PURE
3D

Survey on 3D Web Infrastructures – Final Report –

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Chapter 1: Executive Summary

Within the digital humanities community, user-centered design is highly encouraged as a core consideration when developing digital tools for the public. Therefore, the PURE3D Project Team has plans to implement user feedback and evaluation across every stage of project development. As the project is still in the design phase, the team has conducted an exploratory survey of content creators and managers of 3D digital materials to collect input from this target user group on their personal and professional backgrounds, what they would ideally like to see in an online 3D infrastructure and their past experiences with developing 3D heritage projects.

The goal of this report is to summarize and analyze these quantitative and qualitative responses collected from the 3D digital heritage community about front-end functionality of a 3D web platform and back-end data storage (Chapters 3 and 4). The final outcome will be a prioritized list of recommendations for advancing the PURE3D Project to further phases of infrastructure development (Chapter 5). This report will also guide future user requirements activities such as interviews, focus groups, and user-testing.

Chapter 2: Survey Structure

2.1 Overview

The 3D Web Infrastructures Survey was designed using the Qualtrics XM[1] software package. The survey contained three sections consisting of a total of 47 questions. The first related to the personal and professional demographic information on the respondents themselves (Appendix 1). The second asked hypothetical questions about the ideal features, user accessibility and sustainability of a scholarly 3D web infrastructure (Appendix 2). The third and final category provided an optional section in which respondents may answer project-specific questions based on their experiences of developing and disseminating their 3D content and associated research (Appendix 3).

2.2 Collection Methods

The survey was open for a total of 9.5 weeks – beginning on 19 May 2021 and concluding on 25 July 2021. It was conducted digitally and anonymously and distributed through email, Twitter, Facebook and LinkedIn. Figure 1 provides a breakdown of the method of distribution through which each respondent found the survey. Email was the most effective form of outreach. This is likely due to the direct and semi-personal nature of this method. However, Twitter was also an effective method for reaching the 3D digital heritage community. The PURE3D project currently has less of a digital presence on LinkedIn and Facebook and this is reflected in the graph below.
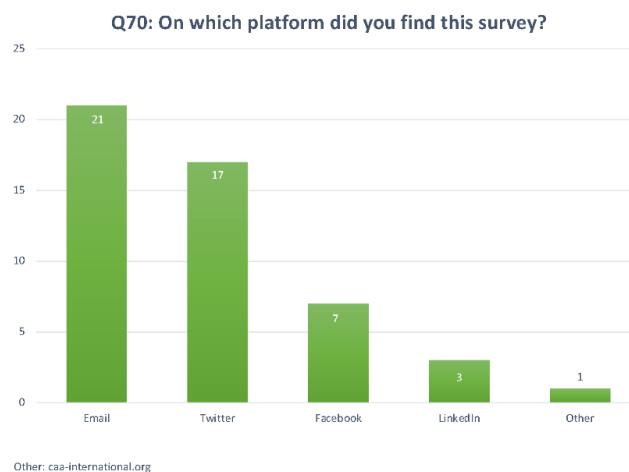

Figure 1: Representation of the multi-choice counts out of 49 for Question 70.

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[1] https://www.qualtrics.com/

Chapter 3: Respondent Profiles

For the duration of the survey, more than 90 responses were recorded but, due to various levels of incomplete responses, an actual total of 48 responses is the final number analyzed in this report. Of those 48 records, 24 offered to answer the survey section about a specific 3D heritage project they were involved in.

In order to get some context on the survey results, some personal and professional demographic questions were added to the survey in order to understand the working sectors our potential content creator audience is coming from. Additionally, knowing this will help us to isolate specific needs and desires from different sectors that work in 3D digital heritage. Finally, the results of the survey highlight which sectors will require different methods of outreach for future user studies.

3.1 Professional Profile

The first question on the survey asks in which sector the respondent is working (Figure 2). More than half of the respondents (54%) are coming from the University/Higher Education sector. However, a differentiation was not made between early career academics and professors/established researchers. It would have been interesting to see at which stage in their career these academic respondents are currently at. The other working sectors are: Research Lab/Institute (15%); Private Business (13%); Museum or Cultural Institution (10%); Non-profit (6%); Public Sector (0%). Additionally, one respondent said they worked in an 'academic museum' and therefore didn't know how to identify themself.
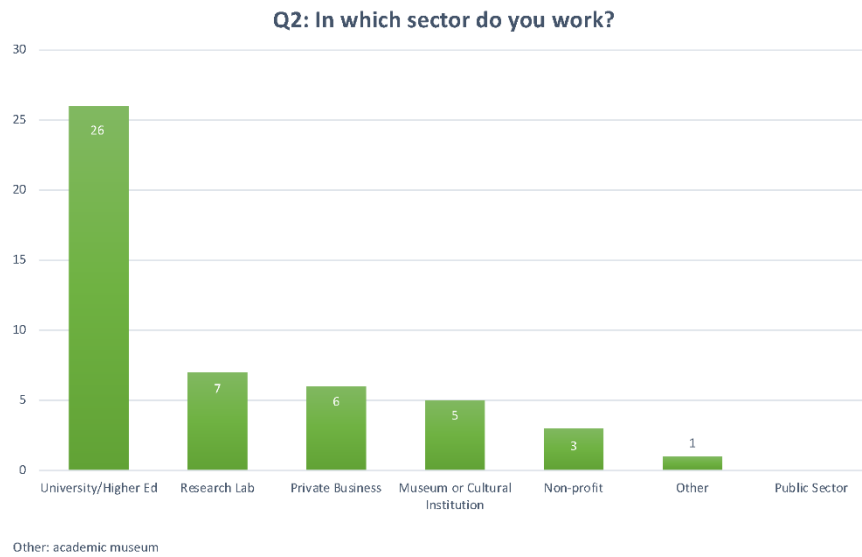
Figure 2: Representation of the counts out of 48 responses from Question 2.

In later stages of the survey development, it was suggested to add a question about how the respondent was answering the survey – either on behalf of themselves as an individual or on behalf of their project or institution. Of the 45 respondents who chose to answer this question, 78% respondents said they are completing the survey as an individual and 22% indicated they were doing it on behalf of a larger team or institution.

Two further questions were asked of the respondents regarding their professional work – which file formats and the types of 3D models they are predominately working with. Keeping this is mind may help to contextualize the responses based on model and file format limitations or workflows. For these graphs it is important to note that these two questions allowed for multiple responses to acknowledge that content creators and managers are working with multiple types of 3D models. Additionally, some of the text-based entries were added to the counts if they generally matched one or more of the categories. Therefore, the charts were recalibrated to account for these numbers out of the 48 total respondents and can be viewed in Figures 3 and 4.

Question 3 of the survey asks, "what kind of 3D models do you create and/or work with?". Based on the responses, photogrammetry was the most frequently cited type of 3D data as nearly all respondents (87.5%) cited this as one of the model types they are working with. The other kinds

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of models they use are as follows: 69% with 3D graphic reconstruction, 65% with 3D Scans, 21% of respondents also selected "Other" and provided comments, some notable entries were:

o   "motion capture"

o   "micro-CT scans"

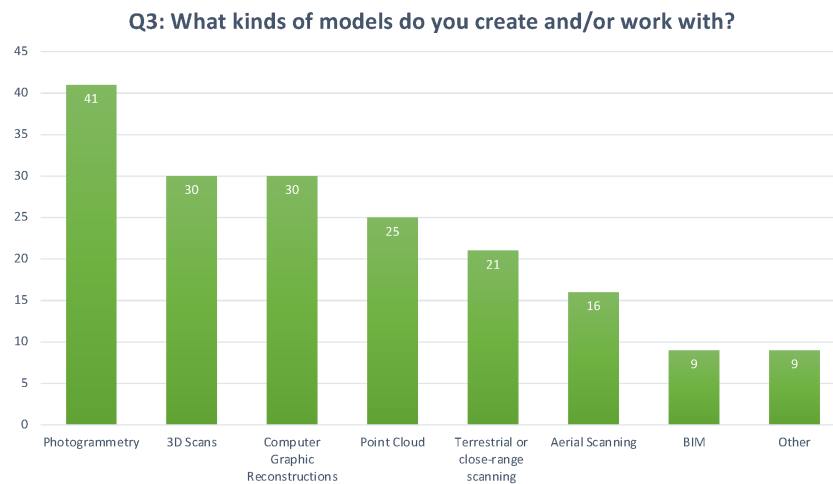o   "tomography"

o   "geophysical data"

Figure 3: Representation of the counts out of 48 responses from Question 3.

Question 4 of the survey requested that the respondents indicate which 3D file formats they most commonly use. .obj was the most common as 85% of respondents said they use this file format in their work. The other 3D file formats that the respondents cited as the most commonly used in their work are: 42% for .stl; 35% for .blend; 33% for .fbx; 29% for .gltf; 27% for .glb; 27% for other file formats; 21% for .ply; and 17% for .dae. .ply was not listed as one of the options in the survey but the high rate of text-based entries indicate that this file format is frequently used as well, this makes sense since it is the industry standard for point cloud data. Thus, .ply was removed from the other category and added to the chart of principle 3D file formats.

Q4: Which 3D file formats do you most commonly use?
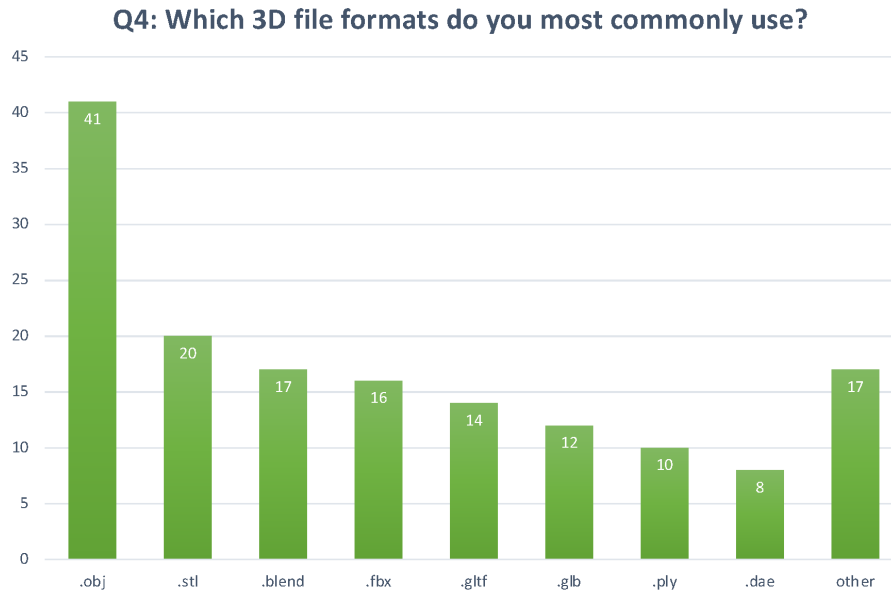
Figure 4: Representation of the counts out of 48 responses from Question 4.

3.2 Personal Profile

The age range of the respondents who chose to provide this information (33 in total) is between 27 and 61 years of age (48% are under the age of 40; 52% are 40 or above). The gender of respondents who chose to provide this information (34 in total) is 56% Male and 44% Female.

When asked to provide nationality information, 32 respondents chose to give this data and the results were 100% from Europe and North America. A breakdown of the nationalities cited can be viewed in Figure 5 below. When comparing this to the country in which the respondent's organization is based, more chose to provide this information (42). This demographic breakdown can also be viewed in Figure 6.
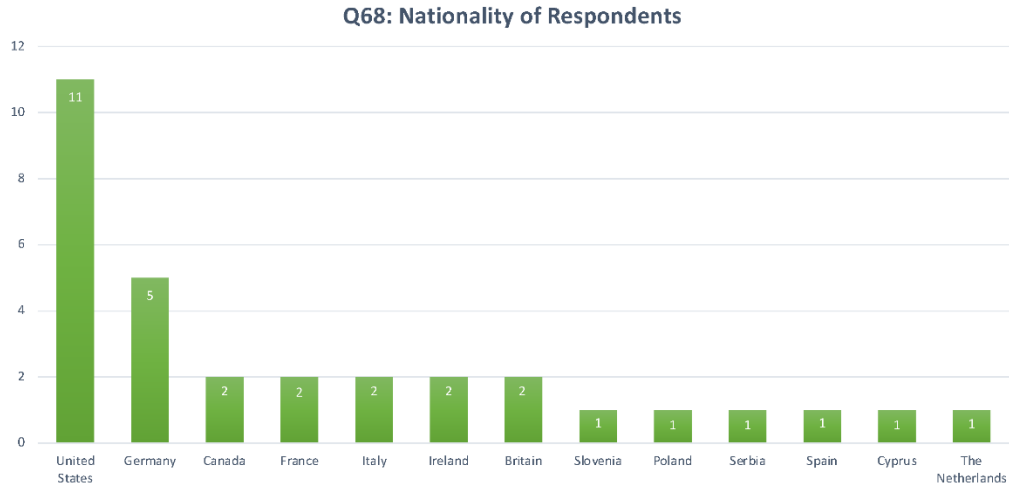
Figure 5: Representation of the counts out of 48 responses from Question 68.
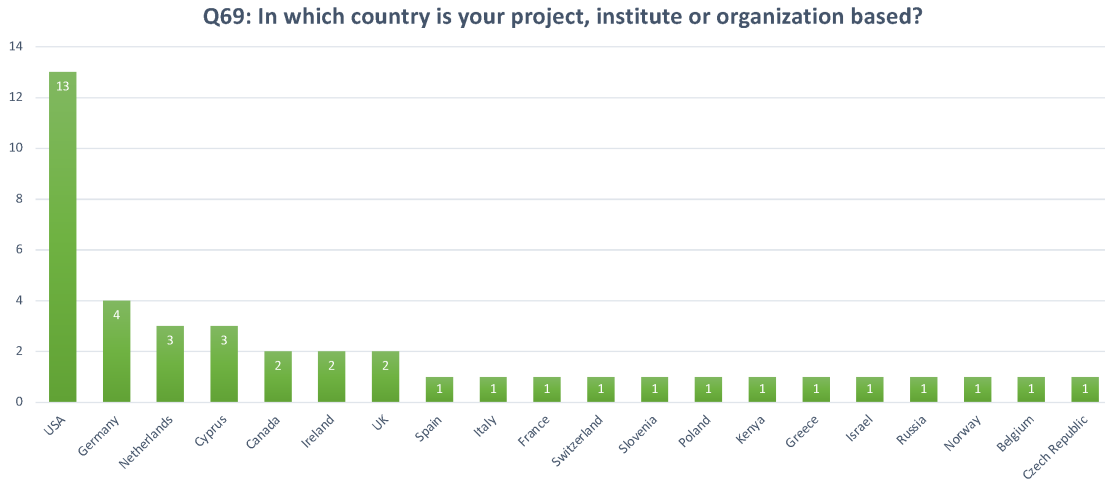
Figure 6: Representation of the counts out of 48 responses from Question 69.

While interesting, these numbers likely reflect a number of biases in the survey dissemination, such as: English being the sole language of dissemination; the tendency for Twitter users in DH to be from predominantly North America and Europe; email groups also being a tool of North American and European colleagues. Unfortunately, we were not able to get responses from nationalities or organizations from any other regions, with the exception of Israel and Kenya.

3.3 Conclusion

Based on this brief profiling of the survey respondents, we have an idea of the individuals behind the survey and can thus read the results from questions about 3D infrastructures with the following basic knowledge:

1. Most respondents are coming from the academic or research-based professional sector.

2. They are mostly responding to the survey as an individual, but some are responding on behalf of their research project or organization.

3. Photogrammetry is the most used model type in their work. However, other 3D capture devices are being used and can be classed under 3D acquisition of existing cultural heritage sites and objects.

4. While less frequent, computer graphic (re)construction is also utilized in the respondents' work at a significant rate.

5. .obj is the most commonly used 3D file format.

6. The respondents are generally of a more mature age, from late 20's to early 60's.

7. There is an almost equal spread of gender, slightly favoring male.

8. Almost exclusively, the respondents are from North America or Europe in both their nationality and their workplace.

Chapter 4: Quantitative Results

This chapter of the report covers the quantitative section of the survey from a range of generalized questions about the respondents' needs and desires for a web-based 3D infrastructure. A number of infrastructure aspects were addressed in these questions including: viewing device, web-viewer features, annotation features, searchability, licensing, end-user capabilities, preservation of the data and valorization of 3D scholarship. The full graphs of the 48 selected responses generated by Qualtrics can be viewed in Appendix 7.2 of this report. Here, the responses were organized into charts and graphs to reflect the different themes of the survey as well as differentiate between question type (Likert scale, single-answer questions, and multi-answer questions) in order to synthesize better the data. Each sub-category of the responses are analyzed and recommendations provided.

The Likert scale questions used a five-point text-based scale to determine the respondents' attitude about different aspects of a 3D infrastructure. The different scale values are as follows (1) Not Important at All; (2) Somewhat Important; (3) Neutral; (4) Fairly Important; (5) Essential. Using these values, we can calculate a mean value for each sub-question on a scale of 1 to 5; 1 being a negative attitude and 5 being a positive attitude. By determining the mean value for Likert scale results, we can get a single sum value for each Likert scale sub-question. This single value is meant to conflate the values in order to determine the more subtle preferences of the respondents.

When an individual chose not to respond to the question, their count was added to the 3-value category (neutral) – in so doing, we make the assumption that the respondent has no opinions on the sub-question and thus their lack of response indicates an ambivalence.

4.1 Viewing Device

Question 5 of the survey asked about which device the platform should be viewed on. An overview of the responses can be viewed in Figure 7, whereas Figure 8 shows the mean value from the Likert scale results for each sub-question.

Figure 7: Bar chart depicting Likert Scale counts for Question 5.

Figure 8: Representation of the mean values of the Likert scale results for Question 5.

These mean values suggest that desktop/laptop compatibility is the most 'essential' device for a 3D scholarly infrastructure (4.9). Respondents feel that mobiles and tablets are equally 'fairly important' (4.3), while their opinions about compatibility with AR/VR headsets are between 'neutral' and 'fairly important' (3.6). 'Other' was selected 4 times without information provided, we should look into what other possible devices that PURE3D could be supported on.

4.2 Viewer Features

Questions 6 and 7 attempted to get a sense of the kind of features that content creators are most in need of. The results can be viewed from the Likert Scale graphs in Figures 9 and 11, whereas Figures 10 and 12 show the mean values for these results.
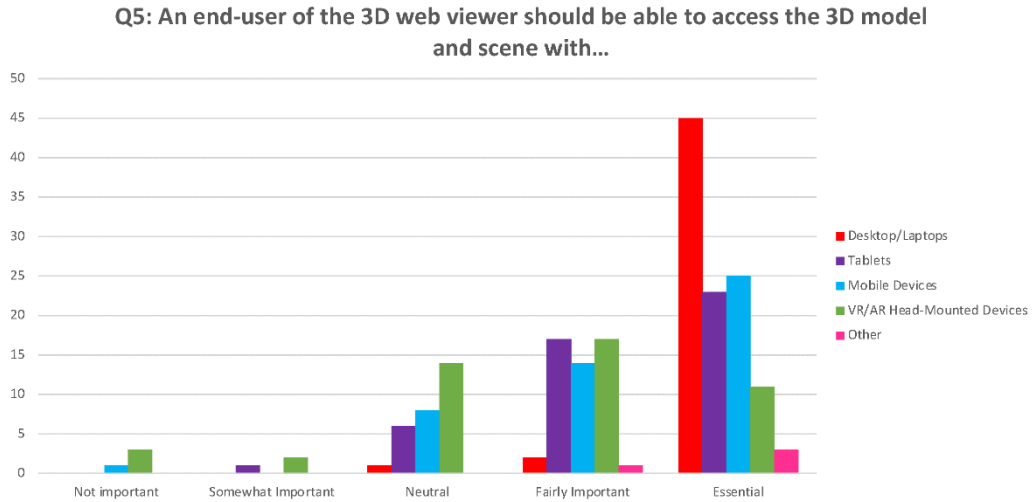

Figure 9: Bar chart depicting Likert Scale counts for Question 6.

