak A, Blomberg N, Boiten J W, da  
409 Silva Santos L B, Bourne P E, Bouwman J, Brookes A J, Clark T, Crosas M, Dillo I, Dumon O, Edmunds S,  
410 Evelo C T, Finkers R, Gonzalez-Beltran A, Gray A J G, Growth P, Goble C, Grethe J S, Heringa J, Hoen P A  
411 C 't, Hooft R, Kuhn T, Kok R, Kok J, Lusher S J, Martone M E, Mons A, Packer A L, Persson B, Rocca-Serra  
412 P, Roos M, van Schaik R, Sansone S A, Schultes E, Sengstag T, Slater T, Strawn G, Swertz M A, Thompson  
413 M, van der Lei J, van Mulligen E, Velterop J, Waagmeester A, Wittenburg P, Wolstencroft K, Zhao J,  
414 Mons B (2016). The FAIR Guiding Principles for Scientific Data Management and Stewardship. *Scientific*  
415 *Data*, **3**, 160018. <https://doi.org/10.1038/sdata.2016.18>