Figure 10: Representation of the mean values of the Likert Scale results for Question 6.

Figure 11: Bar chart depicting Likert Scale counts for Question 7.
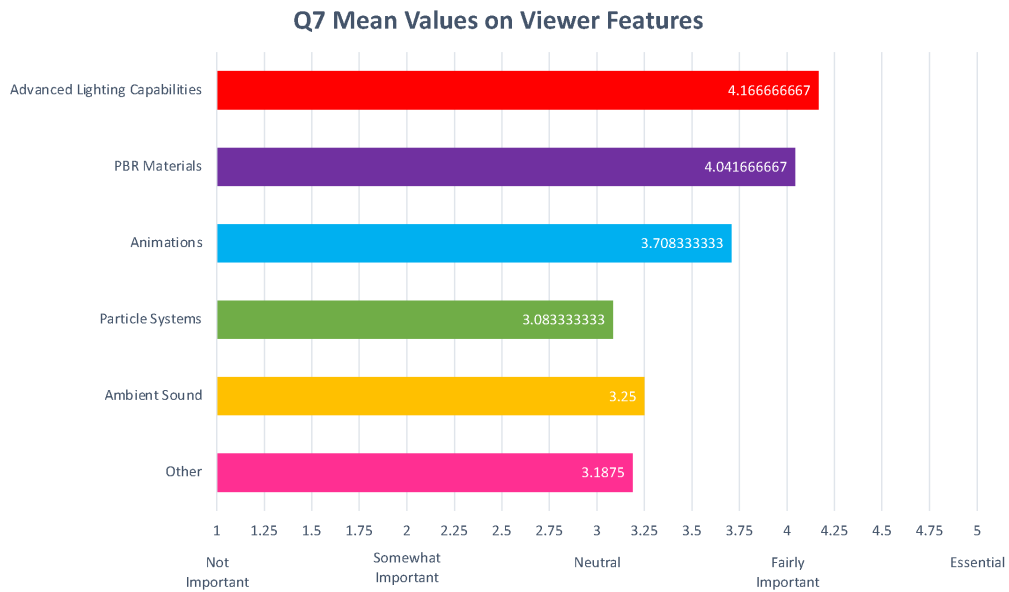
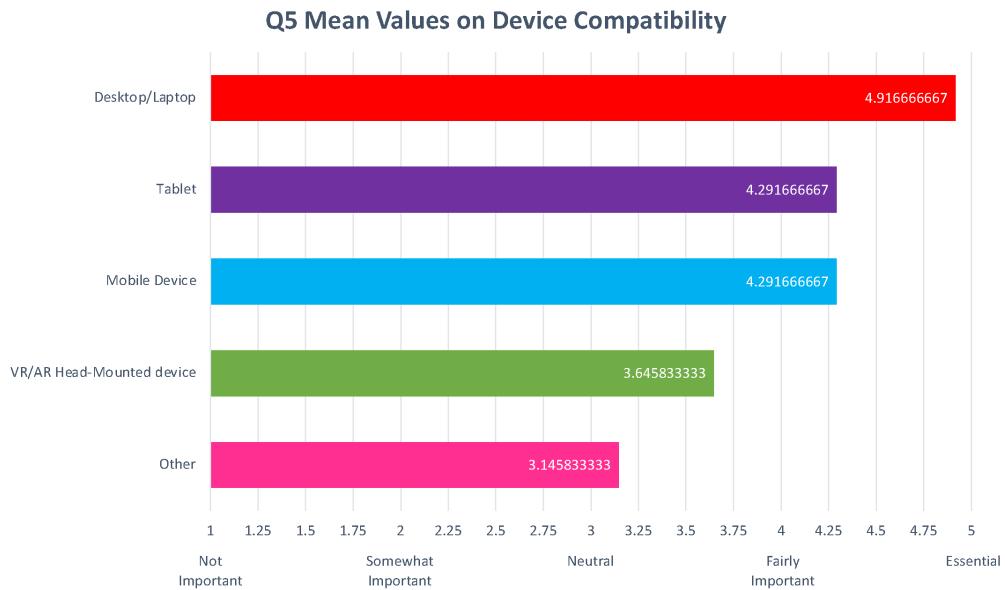Figure 12: Representation of the mean values of the Likert scale results for Question 7.

At first, the viewer features that respondents thought were essential was surprising, but when compared with the 3D model type majority (3D Acquisition) it makes sense that measurement tool (4.5) was significantly more important. Cross-section tools (4.1), the ability to remove parts of the scene (4.1), Lighting (4.1), PBR materials (4.0), integrated screenshot capabilities (3.8) and Timeline (3.8) were viewed as important, albeit less essential. Animation

(3.7), allowing the end-user to add annotations (3.6), Ambient Sound (3.3) and Particle systems (3.1) were the least favored of these suggested features.

'Other' was selected at a higher rate than usual, although no examples were provided. This may mean that users are looking for capabilities that we have not considered yet or do not yet exist. Unfortunately, we cannot include all desired features into the platform and so we will need to choose carefully to decide which viewer features are supported in PURE3D. The other features are a bit inconclusive and therefore this topic should be explored more in interviews and focus groups with different target audiences to get a better sense of the kinds of interactive features that users are looking for.

4.3 Annotations

Question 8 of the survey covers general questions about annotations within the 3D web viewer, e.g., how are they identified within the scene or whether they are searchable within and without the platform. An overview of the Likert Scale responses can be viewed in Figure 13, while Figure 14 shows the mean values of these results.
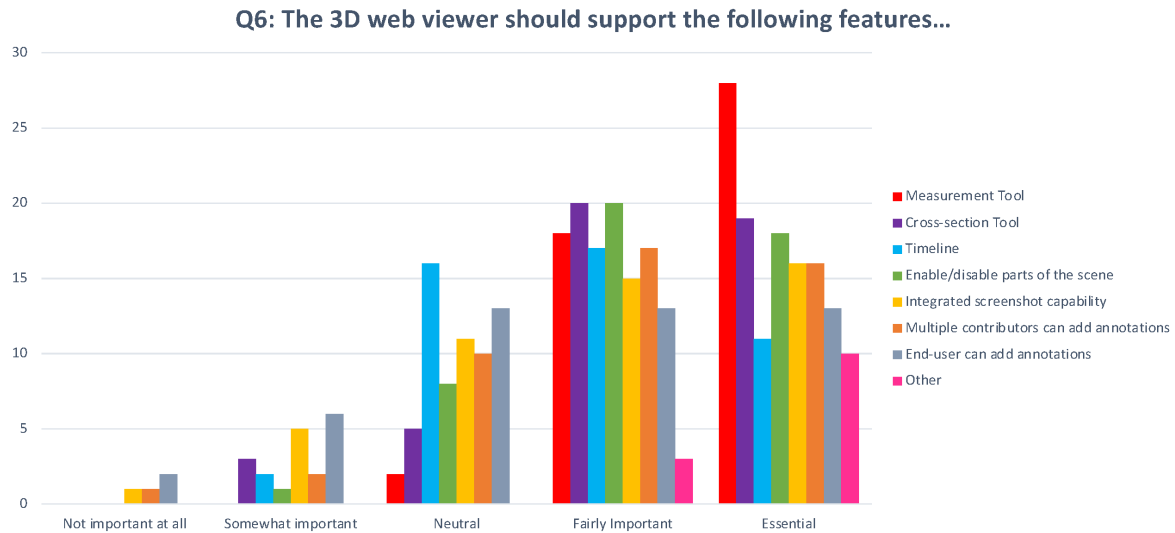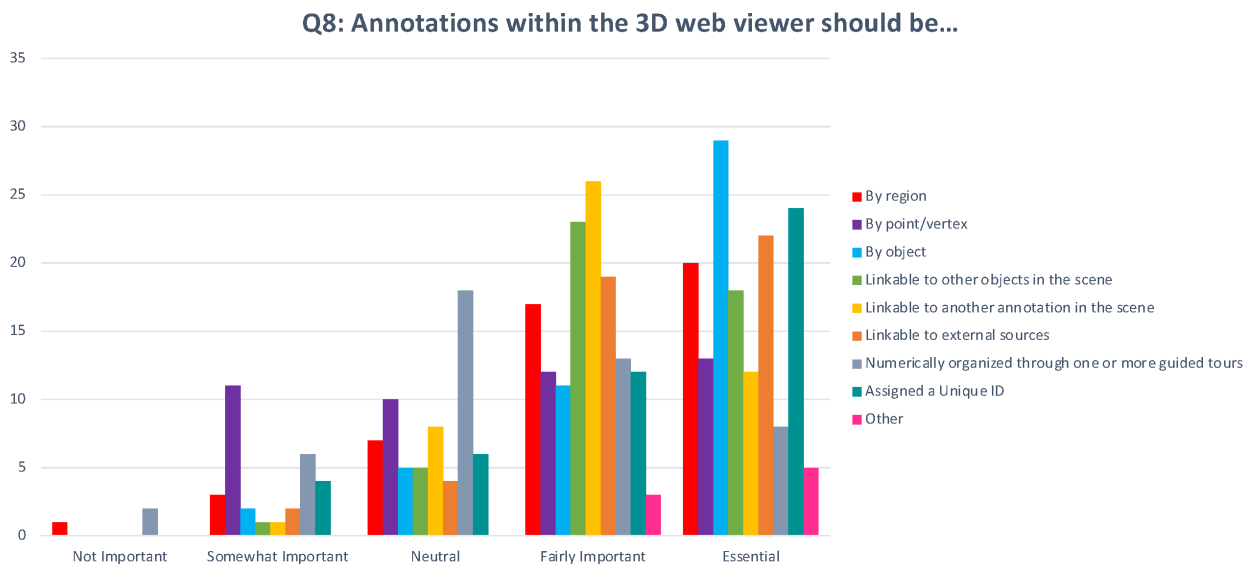

Figure 13: Bar chart depicting Likert Scale counts for Question 8.
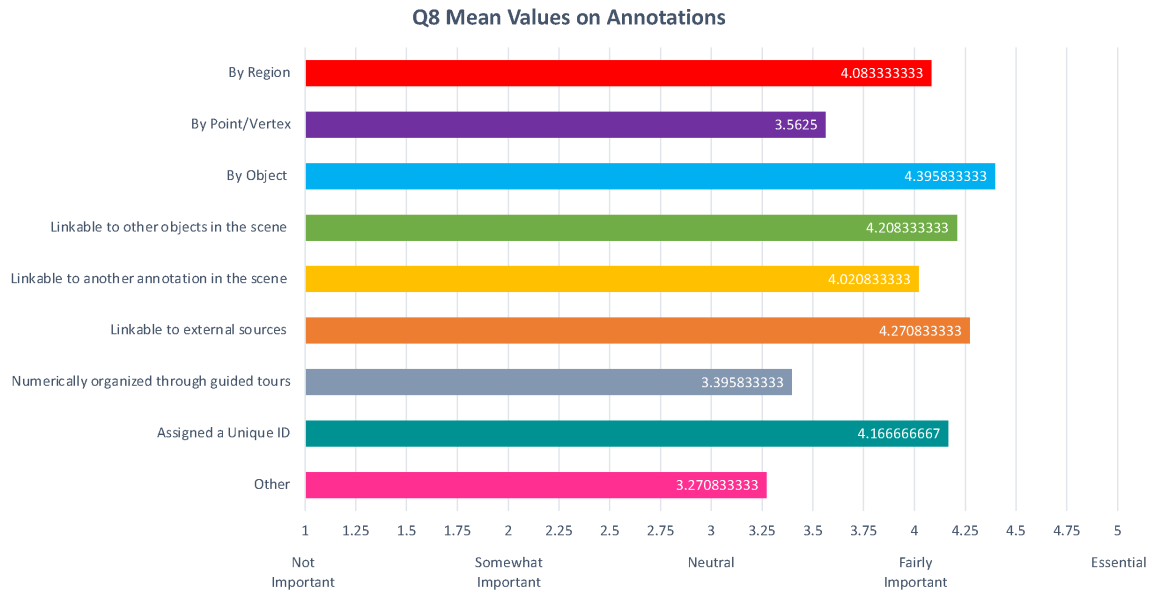
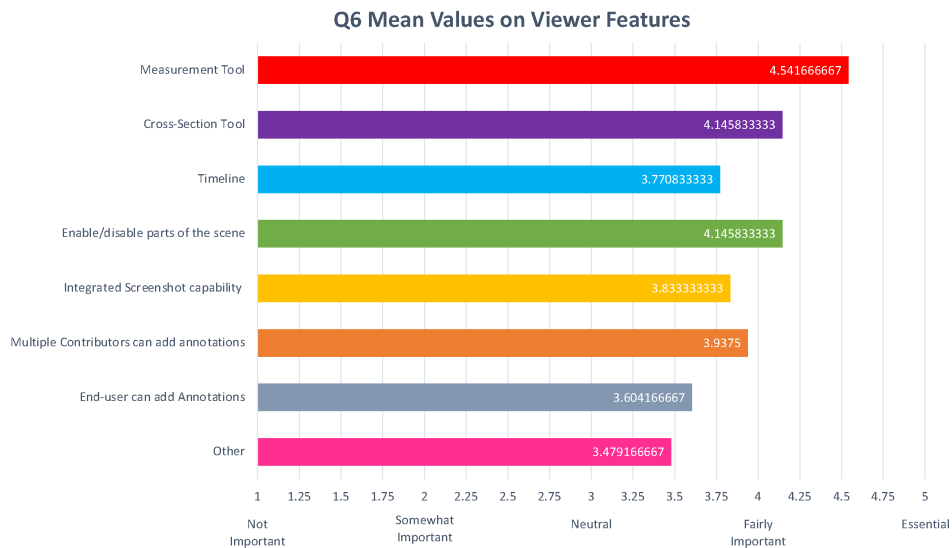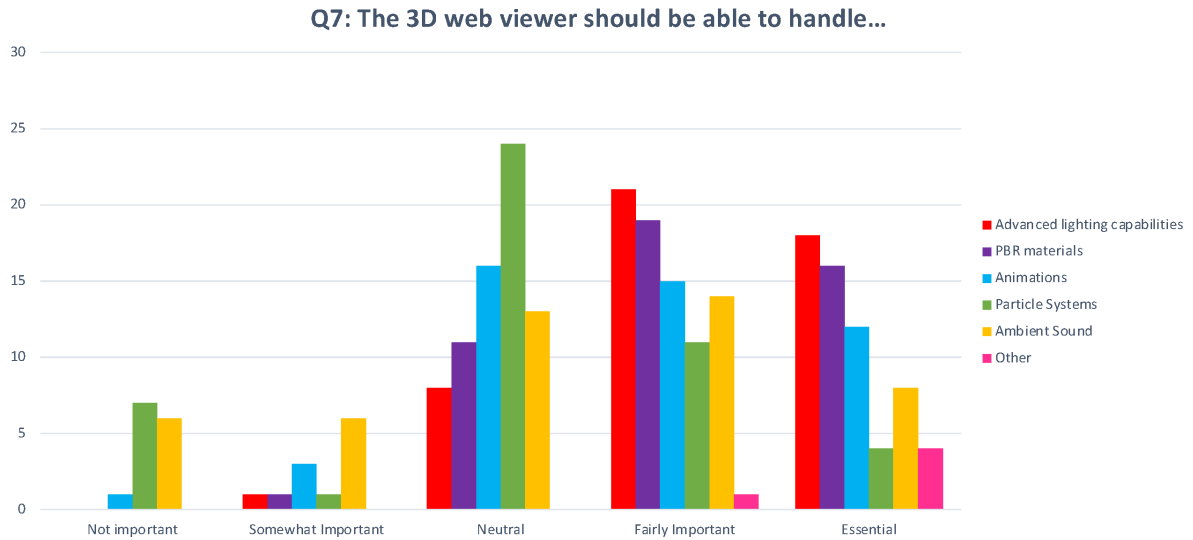Figure 14: Representation of the mean values of the Likert scale results for Question 8.

The majority of the respondents (4.4) think it is essential that annotations be attached to 3D objects. Region (4.1) was also favored, especially compared to annotations designated by Point/Vertex (3.7). We should consider clarifying how respondents interpreted 'region' – i.e., region of a single object or region of a larger scene that may include multiple objects, e.g., a room or section of a city. Annotation designated by vertex was less desired by the respondents. We may consider not supporting this option for PURE3D.

Respondents slightly prefer the idea that annotations are linkable to external resources (4.3) rather than to objects (4.2) or to other annotations (4.0) within the scene. They were lukewarm about a numerically organized narrative or guided tour (3.4). However, the results suggest respondents tend to favor a Unique ID assigned for each annotation (4.2).

4.4 Searchability and Licensing

Question 13 of the survey asks respondents about further platform features that can be synthesized into searchability of projects both inside and outside the platform as well as questions about licensing and citation of the projects. An overview of the Likert Scale responses can be viewed in Figure 15, while Figure 16 shows the mean values of these sub-questions.

Q13: In addition to web-viewing capabilities, the platform should…
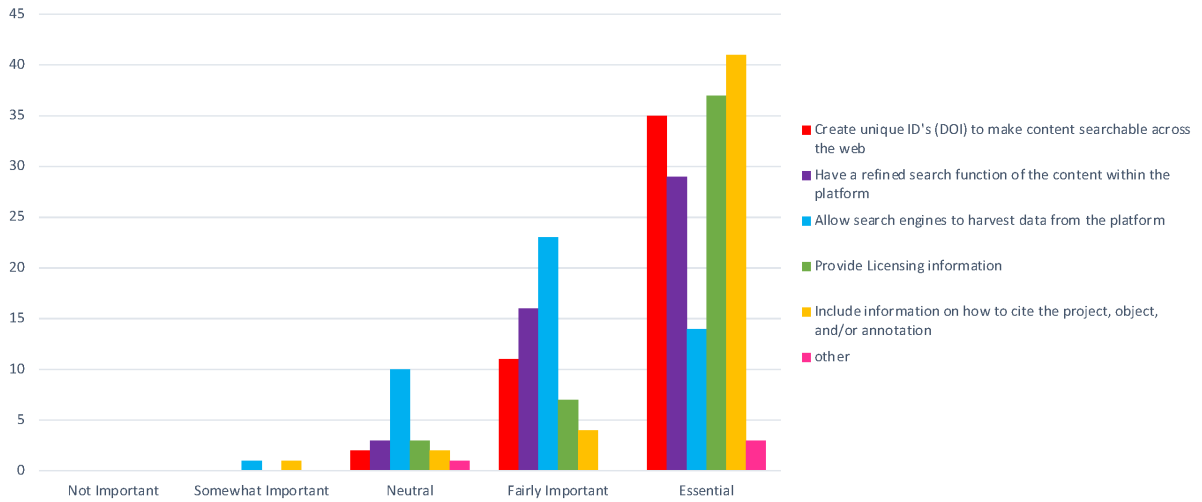
Figure 15: Bar chart depicting Likert Scale counts for Question 13.

Q13 Mean Values on Platform Capabilities
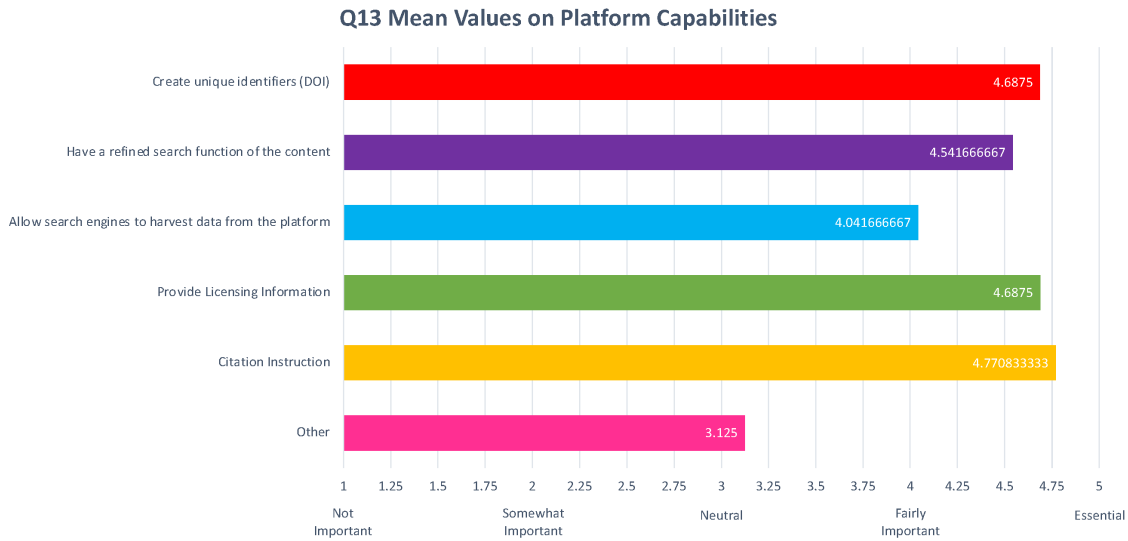
Figure 16: Representation of the mean values of the Likert scale results for Question 13.

The creation of a DOI for the 3D content to be searchable across the web was highly favored by respondents (4.7). As was the ability to have a refined search function within the platform (4.5). Something which was less attractive was allowing external search engines to harvest data from the platform (4.0). Perhaps this question was ambiguous or too high-level that

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the respondents were unsure about its meaning. We should seek to clarify this topic in further user studies.

For licensing and citation, the respondents found these kinds of information highly favorable for an ideal platform. Licensing information (4.7) and information on how to cite the various elements of the project (4.8) both gained some of the overall highest mean values from the Likert Scale questions. While licensing of the project materials is clarified a bit more in the subsequent section, we should refine more how content creators may wish to share or protect their materials. It would also be interesting to conduct a small study or focus group about project, object and annotation citation conventions. Do standards for this kind of material currently exist? If not, how could such a citation look?

4.5 End-User Capabilities

Questions 9 to 12 of the survey asks respondents to answer multiple choice or multiple answer questions related to end-user capabilities.

Q9 - Should end-users create a personal profile?
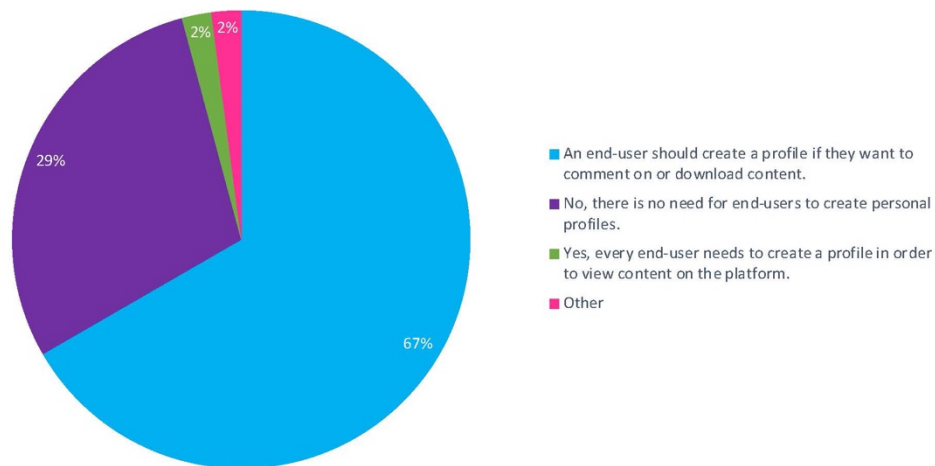
Figure 17: Pie chart depicting single-answer percentages for Question 9.

Question 9 of the survey asks a single-answer question about end-user capabilities. The majority of respondents (67% or 32/48) think that user profiles should be obligatory but only if the user wants to comment on projects or download content. While 29% (14/48) of respondents think that it is unnecessary for an end-user profile. One respondent (2%) thinks that every end-user

should create a profile in order to view content on the platform. One comment was left under "Other" and states:

- "All the above solutions….it depends on the access restrictions chosen by the rights owner of the 3D object chosen by the creator"
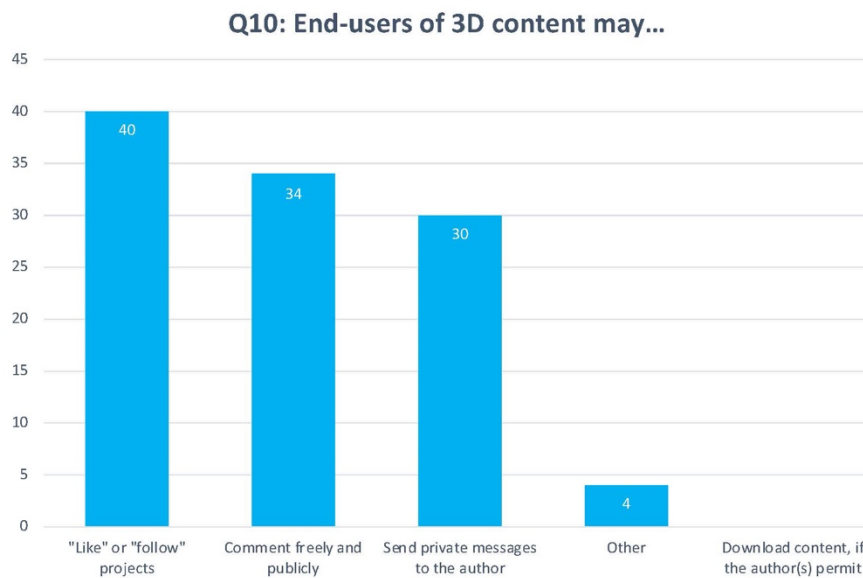
Figure 18: Bar chart depicting multi-answer counts out of 48 respondents for Question 10.

Question 10 regards end-user capabilities. 80% (40/48) of respondents feel that users should be able to like or follow projects; 71% (34/48) think that end-users should be able to comment freely and publicly; 63% (30/48) think that end-users should be able to privately message the author of a project. three comments were left under the "Other" category, they are:

- "comment privately"
- "make annotations to improve the 3D content by the author"
- "download without permission"
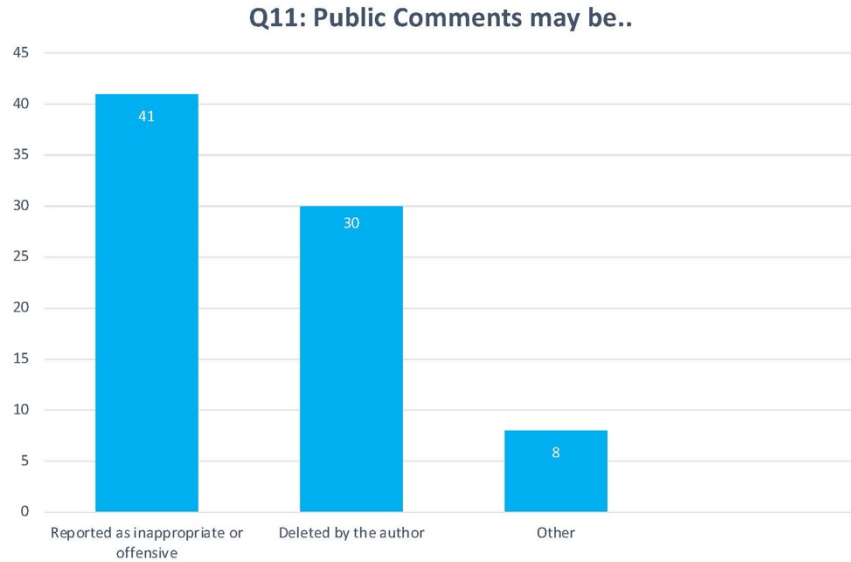
Figure 19: Bar chart depicting multi-answer counts out of 48 respondents for Question 11.

Question 11 asks about public comments made by end-users. 90% (41/48) believe that some comments can be reported as inappropriate or offensive and 63% (30/48) believe that the author should have the authority to delete comments about their project. There was a decent amount of input from the respondents about this question, these are:

o   "Not possible"

o   "No public comments"

o   "Public comments should not be present at all"

o   "disabled on a given model by the creator"

o   "spam filtered";

o   "answered by the author"

o   "mediated by curator"

Questions 10 and 11 suggest that while authors like the idea of having interactions with end-users, they also want to retain the capacity to filter or disable public comments altogether. It may be the case that certain project authors only want to have private feedback from the end-user. We should look into ways to permit the project owner to set whether a project is open to public comments or closed. If the project is closed, is there a private messaging system within the platform? Or does the project page have an email where an owner can be contacted?
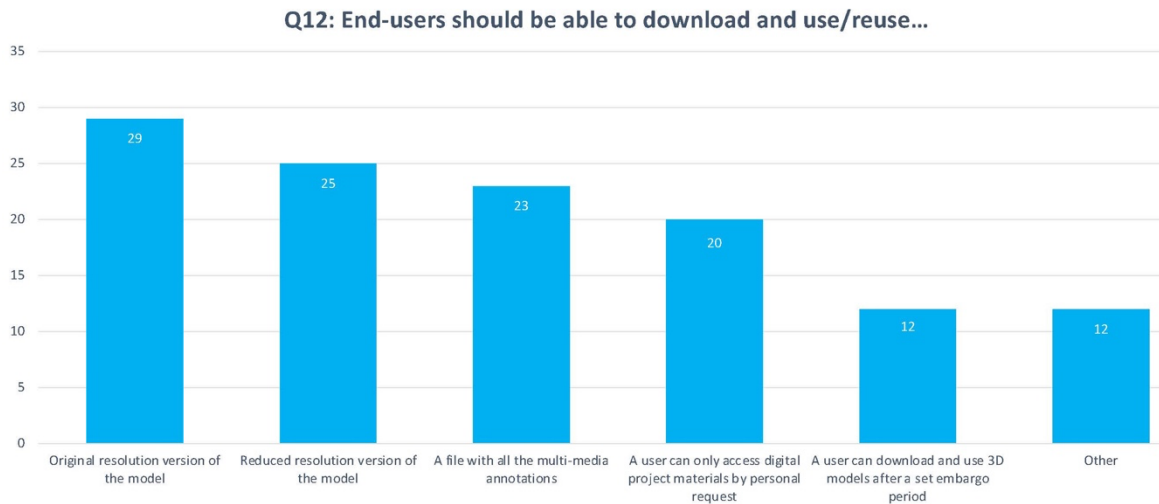
Figure 20: Bar chart depicting multi-answer counts out of 48 respondents for Question 12.

Question 12 asks respondents to provide multiple choice answers to the question about downloading content for use and/or reuse. 60% (29/48) agree that end-users should be able to download original resolution content; 52% (25/48) think they should have this ability but with a reduced resolution version; 48% (23/48) think that users should be able to download a file with all the annotation multi-media; 42% (20/48) think that users can access digital project materials only by personal request; 25% (12/48) think that users can access after a set embargo period. Additionally, Question 12 generated a lot of comments in the "other" section, they are:

o   "has to be defined by resource"

o   "All of them, but it depends on the author's will"

o   "possible API access enabled at some point for analysis of 3D files as data"

o   "these settings should be determined by the model owner"

o   "this should be left to decided by the modeler on a case-by-case basis"

o   "Creative Commons licensing"

o   "it depends on the access rights on the object"

o   "original resolution version of the model by personal request to the author"

o   "depends on context and sensitivity issues"

o   "metadata and paradata for the model and its creation process"

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- o "All of the above with author permission for derivative creations. For public collections, original full resolution scans should be made available after the initial limited embargo period allow for the researcher to publish"

- o "A robust system should be able to accommodate all of those scenarios, depending on the content and its community of origin"

What we can surmise from this fruitful feedback is that content creators are desirous of a flexible solution in which the author or owner has sole discretion on which datasets (3D models, metadata, paradata, annotations, etc.) are permissible for public download, as opposed to just viewable on the platform. This question sparked quite a lot of respondent feedback and we should note it as a topic that will require further user requirement probing and research.

4.6 Preservation and Valorization

Questions 14 to 18 on the survey have respondents answer single-choice questions about sustainability, recognition and quality management of 3D scholarship. These questions also generated a lot of comments from respondents who have opinions about these topics that did not fit into oversimplified "Yes" or "No" categories. For this reason, future user studies could have more depth and breadth when addressing these topics. The results of these five questions are described below along with comments made by respondents.

Q14 - It is my expectation that a free open-source repository would keep and maintain my models for a duration of...

Legend:
- For however long the platform is being supported
- more than 10 years
- 5 years
- 3 years
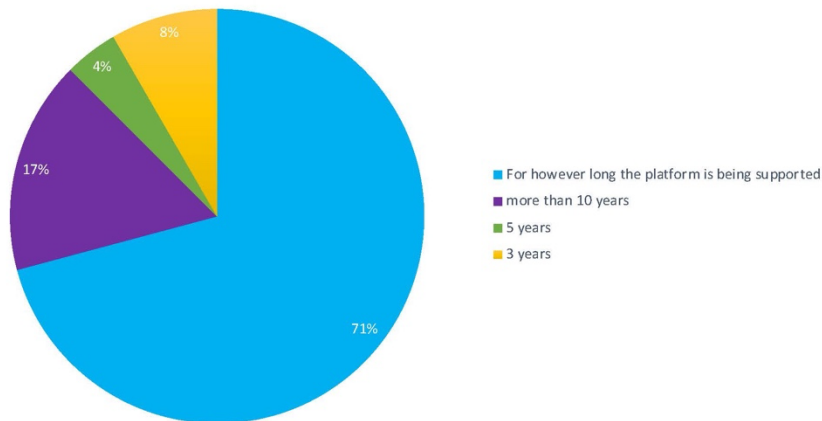
Figure 21: Pie chart depicting single-answer percentages for Question 14.

Question 14 asks about duration of preservation and maintenance that they would expect from a free and open-source repository. 71% (34/48) think that the repository should keep models for as long as the platform is being supported; 17% (8/48) believe that more than 10 years is a

sufficient time; 8% (4/48) said 3 years was enough; 4% (2/48) marked 5 years for the ideal duration.

Q15 - Would you include in a project's funding module the cost of perpetual care and long-term preservation?
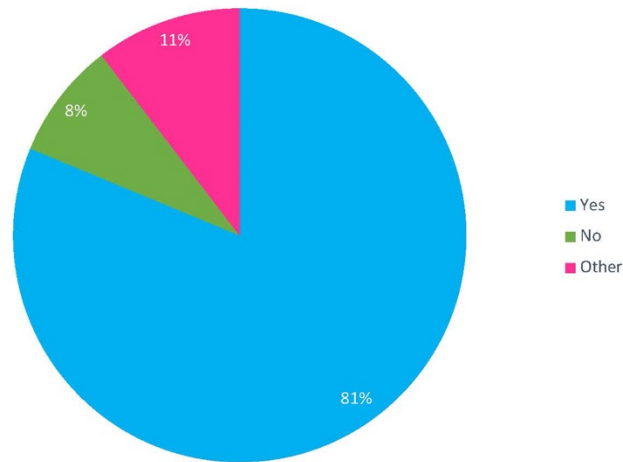
Figure 22: Pie chart depicting single-answer percentages for Question 15.

Questions 15 sought to refine a bit further this topic of long-term support by asking whether the respondent would include in their project funding module a portion of the funds to go to perpetual care of their project materials. 81% (39/48) said yes, they would do this; 8% (4/48) said no, they wouldn't; and 11% (5/48) selected "Other" and stated their opinion:

o   "depends on the cost"

o   "if allowable, yes"

o   "I don't know what a funding module is"

o   "I would be in favor of a paid tier for longer term storage/hosting, or free if the model is shared on a Creative Commons license"

o   "It depends on what that cost is, and how it would be paid for – yes, if it was a one-time fee that was in proportion to rest of the project budget"

Q16 - With either personal funding or project funding, would you be willing to pay for perpetual care of the models?

- Yes, based on a single upfront fee
- Yes, based on a yearly subscription model
- No, this does not interest me
- No, but I would be willing to update my 3D content myself to future standards when prompted by the platform
- Other
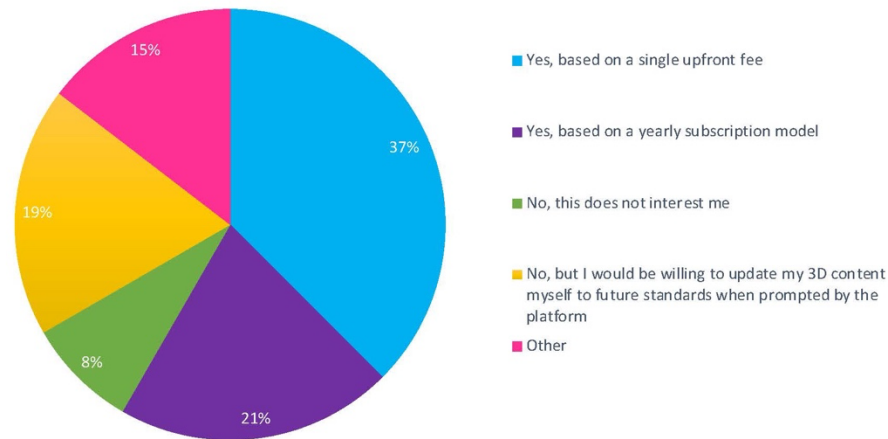
Figure 23: Pie chart depicting single-answer percentages for Question 16.

Question 16 followed up on this and asked if the respondent would pay for perpetual care of the models with either personal or project funding. Results for this question are a bit more variable: 37% (18/48) said yes, based on a single upfront fee; 21% (10/48) said yes, based on a yearly subscription model; 8% (4/48) said no, this was not of interest to them; 19% (9/48) said no, but they would be willing to update the models to future standards if prompted by the platform; 15% (7/48) selected "Other" and responded with the following input:

o   "I would love to have a pay per view option for the creator sharing the revenue between him and related parties, e.g., the project maintainers"

o   "Depends on the fee"

o   "Any of these models are potentially of interest. My most important feature would be that the platform itself is stable long term"

o   "If I was an end user with funding, I would be open to paying either a single fee or a yearly subscription fee, depending on who was offering it and what services came with it"

o   "Core functionality should be integrated into existing (and funded) open research data platforms";

o   "yes, but with the donation/Wikipedia model"

o   "Yes, with project funding based on a yearly or perpetual fee"

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Q17 - Does your organization or institution recognize and reward this type of atypical scholarly output?

Figure 24: Pie chart depicting single-answer percentages for Question 17.

Question 17 asks whether the respondent gets any kind of institutional recognition for 3D scholarship. 56% (27) said "yes"; 17% (8/48) said "no"; this wasn't revenant for 15% (7/48) of respondents; 12% (6/48) provided comments under "Other":

o   "not sure"

o   "they do not grasp the significance of 3D modelling (although they are getting the general idea)"

o   "this output may be recognized on an ad hoc basis, but it is not considered scholarly output on a policy level"

o   "they're working on standards for this not. I expect that they will in ~3 years"

o   "Depends on who asks for it"

o   "Not sure as I'm ERC and don't count for most things at my Uni!"

Q18 - Should projects be peer-reviewed before being published on the platform?
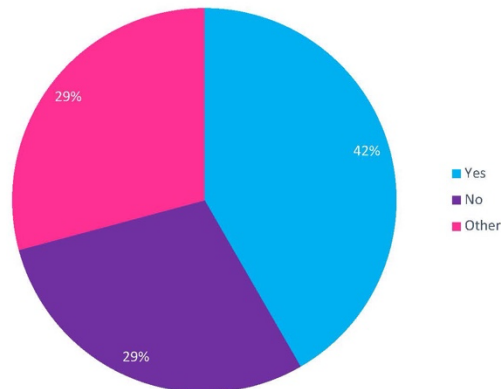
Figure 25: Pie chart depicting single-answer percentages for Question 18.

Question 18 wraps up the general hypothetical questions section by asking whether projects should be peer-reviewed before being published on such a platform. 42% (20/48) said "yes"; 29% (14/48) said "no"; and another 29% (14/48) provided comments under "Other":

o   "Depends on the object and purpose"

o   "Peer-reviewed projects should be identified"

o   "Only if end-user is not member of a university"

o   "Provide the option"

o   "I would love for this to be an option, and to make it possible to search only peer-reviewed models. I would not want that to be the only way to upload and share, especially given the turnaround time for peer review"

o   "It depends on the context"

o   "Not as a condition of publication, but certain models could be submitted for review"

o   "I'd say it depends on the mission of the platform"

o   "Let creators choose if they want peer review"

o   "It depends on what stipulations the institution is making about the content and who the audience is. (young school ago education, academic, or "life-long learning")"

o   "The content should be curated, but only so the content is relevant"

o   "If the projects meet the standards defined by the platform, it shouldn't"

o   "Not necessarily, but the option is interesting and good to add"

26

4.7 Recommendations

In order to find value in the Likert Scale survey results from this section on generalized hypothetical requirements for a 3D scholarly infrastructure it was decided to focus on sub-question features and capabilities that received a 4.0 or more as a mean value from the Likert scale results. This would help to narrow down the PURE3D platform's capacity based on what content creators are looking for in such an infrastructure. In using this parameter, the following recommendations are provided in order of priority per sub-category:

The compatible viewing devices should be:

1. Desktop/Laptop (4.92)

2. Mobiles (4.29)

3. Tablets (4.29)

The viewer should have the following features:

1. Measurement Tool (4.54)

2. Advanced Lighting capabilities (4.16)

3. Cross section Tool (4.15)

4. Enable/disable parts of the scene (4.15)

5. PBR materials (4.04)

Annotations should be:

1. By Object (4.40)

2. Linkable to external sources (4.27)

3. Linkable to other objects in the scene (4.21)

4. Assigned a Unique ID (4.17)

5. By Region (4.08)

6. Linkable to other Annotations in the scene (4.02)

The platform should include the following:

1. Have instruction on how to cite a project, object, and/or annotation (4.77)

2. Create Unique Identifiers (DOI) (4.69)

3. Provide Licensing Information (4.69)

4. Have a refined Search function of the content on the platform (4.54)

5. Allow Search Engines to harvest data from the platform (4.04)

Recommendations for non-Likert Scale questions can be made based on a combination of the percentage values with an analysis of the comments made by some of the respondents.

<u>End-User Capabilities</u>

1. End-users should be given the option to create profiles, depending on how they wish to use and interact with the platform. It should not be a requirement for entering or engaging with the platform.

2. Users should be able to like or follow a project

3. Users should be able to comment on projects if the author of the content permits

4. Users should be able to privately message the author if the author permits

5. Comments should be reported as inappropriate or offensive

6. The author of a project should have the ability to delete comments themselves, without a platform mediator.

7. Authors of a project should have the ability to flexibly configure which digital content is downloadable and reusable

<u>Preservation and Valorization</u>

1. There should be no expiry date of models published on the platform

2. Paid perpetual care of the models/projects should be considered further

3. Authors should have the choice between a single up-front cost or a yearly subscription model for this upkeep

4. Peer-review of a project should be provided as an option for authors, but not a requirement to publish on the platform

5. If a project is peer-reviewed, there should be a label for this that allows users to do refined searches on the platform using "peer-reviewed" as a parameter

Chapter 5: Qualitative Results

Of the 48 respondents, exactly half (24) chose to answer a qualitative section of the survey by providing information about a 3D digital heritage project they participated in. The results of this portion of the survey can be found in Appendix 3 of this report.

The purpose of this section is to highlight and analyze relevant results from the questionnaire based on multiple choice questions and comments made from respondents about their example project. These results are further subdivided into the following topics: Project Details, Project Content, Project Goals, Annotation, Dissemination Methods and Preservation Plan.

5.1 Project Details

Project start date (Q21) and end date (Q22); the country in which the project was organized (Q24) and the country in which the project was based or executed (Q25); how the project was executed (individually or as a team) (Q27); and the respondent's role on the project (Q28).

From this information, we can get some background information for reading the subsequent project data, these are:

1. Project dates range from 2000 to 2025 or beyond.

2. Projects are organized and executed in North America or Europe; with the exception of Israel and Kenya

3. The projects were, to a large extent, executed as a research team. However, some projects were done in the course of a PhD or personal project (see Figure 26).

4. A significant portion of the respondents who answered the survey had technical roles, such as data acquisition, modeler, data steward; While others were in leadership roles, such as PI, project director, coordinator, co-founder, etc.

Q27: Was this 3D project executed by yourself or as part of a larger team?
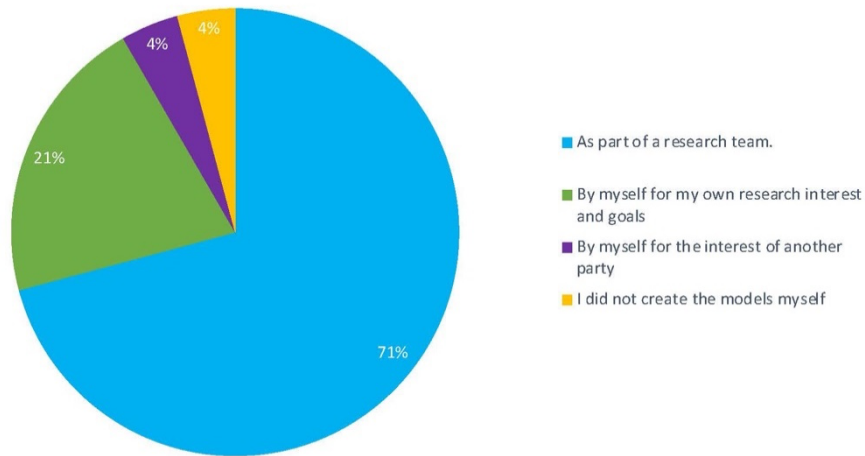
Figure 26: Pie chart depicting single-answer percentages for Question 27.

A 3D Scholarly Infrastructure should have the capacity to accommodate projects executed as a team or as an individual researcher. This may mean that a project is collaborative with multiple authors/owners who have various levels of editing and access rights. Additionally, the variance in roles for a project means that some users will have a higher level of technical know-how and whereas others may have a steeper learning curve. We should try to make the author's user experience as intuitive as possible by using familiar and established interface conventions. Currently, we see tips and short instructions for new users of an online platform, this could be a late stage feature we consider in the course of development of the PURE3D infrastructure.

5.2 Project Content

This section seeks to understand the overall subject matter of the example projects as well as what kind of 3D project it is.

Figure 27: Bar chart depicting multi-answer counts for Question 26.

Figure 27 shows the results of Question 26 from the survey in which respondents were asked which discipline(s) the project would fall under. While there was a healthy spread, the top choices were Archaeology (62.5%), Art History (54%), Historic Buildings (42%) and History (42%). Other disciplines include: Architecture (37.5%), Anthropology (21%), Contemporary or Modern Art (8%), Science (8%) and Museology (4%).

Figure 28: Bar chart depicting multi-answer counts for Question 29.

Figure 28 shows the results of Question 29 from the survey in which respondents were asked to identify the types and general subject matter of the 3D models in a project. Based on these numbers (81/24), we know that multiple model types were generated per project. The results

indicate that digitized single objects or a collection of single objects were the most popular model type at 71%, with 3D computer graphic reconstruction of a site (42%) or an object/set of objects (42%) coming tied in second place. The percentages for the other categories are as follows: 3D scan/photogrammetry of an Interior (33%), 3D scan/photogrammetry of a site/landscape (33%), point cloud of a site or building (33%), point cloud of an interior (29%), 3D computer graphic reconstruction of a landscape (25%) and 'Other' (29%).

Q37: What is the level of detail for your 3D scene?
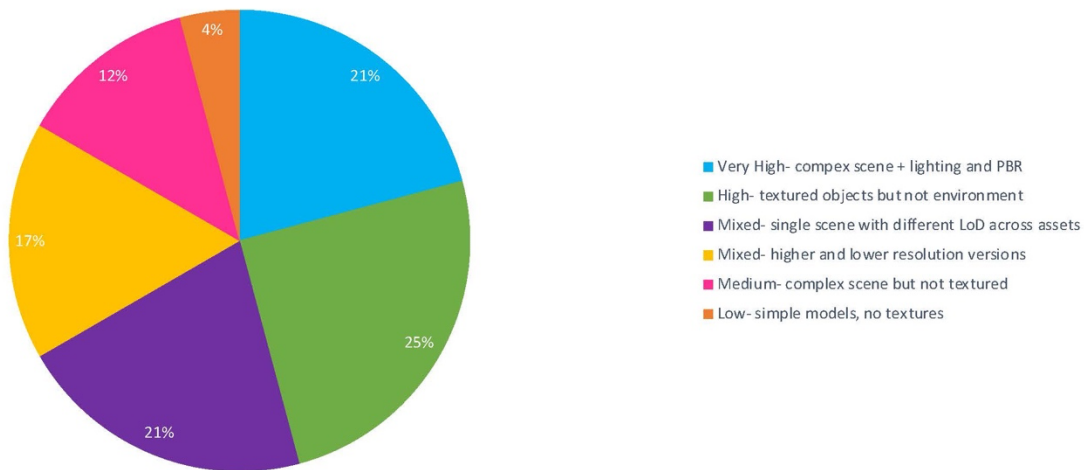
Figure 29: Pie chart depicting single-answer percentages for Question 37.

Figure 29 shows the results of Question 37 from the survey in which respondents were asked about the level of detail for their 3D project. The range of details varies across the project, although they tend towards a higher LoD (Level of Detail). 21% have a very high LoD using illumination and atmospherics, 25% have a high LoD using textured materials, 12.5% have a medium LoD, meaning the model is complex but not photo-realistic, 4% said their model was low LoD, not complex and not photo-realistic. 16% said they had a project with multiple resolution outputs, e.g., high for rendering image, and low for use in interactive spaces, and 21% said they had a single 3D scene with a mixed level of detail across the different 3D assets.

While history-based projects will likely be the most frequently published on PURE3D, we should not disconsider other disciplines within the humanities and social sciences, especially if these projects may require different features, labels, data types or metadata schemas. 3D scans/photogrammetry of a single object viewing is the most popular model type, but there are

already well-established platform options for viewing these models online (e.g., Sketchfab, 3DHOP and Smithsonian Voyager) but multiple objects in a complex scene (virtual world) is less common and is still being explored and developed. It will be a challenge for PURE3D to attempt a single web infrastructure that can accommodate both model types. Would we essentially need two viewers in this case? Or one viewer that can handle both types? We can expect a higher level of detail for projects, meaning complex scenes with photorealistic textures and possibly illumination or other atmospherics. However, since publishing on the web presents issues with file size, we will have to ask authors to convert or downgrade their interactive scene for publishing on the platform. There may be an option in which authors can also upload original resolution materials that end-users can download and view offline. Or provide a URL link to an institutional repository where they can access the raw materials.

5.3 Project Goals

Figure 30 shows the results of Question 30 from the survey in which respondents were asked about the role of the 3D work in the project. They were asked if generating 3D models were the intended outcome of the project (29%), if it was one of many other outputs (58%) or if it was a by-product of other project-related work (13%).
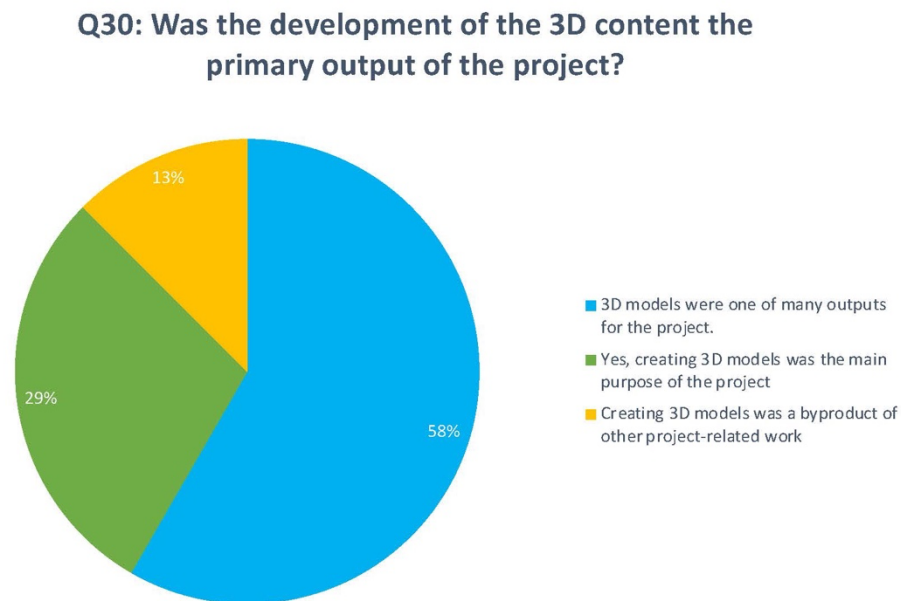
Figure 30: Pie chart depicting single-answer percentages for Question 30.
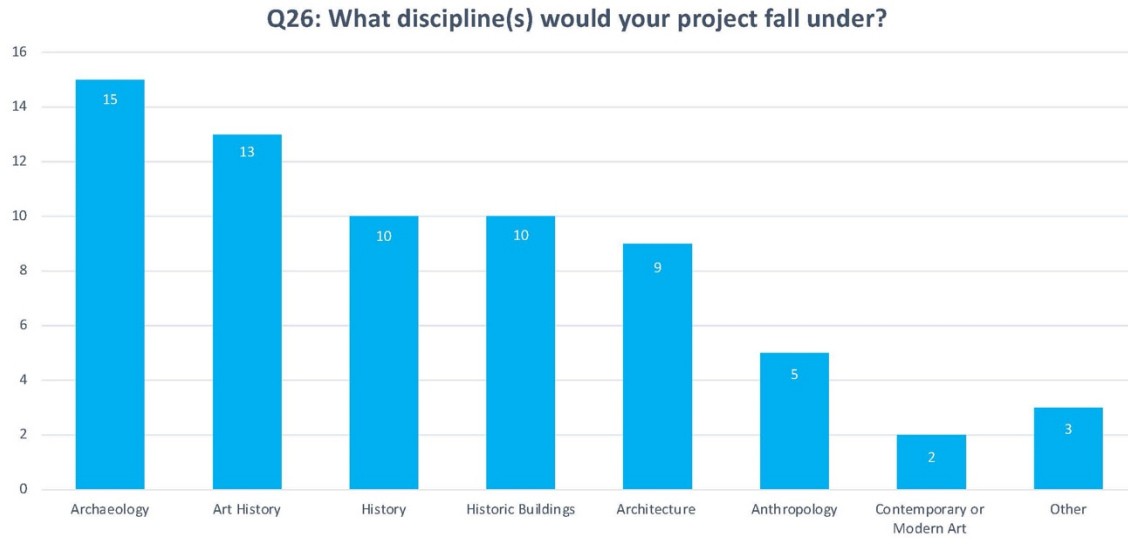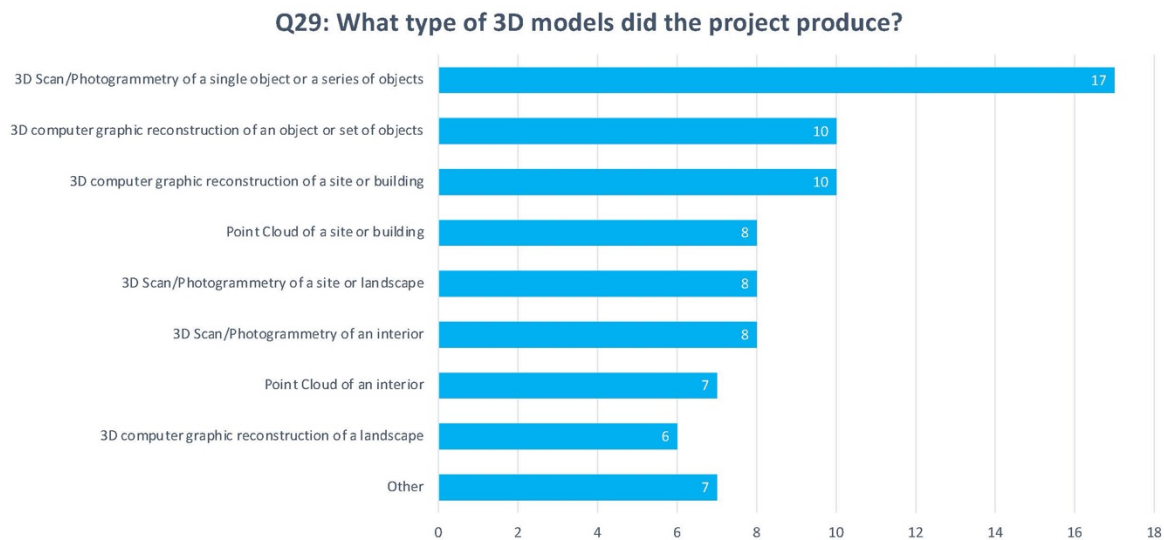
33
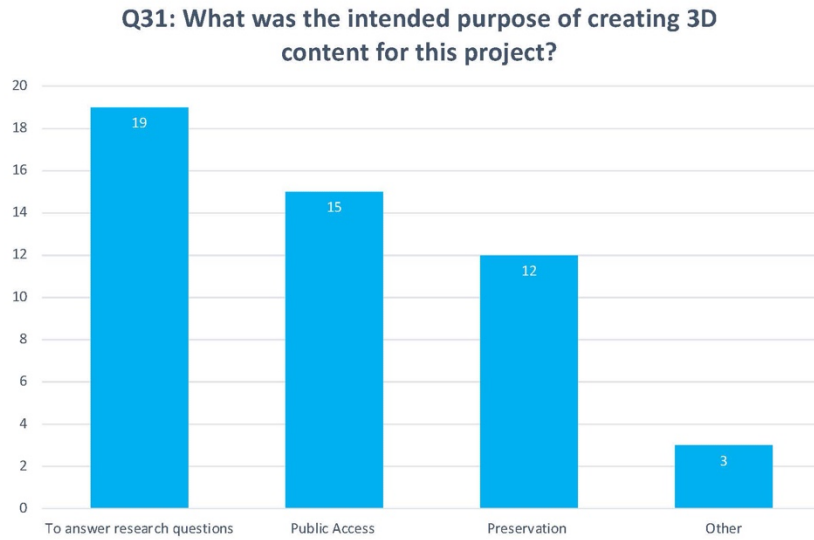
Figure 31: Bar chart depicting multi-answer counts for Question 31.

Figure 31 shows the results of Question 31 from the survey in which respondents were asked about the intended purpose of creating 3D content for their project; they were allowed to select more than one purpose. 79% said it was to answer research questions, 62.5% said it was for public access, 50% said it was for preservation purposes. Three respondents left comments:

o "having a mozilla hubs space for events to share more 3D in the future"

o "Student Research"

o "Interface to explore contextual resources (e.g. Linked Data))"
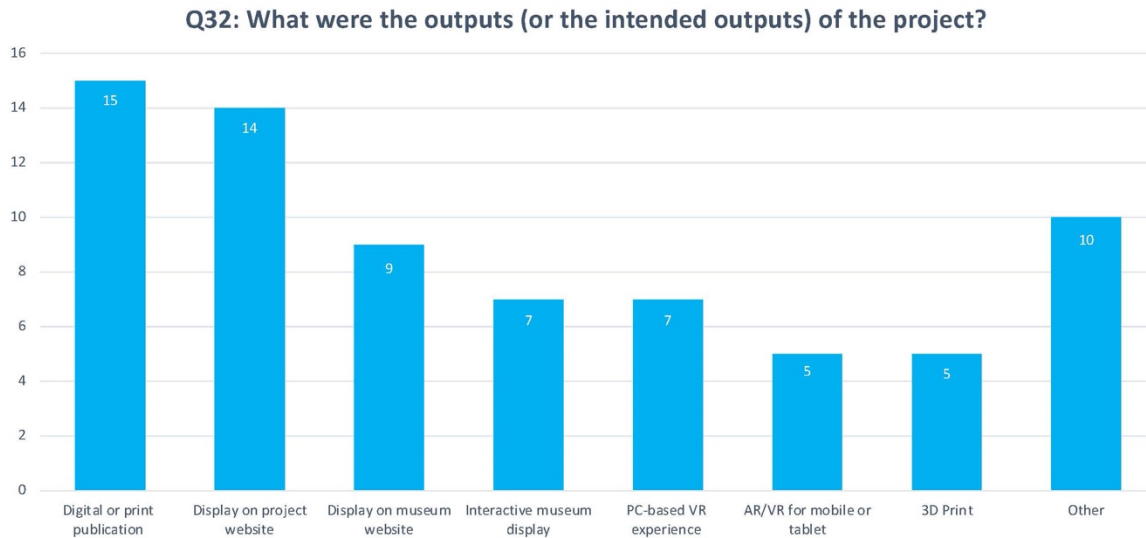
Figure 32: Bar chart depicting multi-answer counts for Question 32.

Figure 32 shows the results of Question 32 from the survey in which respondents were asked about the intended output(s) of the 3D aspect of the project; they were allowed to select more than one purpose. 62.5% said digital or print publication, 58% said for display on a project website, 37.5% said for display on a museum website, 29% said for an interactive museum display, 29% said for PC-based VR experience, 21% said for 3D printing, 21% said AR/VR for mobile or tablet, 12.5% said an online game and 42% selected "other" and some provided comments:

o   "sensitive cultural research collections (osteology)"

o   "Made available for EUROPEANA"

o   "In the longer term, it is hoped that an interactive museum display and an AR/VR experience for both mobile and PC can be produced"

o   "PhD thesis"

o   "Non-interactive museum display"

o   "Micro Traces analysis and thesaurus"

o   "Forward models to assist in archaeological interpretation"

o   "displayed in academic library repository"

Each project is unique and will have differing goals, outputs, constraints and agendas. An ideal infrastructure would be able to accommodate most if not all of these aspects. However, with "answering research questions" as a principle goal for most of the respondents, we should try to cater more to this area of 3D work. These questions of the survey justify the endeavors of PURE3D as there is a high rate of 3D scholarly research being done (79%) and yet a lower rate of interactive use of the models (12.5% to 29%). Instead, the models are disseminated for publication or display on project/museum websites (62% – 37.5%). This is where PURE3D would come in to fill the discrepancy between 3D research goals and 3D research output.

5.4 Annotation

Figure 33 shows the results of Question 38 from the survey in which respondents were asked whether they attached annotations together with their 3D scene. Results show that 58% (14/24) did have annotations within the scene and 42% (10/24) did not.

Q38: Did you include annotations (such as information panels, pop-up boxes, etc.) within the 3D scene?
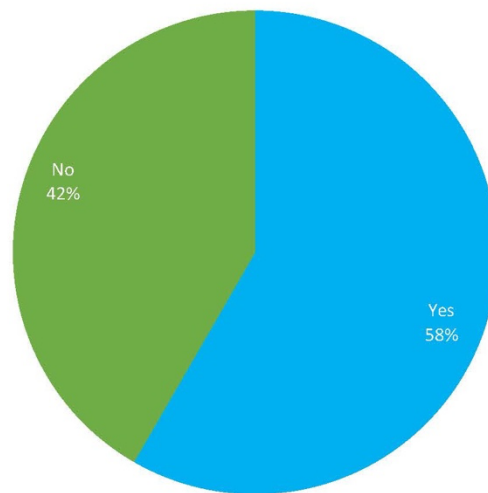
Figure 33: Pie chart depicting single-answer percentages for Question 38.

The 14 respondents who did include annotations were asked two further questions about the media types of their annotations and the content or subject matter of the annotations. They were allowed to select more than one answer for each question. Figure 34 is a representation of the results from Question 39 about the annotation media types and Figure 35 is a representation of the results from Question 40 about annotation subject matter.
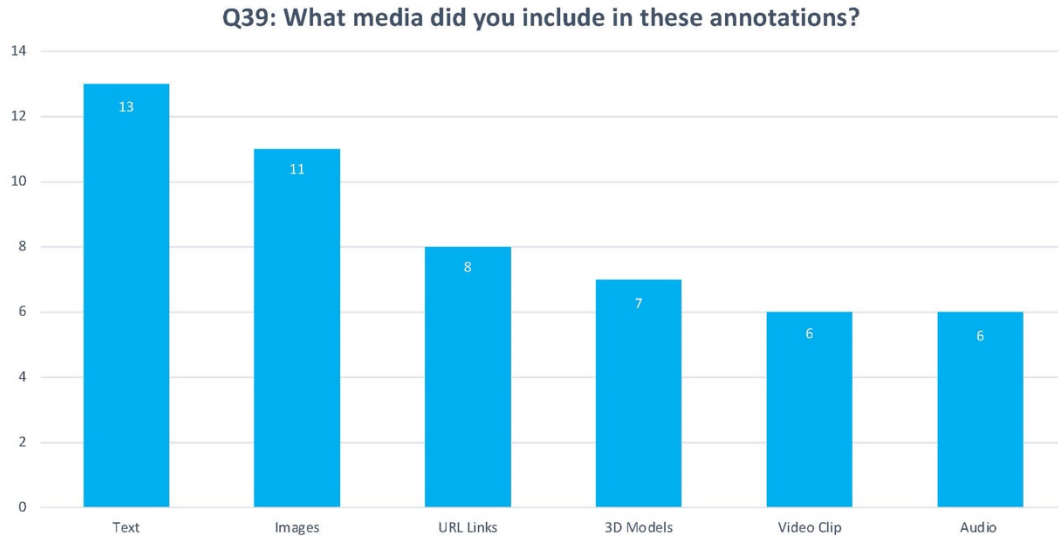
Figure 34: Bar chart depicting multi-answer counts for Question 39.

Nearly all (93% or 13/14) respondents said they used text-based annotations; 79% (11/14) said they used images; 57% (8/14) said they used URL links; 50% (7/14) said they used other 3D models as annotation; 43% (6/14) said they used video clips; and 43% (6/14) said they used audio.
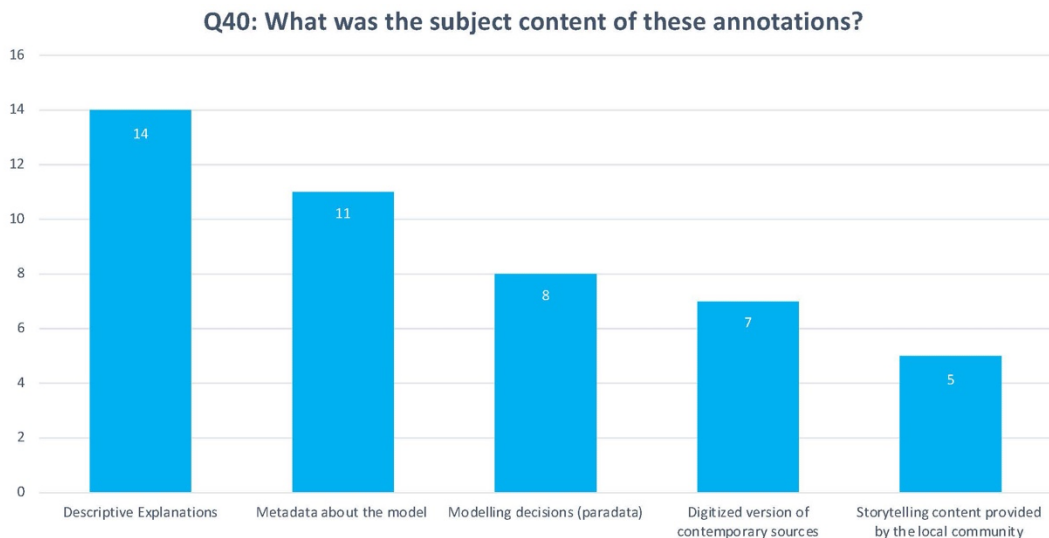
Figure 35: Bar chart depicting multi-answer counts for Question 40.

All respondents said their annotations had descriptive explanations (14/14); 79% (11/14) said their annotations had metadata about the model; 57% (8/14) said they had annotations about modeling decisions, also known as paradata; 50% (7/14) said they had digitized versions of

contemporary sources; 36% (5/14) said they had storytelling content provided by the local community.
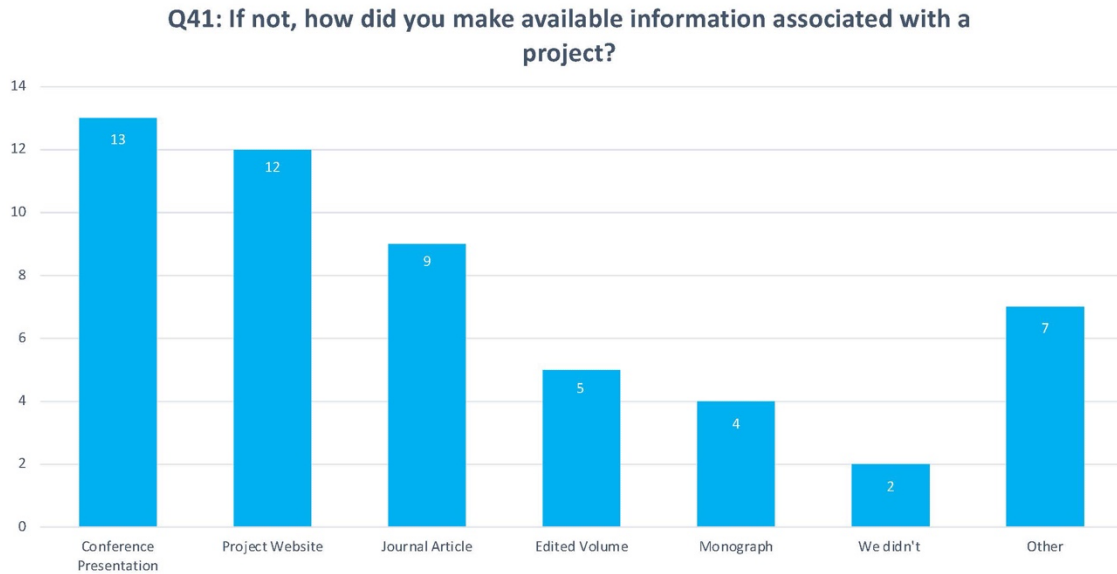
Figure 36: Bar chart depicting multi-answer counts for Question 41.

Question 41 was presented to all 24 respondents and were asked in what other ways they made information available about their 3D project. 54% (13/24) presented their project at a conference, 50% (12/24) provided information on a project website, 37.5% (9/24) published it as a journal article, 21% (5/24) published in an edited volume, 17% (4/24) published as a monograph, 8% said that they didn't and 29% (7/24) selected 'Other' and left the following comments:

o "Live moderation and explanations during events in realtime."

o "commit messages in version control, integrated documentation"

o "Parts shared in a variety of conferences. Other work is still underway"

o "Seminar"

o "ReadMe and CSV file"

o "Online PhD"

o "many of the above in progress"

The results of these questions reinforce what is already known about annotations in 3D environments – they are principally made up of text-based descriptions – but there is also a significant use of non-textual multi-media types and other subject matter that may be of interest to different audiences. We should be prepared to handle most, if not all, potential annotations and have an option in which the author can label or designate the media type and annotation content type. Perhaps one way of accommodating all the annotation varieties without overwhelming the user is to create different annotation categories (levels) for one scene, e.g., the first contains annotations that would be of interest to the public (contextualizing information and narratives); the second would contain annotations for a more informed scholarly (metadata, paradata, etc.).

5.5 Dissemination Methods

Question 34 of the survey asked whether the respondents used a web viewer to display their 3D content online. 62.5% (15/24) said that they did and were directed to Question 36 where they were asked which viewer they used (Figure 36). 37.5% of the respondents said they did not put the 3D content on a web viewer (9/15), they were directed to Question 35 where they were asked why they chose not to publish the models online (Figure 37).

Q34: Did you use a web viewer for displaying the 3D content online?

No
28%

Yes
72%
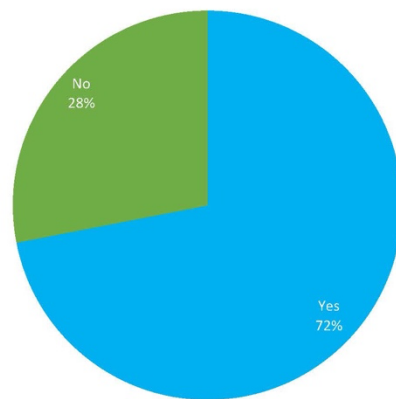
Figure 37: Pie chart depicting single-answer percentages for Question 34.
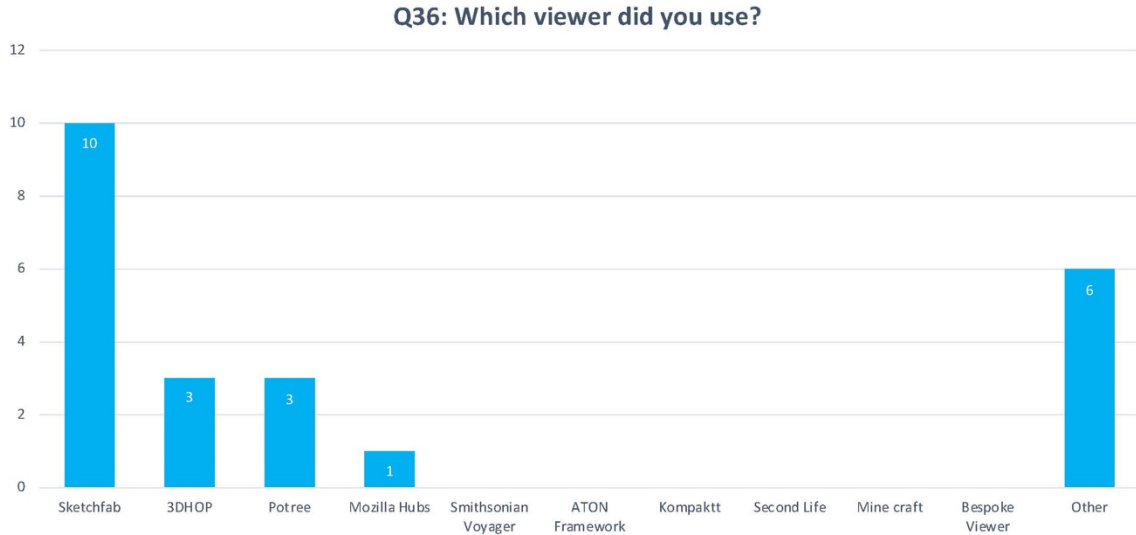
Figure 38: Bar chart depicting multi-answer counts for Question 36.

For Question 36, respondents were allowed to select more than one viewer. Sketchfab was the most common at 67% (10/15), after that 3DHOP and Potree were tied in second place at 20% (3/15) and Mozilla Hubs was selected once 6% (1/15). 'Other' had 40% (6/15), the comments for this are:

o "Currently experimenting with output of UE5, Unity and TivoliCloud VR"

o "open source- customized"

o "Matterport"

o "A web-viewer designed within our project"

o "Google Model Viewer"

o "working on local solution based on 3Dom"
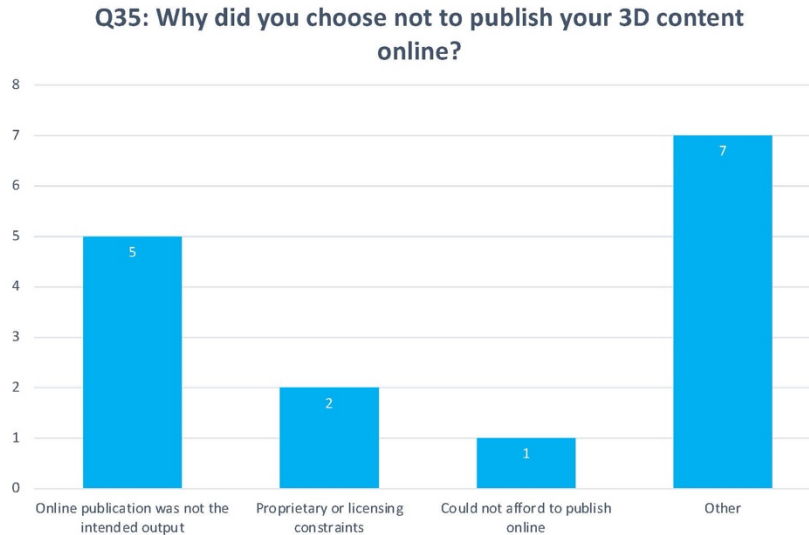
Figure 39: Bar chart depicting multi-answer counts for Question 35.

Question 35 was also a multi-answer question. 56% (5/9) said publishing online was not the intended output of their project; 22% (2/9) said there were proprietary constraints; 22% (2/9) said there was a lack of funding; 78% (7/9) said they had other reasons for not publishing online and provided comments:

o   "Sensitive cultural collections and human remains"

o   "Too complex geometry at the time of creation (was not even possible to load entire model into a local workstation), 3D model was a means to generate the primary research data."

o   "Work is intentionally experimental and I don't want it being taken as a definitive reconstruction"

o   "Time constraints – it is hoped that this will be achieved in the next phase of the project"

o   "We did not incorporate a viewer into the database, and the formats available were not suitable (although we are still exploring the possibility of displaying models in an ESRI online environment); we also have a model in Unity but have not yet figured out how to publish it online"

Based on the results and feedback from the Dissemination questions we have a glimpse into some of the challenges that 3D content creators are facing when it comes to publishing their 3D content online. One issue is lack of technical know-how, Sketchfab is popular and easy to use which may explain the higher rate of its use. Lack of funds is also a constraint for many projects thus a bespoke solution is not available to many. Proprietary or sensitive subject matter is a lesser, but still important, reason that many 3D projects are not published online. Finally, although it is

41

only mentioned once it is a reason that likely many other researchers also encounter – the fear of misrepresentation of hypothetical models (e.g., 3D computer graphic reconstructions) and thus the fear of academic censure because of this.

5.6 Preservation Plan

Question 33 of the survey was an open-ended question whereby respondents were asked to describe their preservation plan for the project. 22 out of 24 answered this question and the full responses can be viewed in Appendix 3 under Question 33. Provided here is a synthesis of their overall comments as well as highlighting some interesting or relevant entries.

Many preserve their content locally or on project websites. Others have institutional repositories where they can deposit their data. Two nationally funded repositories were mentioned – DANS and Historic Environment Scotland. And some projects either did not take this into consideration or are coming up with plans on how to preserve their data.

Within the respondent comments, a number of repositories, platforms, companies, or infrastructures were mentioned in these comments, they are:

o Golden Agents Infrastructure- Dutch Golden Age Craft research infrastructure https://www.goldenagents.org/about/

o TARA-Trinity College Dublin institutional repository http://www.tara.tcd.ie/

o OAI-PMH- Open Archives Initiative – Protocol for Metada Harvesting https://www.openarchives.org/pmh/

o NextCloud -https://nextcloud.com/about/

o UT Dataverse– University of Texas Dataverse– https://dataverse.tdl.org/dataverse/utexas

o Historic Environment Scotland – https://www.historicenvironment.scot/archives-and-research/

o Europeana – https://www.europeana.eu/en/

o LOCKSS- Preservation initiative started by Stanford University https://www.lockss.org/about

Few respondents provided a detailed plan for preserving their 3D data. Based on the overall tone of the comments, preservation was an after-thought or not taken into consideration at all. Mostly, solutions are ad-hoc, using what is available to them from their research organization or

provided by the government. Few solutions are specifically designed for 3D data, although one example from the University of Virginia mentions a library system for cloud-based storage of 3D models and they are working on developing a Digital Humanities team to keep the models up to date.

5.7 Recommendations

1. Allow multi-author access and editing rights per project

2. Don't assume higher technical levels of the project authors.

3. Avoid single object viewing from 3D acquisition projects as there are already established platforms for this. Focus rather on a collection (2 or more) of digitized objects viewed together for purposes of comparison.

4. Focus on solid geometry (non-point cloud data)

5. Be prepared to accommodate higher LoD – e.g., complex scenes/high resolution single models with textured materials

6. Authors will need to optimize their projects for web-handling if their original projects are too heavy/complex

7. Offer option of original resolution upload/download or provide space for URL link to data storage platform or institutional repository

8. Determine if PURE3D can successfully encompass the three main goals of 3D heritage – research, public access and preservation

9. Require authors to label/tag their annotations by multi-media type and by subject matter for better search functions

10. Have at least two annotation levels for a project – general public (explanation/contextualization, narratives, games) and scholarly audience (metadata, paradata, analysis tools).

11. Use PURE3D to promote sharing 3D research in various states of the project—authors can update their models/information attached to them over time.

12. Require minimum preservation protocols and standards as a condition for uploading to PURE3D.

Chapter 6: Conclusion

Moving forward, we can use the results and analysis of the PURE3D Survey on 3D Web Infrastructures to guide our next steps in the project development, both for infrastructure design and further user studies. For infrastructure design, final recommendations for front-end and back-end features based are presented in Section 6.1 of this report. For next steps in user studies for PURE3D, Section 6.2 provides a list of potential questions for future focus groups. Section 6.3 is a short reflection on the survey execution and makes suggestions on how to improve for the future.

6.1 Front- and Back-end Recommendations
Front-End Features

High Priority

1. Desktop compatibility
2. Solid geometry 3D content
3. Multi-object scenes
4. Measurement tool
5. Object-based annotation
6. Annotations linkable to external sources and other objects in the scene
7. PBR material compatibility

Mid-level Priority

1. Mobile/Tablet compatibility
2. Advanced Lighting
3. Cross-section
4. Enable-disable parts of the scene
5. Labeling/tagging objects and annotations by content type and multi-media type
6. Two Interaction/content levels: one for public audience, one for researcher

Low Priority

1.   Region-based annotation

2.   Annotations linked to other annotations in the scene

Back-end Features

High Priority

1.   Unique ID generation for the project

2.   "how to cite" feature for project, object, annotation

3.   Permissions, or licensing information on how the data/models/information can be used

4.   Refined Search function

5.   User profile for authors

6.   Functionality for authors to flexibly select what content can be downloaded and reused

Mid-level Priority

1.   Unique ID generation for an annotation

2.   User profiles for end-users

3.   Private messaging of authors

4.   Multi-author access and editing

5.   A project can be updated/adapted over time

Low Priority

1.   Allow search engines to harvest data from the platform

2.   End-user like/follow/comment features

3.   Flagging or deleting inappropriate comments

4.   Peer-review option for projects

5.   Peer-reviewed projects search function

Appendix 1: Demographic Report

Q2 - In which sector do you work?

Q2 - In which sector do you work?
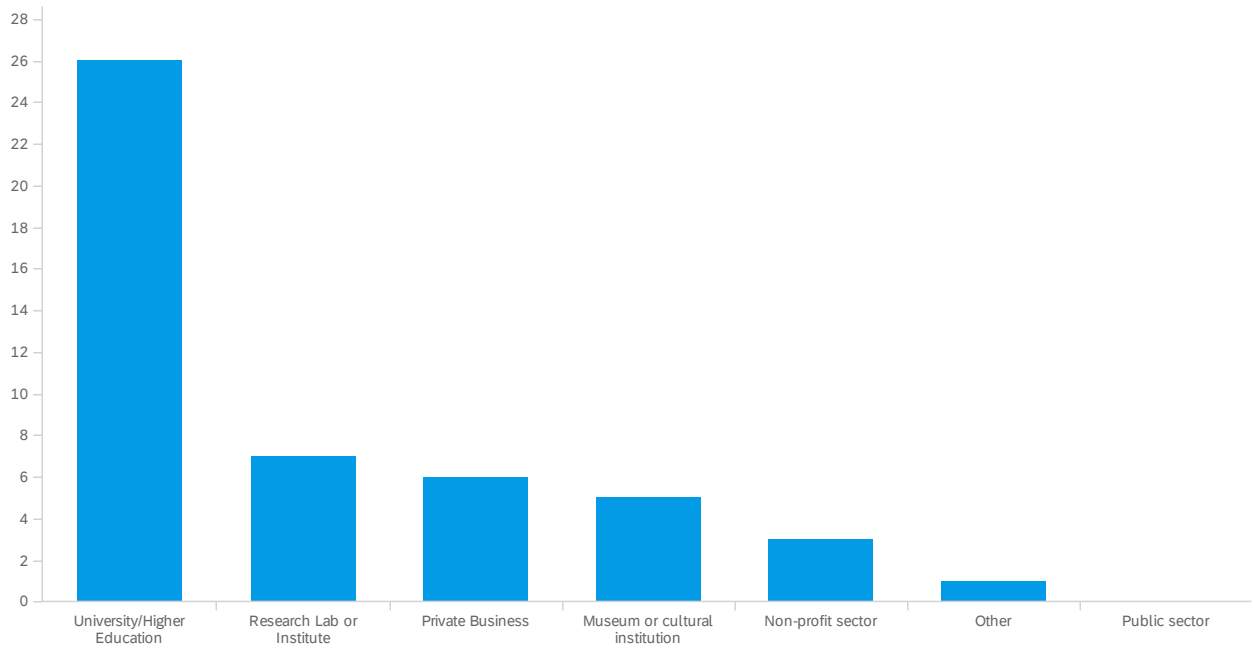
#	Field		Choice Count
1	University/Higher Education	54.17%	26
2	Private Business	12.50%	6
3	Museum or cultural institution	10.42%	5
4	Research Lab or Institute	14.58%	7
5	Public sector	0.00%	0
7	Non-profit sector	6.25%	3
8	Other	2.08%	1
			48

Showing rows 1 - 8 of 8

Q2_8_TEXT - Other

Other

Academic museum (so both higher ed & museum)

Q3 - What kinds of 3D models do you create and/or work with?

Q3 - What kinds of 3D models do you create and/or work with?
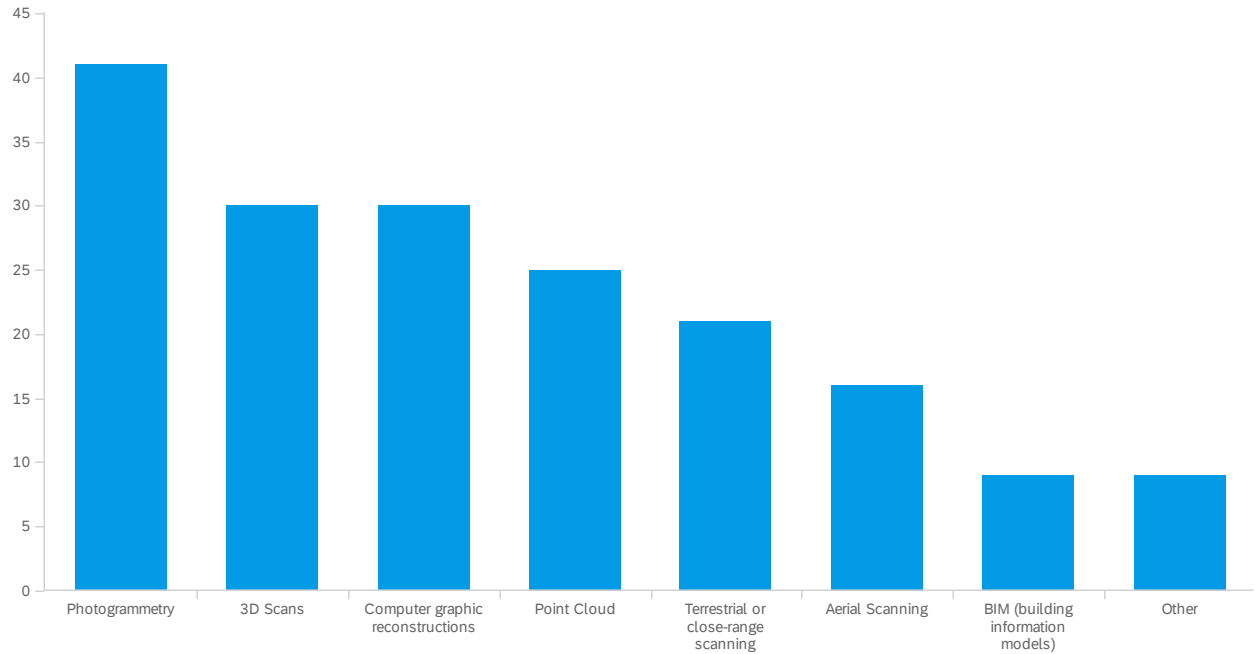
#	Field	Choice Count	
1	3D Scans	16.57%	30
2	Computer graphic reconstructions	16.57%	30
3	Point Cloud	13.81%	25
4	BIM (building information models)	4.97%	9
5	Aerial Scanning	8.84%	16
6	Other	4.97%	9
7	Photogrammetry	22.65%	41
8	Terrestrial or close-range scanning	11.60%	21
			181

Showing rows 1 - 9 of 9

Q3_6_TEXT - Other

Other
Mocap and Game Assets for educational purposes
All of them

Other

physically-based rendering

RTI, VFX, Animation,

Tomography

micro CT

Geophysical data

Q4 - Which 3D file formats do you most commonly use?

Q4 - Which 3D file formats do you most commonly use?
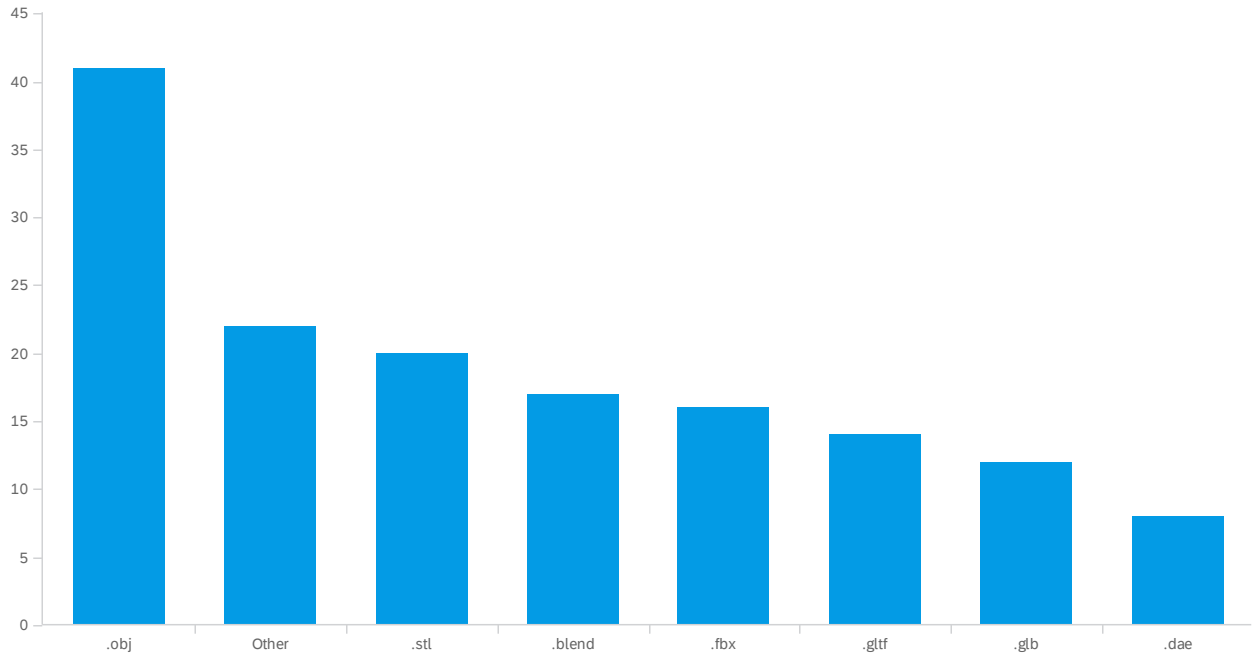
#	Field		Choice Count	
1	.obj		27.33%	41
2	.fbx		10.67%	16
3	.blend		11.33%	17
4	.dae		5.33%	8
5	.gltf		9.33%	14
6	.glb		8.00%	12
7	.stl		13.33%	20
8	Other		14.67%	22
				150

Showing rows 1 - 9 of 9

Q4_8_TEXT - Other

Other
c4d
.las;.ply

Other
ply
xyz, ply
PLY; LAZ; TIFF (DEM)
.abc, alembic
.ply
3ds, ply, E57
.ply
.ply .wrl
stp csg
.ply
.svx
c4d
ply
Usd
x3d

Q65 - Are you responding to this questionnaire as an individual or as a team?
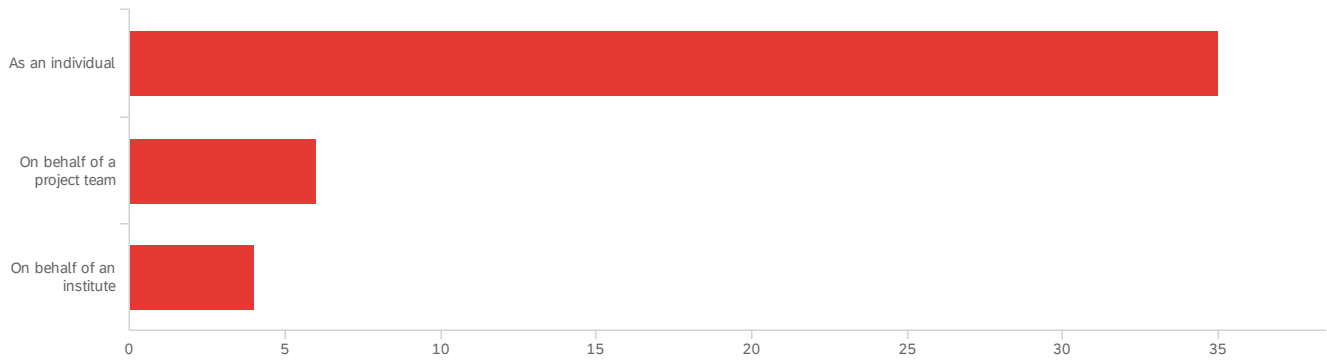
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Are you responding to this questionnaire as an individual or as a team?	1.00	3.00	1.31	0.63	0.39	45

#	Field		Choice Count	
1	As an individual		77.78%	35
2	On behalf of a project team		13.33%	6
3	On behalf of an institute		8.89%	4
				45

Showing rows 1 - 4 of 4

Q66 - What is your age?

What is your age?

47
29
28
46
59
40
38
50
38
27
34
39
40
49
41
39
34
48
28
45
53
33

What is your age?

61

40

36

54

42

31

40

33

54

35

28

Q67 - What is your gender?
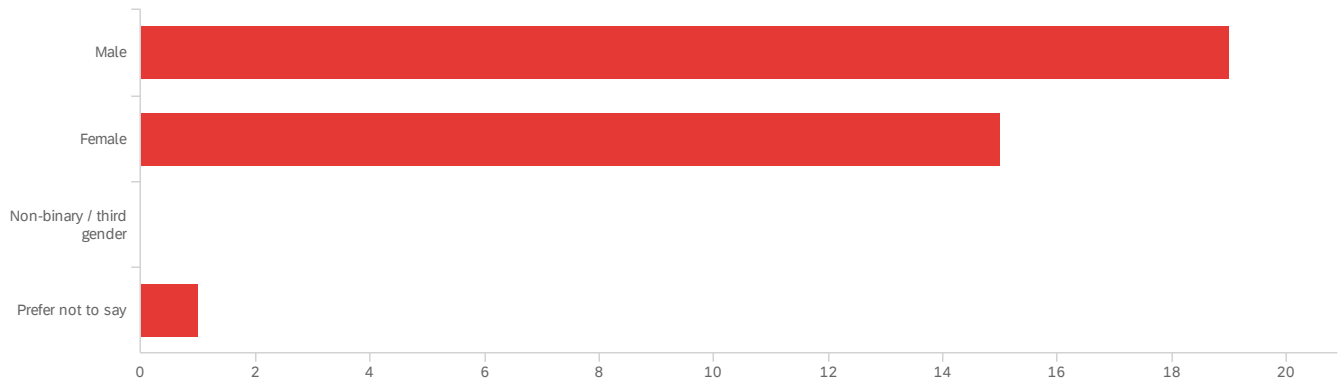
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is your gender?	1.00	4.00	1.51	0.65	0.42	35

#	Field		Choice Count
1	Male	54.29%	19
2	Female	42.86%	15
3	Non-binary / third gender	0.00%	0
4	Prefer not to say	2.86%	1
			35

Showing rows 1 - 5 of 5

Q68 - What is your nationality?

What is your nationality?

German

Canadian

Canadian

German

french

American (US)

USA

Italian

USA

Slovenian

polish

French

Serbian

American

US

Irish

United states

US citizen

American

german

American

Cypriot

What is your nationality?

- British
- Spanish
- USA
- Dutch
- United States of America
- German
- GERMAN
- Irish
- Italian
- british

Q69 - In which country is your project, institute or organization based?

In which country is your project, institute or organization based?

Germany, but we want to move on. maybe Netherlands and Greece.

Canada

Netherlands

Switzerland

Germany

Italy

France

USA

Belgium Panorama ULB

USA

Netherlands

USA

Slovenia

Poland

Canada

Cyprus

USA

US

Ireland

Kenya

USA

United States

In which country is your project, institute or organization based?

USA

France

United States

USA

Czech Republic

Israel

Greece

United States

Cyprus

UK

Spain

USA

Netherlands

United Kingdom

Russia

Germany

GERMANY

Ireland

Cyprus

norway

Q70 - On which platform(s) did you find this survey?
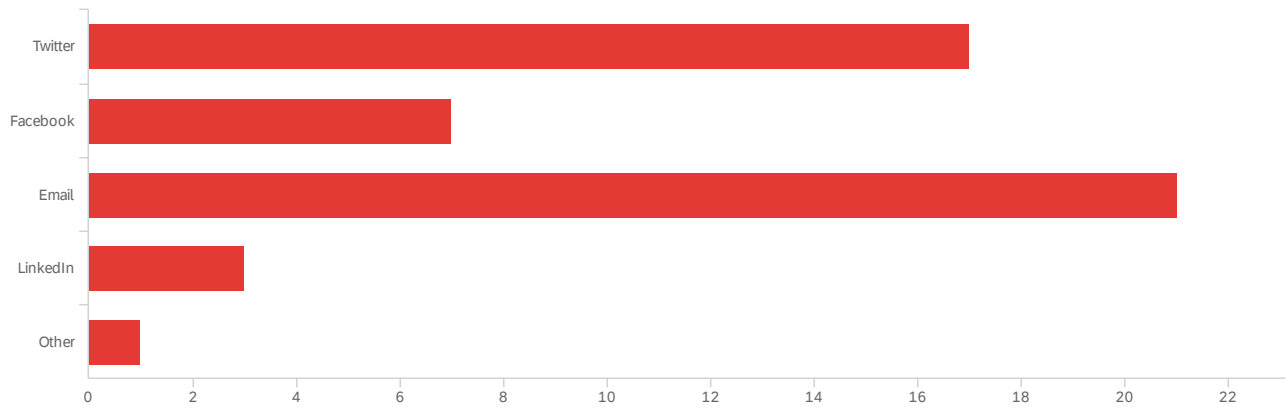
#	Field		Choice Count	
1	Twitter	34.69%	17	
2	Facebook	14.29%	7	
3	Email	42.86%	21	
4	LinkedIn	6.12%	3	
5	Other	2.04%	1	
			49	

Showing rows 1 - 6 of 6

Q70_5_TEXT - Other

Other

caa-international.org

End of Report

Appendix 2: Quantitative Report

Q5 - An end-user of the 3D web viewer should be able to access the 3D model and scene with...
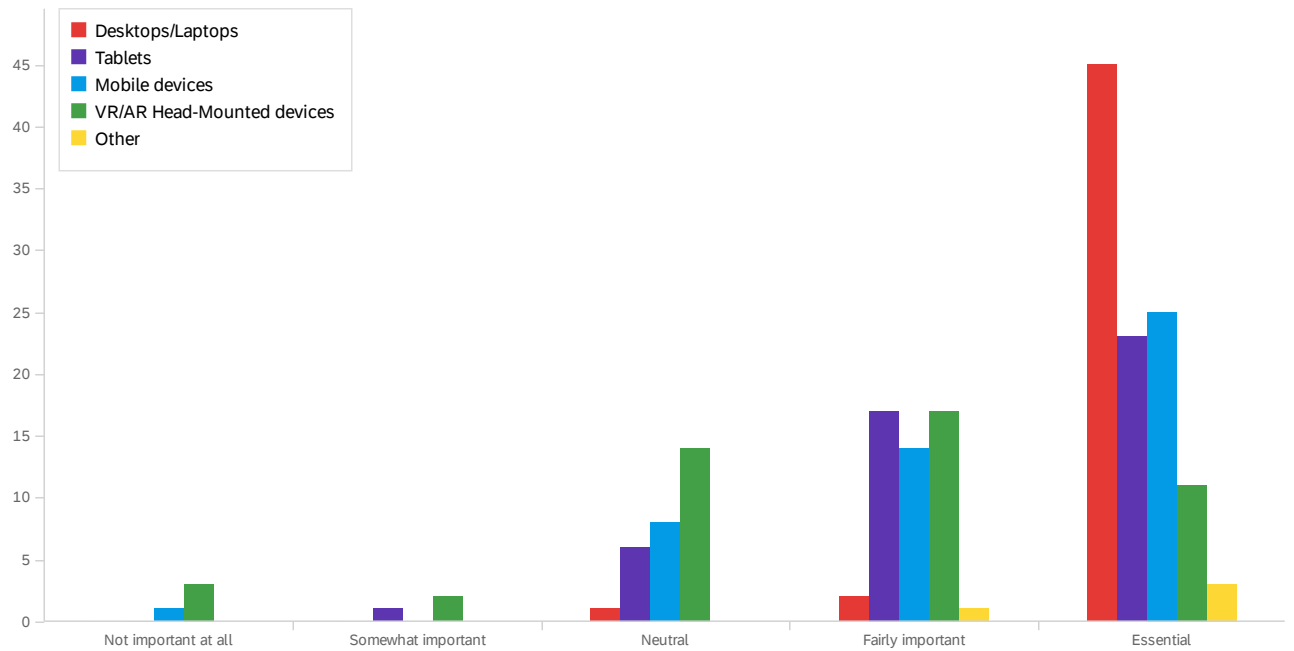
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Desktops/Laptops	3.00	5.00	4.92	0.34	0.12	48
2	Tablets	2.00	5.00	4.32	0.77	0.60	47
3	Mobile devices	1.00	5.00	4.29	0.89	0.79	48
4	VR/AR Head-Mounted devices	1.00	5.00	3.66	1.08	1.16	47
5	Other	4.00	5.00	4.75	0.43	0.19	4

#	Field	Not important at all		Somewhat important		Neutral		Fairly important		Essential		Total
1	Desktops/Laptops	0.00%	0	0.00%	0	2.08%	1	4.17%	2	93.75%	45	48
2	Tablets	0.00%	0	2.13%	1	12.77%	6	36.17%	17	48.94%	23	47
3	Mobile devices	2.08%	1	0.00%	0	16.67%	8	29.17%	14	52.08%	25	48

#	Field	Not important at all		Somewhat important		Neutral		Fairly important		Essential		Total
4	VR/AR Head-Mounted devices	6.38%	3	4.26%	2	29.79%	14	36.17%	17	23.40%	11	47
5	Other	0.00%	0	0.00%	0	0.00%	0	25.00%	1	75.00%	3	4

Showing rows 1 - 5 of 5

Q6 - The 3D web viewer should support the following features...
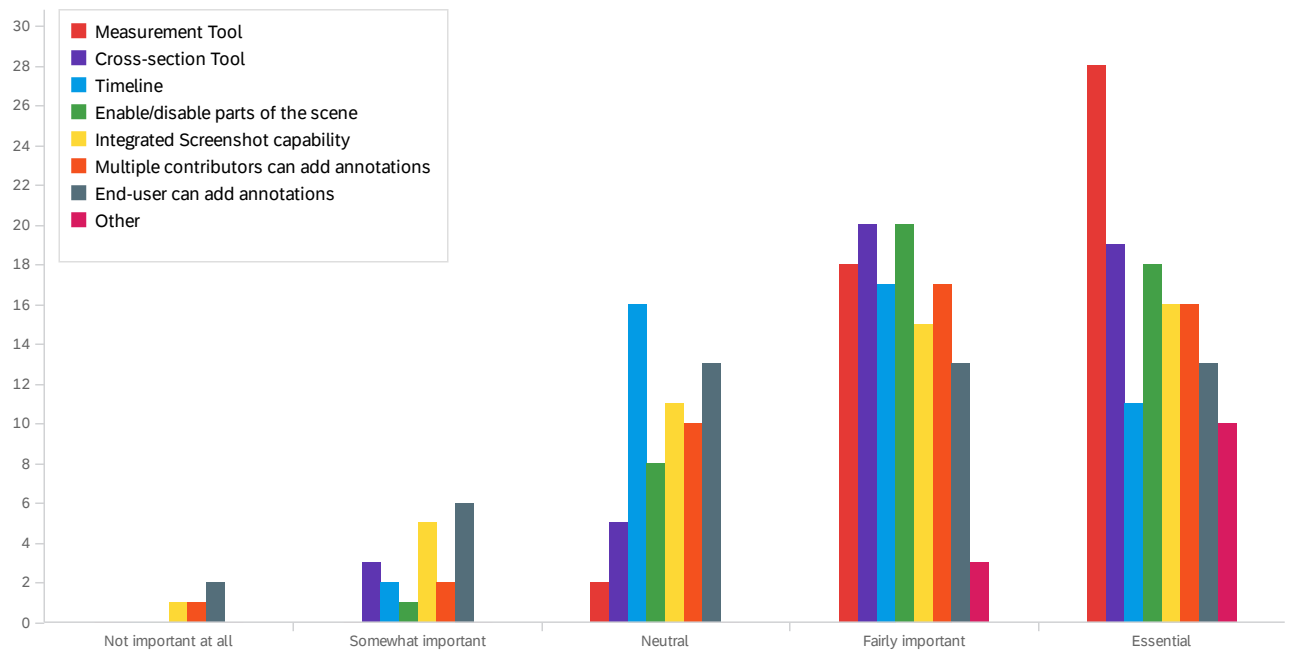
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Measurement Tool	3.00	9.00	8.38	1.22	1.48	48
2	Cross-section Tool	2.00	9.00	7.49	2.26	5.10	47
3	Timeline	2.00	9.00	6.24	2.72	7.40	46
4	Enable/disable parts of the scene	2.00	9.00	7.40	2.25	5.05	47
5	Integrated Screenshot capability	1.00	9.00	6.42	2.89	8.33	48
6	Multiple contributors can add annotations	1.00	9.00	6.85	2.66	7.09	46
7	End-user can add annotations	1.00	9.00	5.83	3.03	9.16	47
8	Other	8.00	9.00	8.77	0.42	0.18	13

#	Field	Not important at all		Somewhat important		Neutral		Fairly important		Essential		Total
1	Measurement Tool	0.00%	0	0.00%	0	4.17%	2	37.50%	18	58.33%	28	48
2	Cross-section Tool	0.00%	0	6.38%	3	10.64%	5	42.55%	20	40.43%	19	47
3	Timeline	0.00%	0	4.35%	2	34.78%	16	36.96%	17	23.91%	11	46

#	Field	Not important at all		Somewhat important		Neutral		Fairly important		Essential		Total
4	Enable/disable parts of the scene	0.00%	0	2.13%	1	17.02%	8	42.55%	20	38.30%	18	47
5	Integrated Screenshot capability	2.08%	1	10.42%	5	22.92%	11	31.25%	15	33.33%	16	48
6	Multiple contributors can add annotations	2.17%	1	4.35%	2	21.74%	10	36.96%	17	34.78%	16	46
7	End-user can add annotations	4.26%	2	12.77%	6	27.66%	13	27.66%	13	27.66%	13	47
8	Other	0.00%	0	0.00%	0	0.00%	0	23.08%	3	76.92%	10	13

Showing rows 1 - 8 of 8

#	Field	Not important at all	Somewhat important	Neutral	Fairly important	Essential	Total

Q7 - The 3D web viewer should be able to handle...
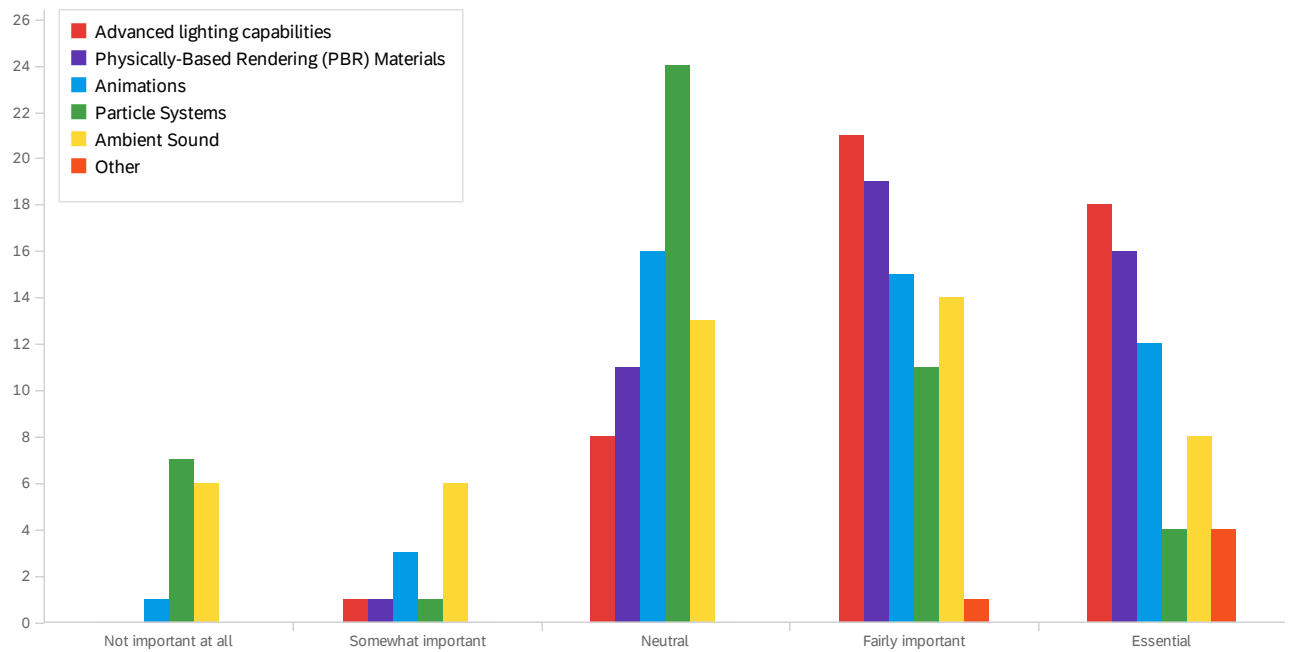
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Advanced lighting capabilities	2.00	7.00	5.79	1.47	2.16	48
2	Physically-Based Rendering (PBR) Materials	2.00	7.00	5.55	1.61	2.59	47
3	Animations	1.00	7.00	4.87	1.90	3.60	47
4	Particle Systems	1.00	7.00	3.72	1.89	3.56	47
5	Ambient Sound	1.00	7.00	4.19	2.15	4.62	47
6	Other	6.00	7.00	6.80	0.40	0.16	5

#	Field	Not important at all		Somewhat important		Neutral		Fairly important		Essential		Total
1	Advanced lighting capabilities	0.00%	0	2.08%	1	16.67%	8	43.75%	21	37.50%	18	48
2	Physically-Based Rendering (PBR) Materials	0.00%	0	2.13%	1	23.40%	11	40.43%	19	34.04%	16	47
3	Animations	2.13%	1	6.38%	3	34.04%	16	31.91%	15	25.53%	12	47
4	Particle Systems	14.89%	7	2.13%	1	51.06%	24	23.40%	11	8.51%	4	47
5	Ambient Sound	12.77%	6	12.77%	6	27.66%	13	29.79%	14	17.02%	8	47

#	Field	Not important at all		Somewhat important		Neutral		Fairly important		Essential		Total
6	Other	0.00%	0	0.00%	0	0.00%	0	20.00%	1	80.00%	4	5

Showing rows 1 - 6 of 6

Q8 - Annotations within the 3D web viewer should be....
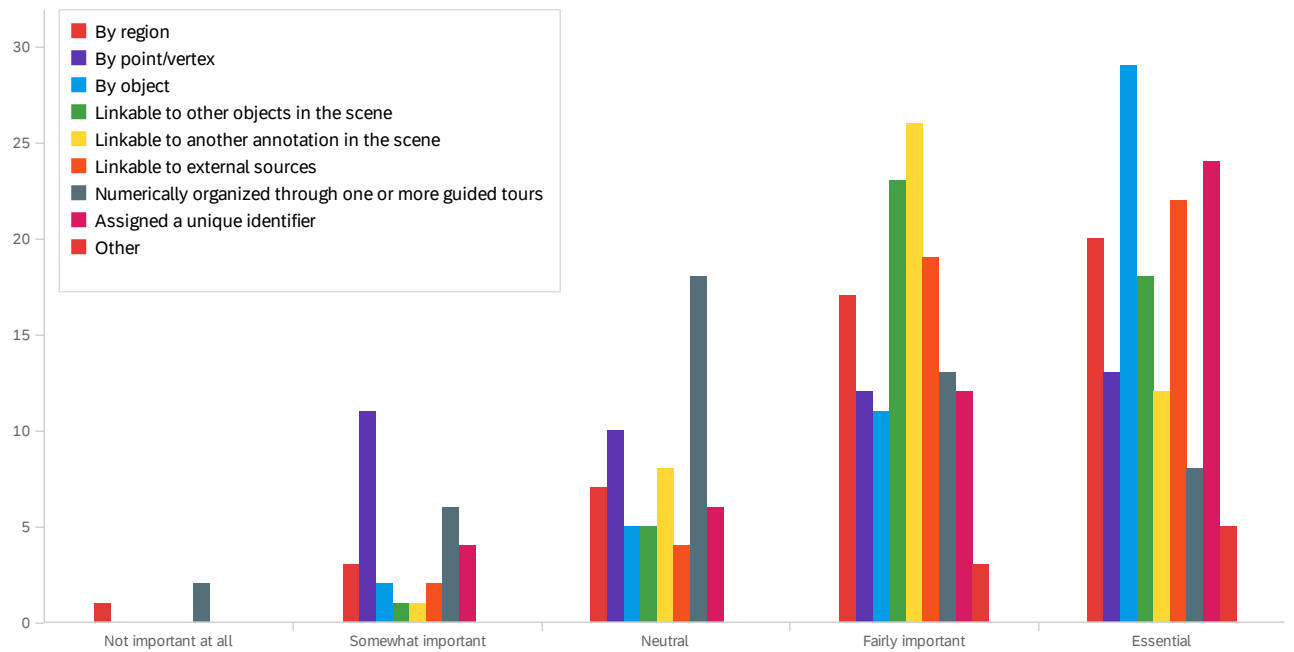
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	By region	1.00	5.00	4.08	1.00	0.99	48
2	By point/vertex	2.00	5.00	3.59	1.13	1.29	46
3	By object	2.00	5.00	4.43	0.84	0.71	47
4	Linkable to other objects in the scene	2.00	5.00	4.23	0.72	0.52	47
5	Linkable to another annotation in the scene	2.00	5.00	4.04	0.71	0.51	47
6	Linkable to external sources	2.00	5.00	4.30	0.80	0.63	47
7	Numerically organized through one or more guided tours	1.00	5.00	3.40	1.04	1.09	47
8	Assigned a unique identifier	2.00	5.00	4.22	0.98	0.95	46
9	Other	4.00	5.00	4.63	0.48	0.23	8

#	Field	Not important at all		Somewhat important		Neutral		Fairly important		Essential		Total
1	By region	2.08%	1	6.25%	3	14.58%	7	35.42%	17	41.67%	20	48
2	By point/vertex	0.00%	0	23.91%	11	21.74%	10	26.09%	12	28.26%	13	46

#	Field	Not important at all		Somewhat important		Neutral		Fairly important		Essential		Total
3	By object	0.00%	0	4.26%	2	10.64%	5	23.40%	11	61.70%	29	47
4	Linkable to other objects in the scene	0.00%	0	2.13%	1	10.64%	5	48.94%	23	38.30%	18	47
5	Linkable to another annotation in the scene	0.00%	0	2.13%	1	17.02%	8	55.32%	26	25.53%	12	47
6	Linkable to external sources	0.00%	0	4.26%	2	8.51%	4	40.43%	19	46.81%	22	47
7	Numerically organized through one or more guided tours	4.26%	2	12.77%	6	38.30%	18	27.66%	13	17.02%	8	47
8	Assigned a unique identifier	0.00%	0	8.70%	4	13.04%	6	26.09%	12	52.17%	24	46
9	Other	0.00%	0	0.00%	0	0.00%	0	37.50%	3	62.50%	5	8

Showing rows 1 - 9 of 9

Q9 - Should end-users create a personal profile?
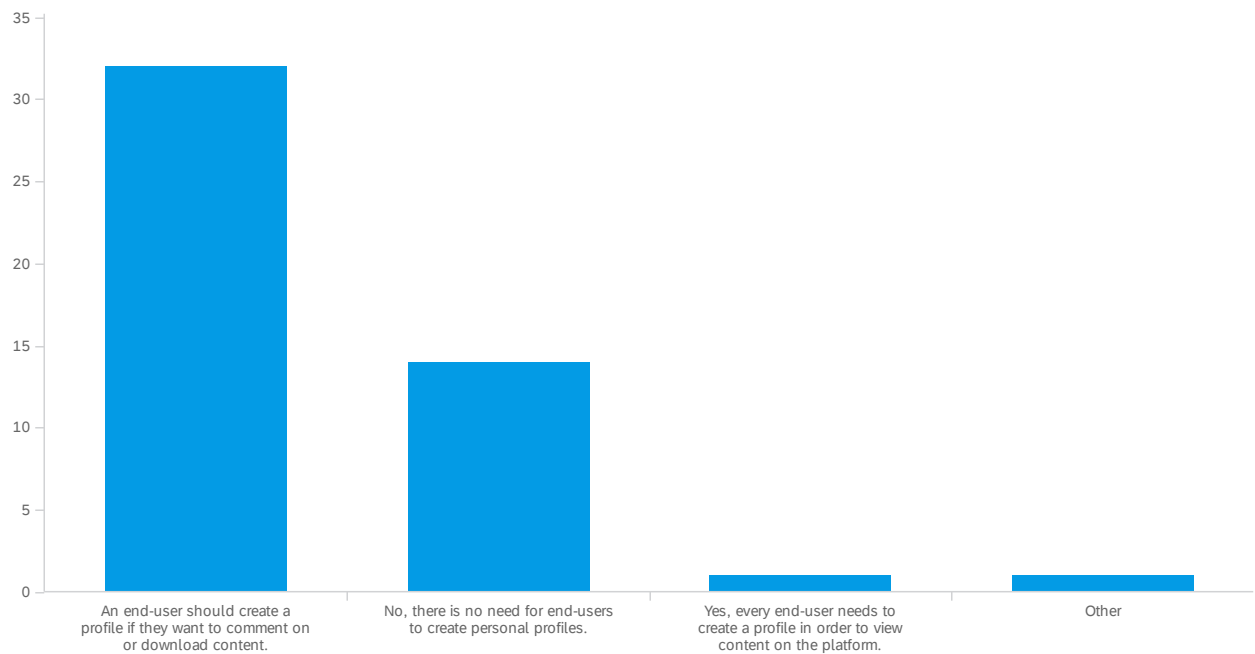
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Should end-users create a personal profile? - Selected Choice	1.00	4.00	1.77	0.59	0.34	48

#	Field		Choice Count
1	No, there is no need for end-users to create personal profiles.	29.17%	14
2	An end-user should create a profile if they want to comment on or download content.	66.67%	32
3	Yes, every end-user needs to create a profile in order to view content on the platform.	2.08%	1
4	Other	2.08%	1
			48

Showing rows 1 - 5 of 5

Q9_4_TEXT - Other

Other

All the above solutions. Its depends on the access restrictions chosen by the right owner of the 3D object chosen by the cr

Q10 - End-users of the 3D content may...
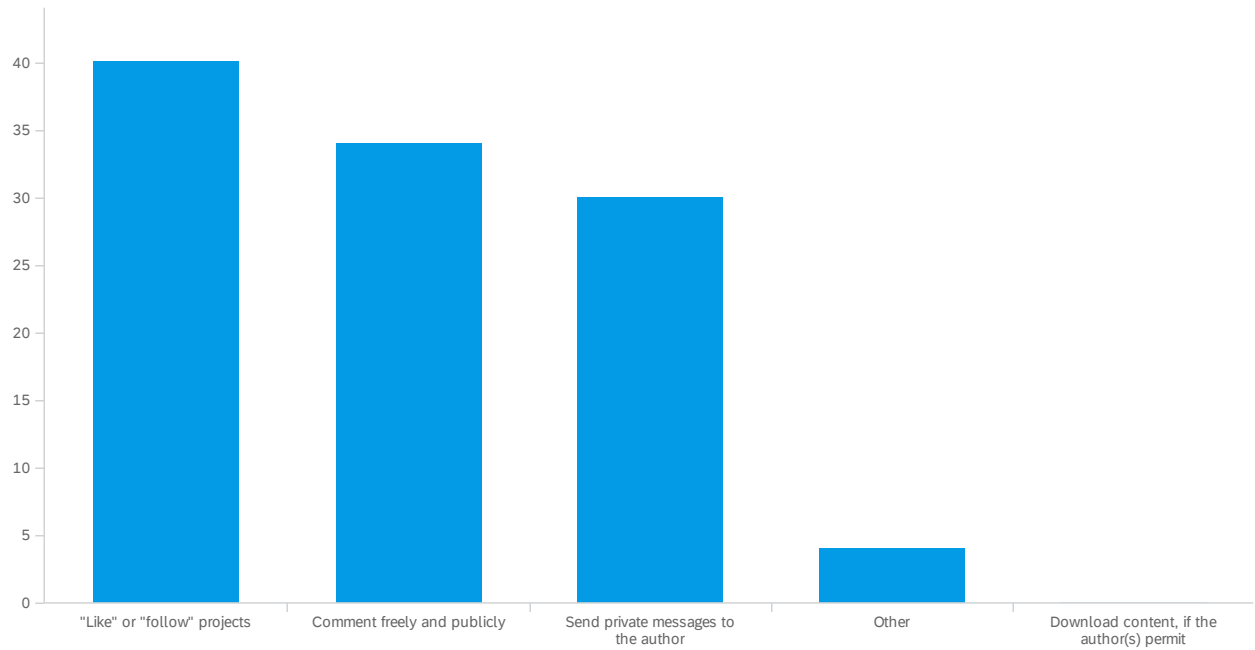
#	Field	Choice Count	
1	Comment freely and publicly	31.48%	34
2	Send private messages to the author	27.78%	30
3	"Like" or "follow" projects	37.04%	40
4	Other	3.70%	4
5	Download content, if the author(s) permit	0.00%	0
			108

Showing rows 1 - 6 of 6

Q10_4_TEXT - Other

Other
Comment privately
Make annotations to improve the 3D content by author
Download w/o permission

Q11 - Public comments may be...

9.88%

37.04%

53.09%

■ Reported as inappropriate or offensive　　■ Deleted by the author　　■ Other
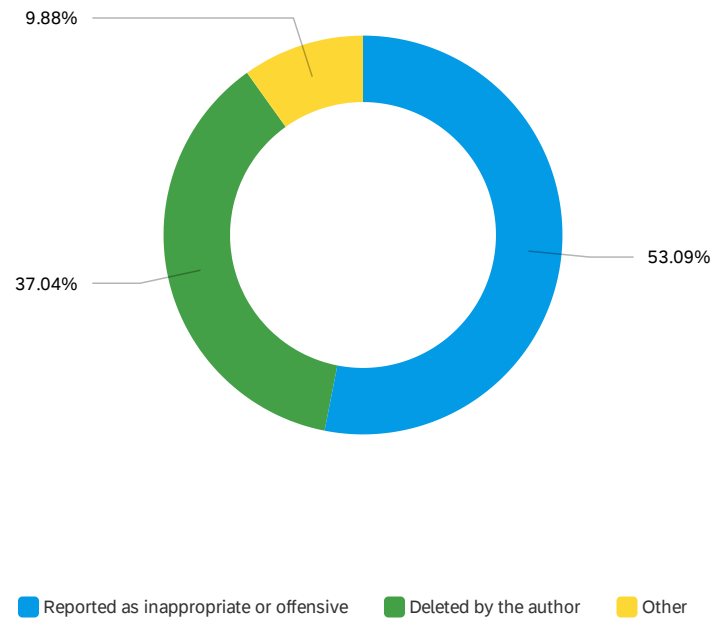
#	Field		Choice Count
1	Reported as inappropriate or offensive	53.09%	43
2	Deleted by the author	37.04%	30
4	Other	9.88%	8
			81

Showing rows 1 - 4 of 4

Q11_4_TEXT - Other

Other
not possible
disabled on a given model by the creator
Spam filtered
No public comments
Public comments should not be present at all

Other

Answered by the author

Mediated by curator

Q12 - End-users should be able to download and use/reuse...
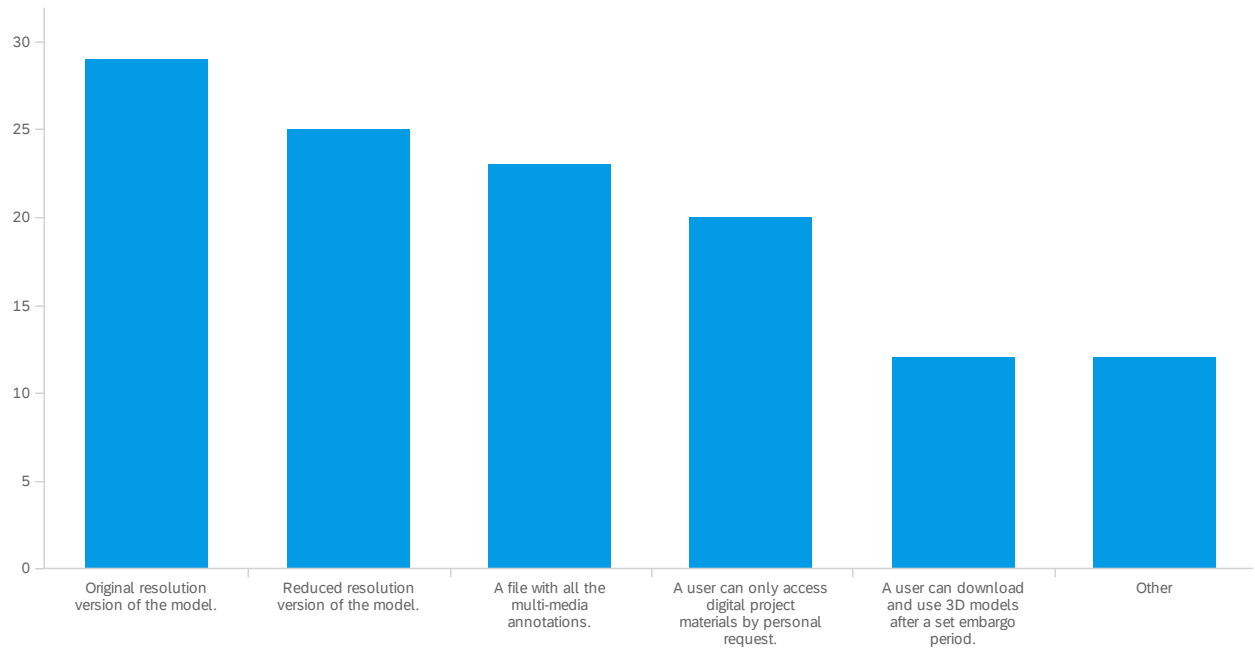
#	Field	Choice Count	
1	Original resolution version of the model.	23.97%	29
2	Reduced resolution version of the model.	20.66%	25
3	A file with all the multi-media annotations.	19.01%	23
5	A user can only access digital project materials by personal request.	16.53%	20
6	A user can download and use 3D models after a set embargo period.	9.92%	12
8	Other	9.92%	12
			121

Showing rows 1 - 7 of 7

Q12_8_TEXT - Other

Other
Has to be defined by resource
All of them, but it depends on the author will.
possible API access enabled at some point for analysis of 3d files as data
These settings should be determined by the model owner

Other

This should be left to decide by the modeller on a case-by-case basis

depends on context and sensitivity issues

Creative Commons licensing

Metadata and paradata for the model and its creation process

Its depends on the access rights on the object.

All of above with author permission for derivative creations. For public collections, original full resolution scans should be made available after the initial, limited embargo period allowing for the researcher to publish.

Original resolution version of the model by personal request to the author

A robust system should be able to accommodate all of those scenarios, depending on the content and its community of origin

Q13 - In addition to web-viewing capabilities, the platform should...
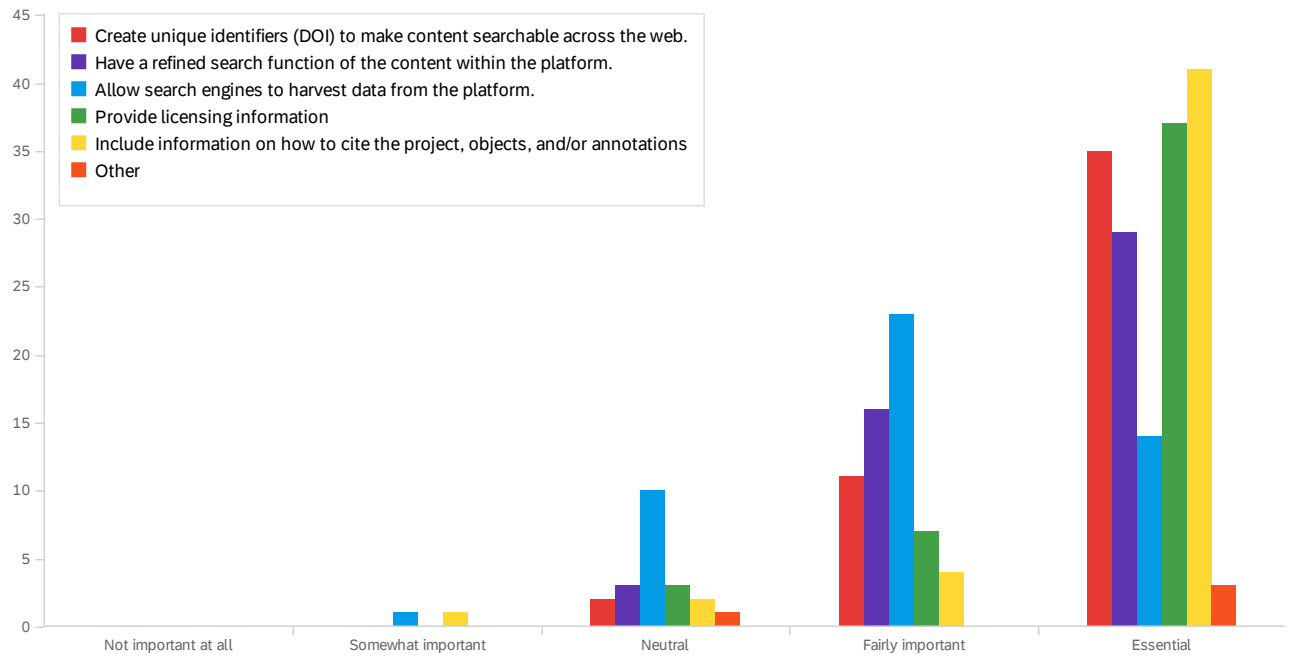
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Create unique identifiers (DOI) to make content searchable across the web.	3.00	5.00	4.69	0.55	0.30	48
2	Have a refined search function of the content within the platform.	3.00	5.00	4.54	0.61	0.37	48
3	Allow search engines to harvest data from the platform.	2.00	5.00	4.04	0.76	0.58	48
4	Provide licensing information	3.00	5.00	4.72	0.57	0.33	47
5	Include information on how to cite the project, objects, and/or annotations	2.00	5.00	4.77	0.62	0.38	48
6	Other	3.00	5.00	4.50	0.87	0.75	4

#	Field	Not important at all		Somewhat important		Neutral		Fairly important		Essential		Total
1	Create unique identifiers (DOI) to make content searchable across the web.	0.00%	0	0.00%	0	4.17%	2	22.92%	11	72.92%	35	48
2	Have a refined search function of the content within the platform.	0.00%	0	0.00%	0	6.25%	3	33.33%	16	60.42%	29	48
3	Allow search engines to harvest data from the platform.	0.00%	0	2.08%	1	20.83%	10	47.92%	23	29.17%	14	48

#	Field	Not important at all		Somewhat important		Neutral		Fairly important		Essential		Total
4	Provide licensing information	0.00%	0	0.00%	0	6.38%	3	14.89%	7	78.72%	37	47
5	Include information on how to cite the project, objects, and/or annotations	0.00%	0	2.08%	1	4.17%	2	8.33%	4	85.42%	41	48
6	Other	0.00%	0	0.00%	0	25.00%	1	0.00%	0	75.00%	3	4

Showing rows 1 - 6 of 6

Q14 - It is my expectation that a free open-source repository would keep and maintain my models for a duration of...

8.33%

4.17%

16.67%

70.83%
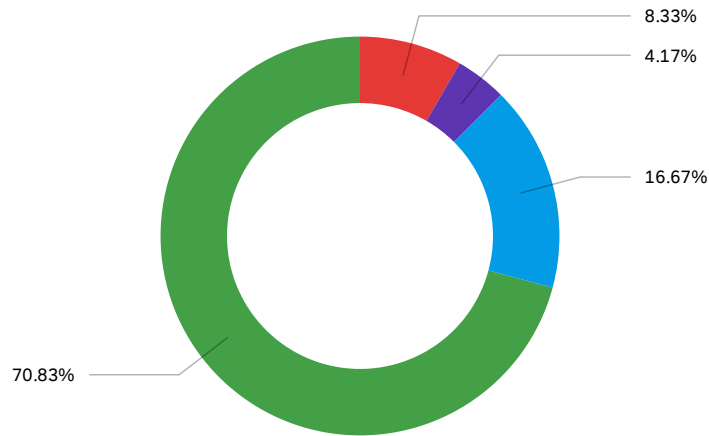
■ 3 years   ■ 5 years   ■ more than 10 years   ■ For however long the platform is being supported

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	It is my expectation that a free open-source repository would keep and maintain my models for a duration of…	1.00	4.00	3.50	0.91	0.83	48

#	Field		Choice Count	
1	3 years		8.33%	4
2	5 years		4.17%	2
3	more than 10 years		16.67%	8
4	For however long the platform is being supported		70.83%	34
				48

Showing rows 1 - 5 of 5

Q15 - Would you include in a project's funding module the cost of perpetual care and long-term preservation?

10.42%

8.33%

81.25%

■ Yes ■ No ■ Other
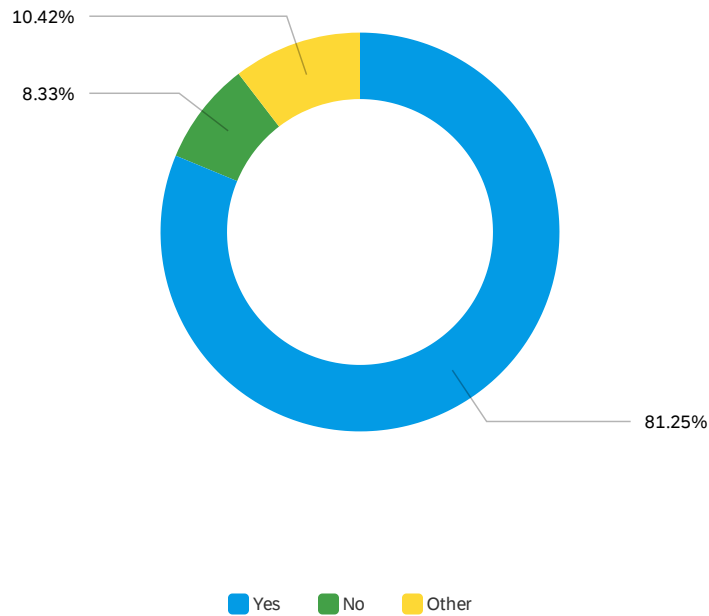
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Would you include in a project's funding module the cost of perpetual care and long-term preservation? - Selected Choice	1.00	4.00	1.40	0.93	0.86	48

#	Field		Choice Count
1	Yes	81.25%	39
2	No	8.33%	4
4	Other	10.42%	5
			48

Showing rows 1 - 4 of 4

Q15_4_TEXT - Other

Other

Other

Depends on the costs

I would be in favor of a paid tier for longer term storage/hosting, or free if the model is shared on a creative commons license
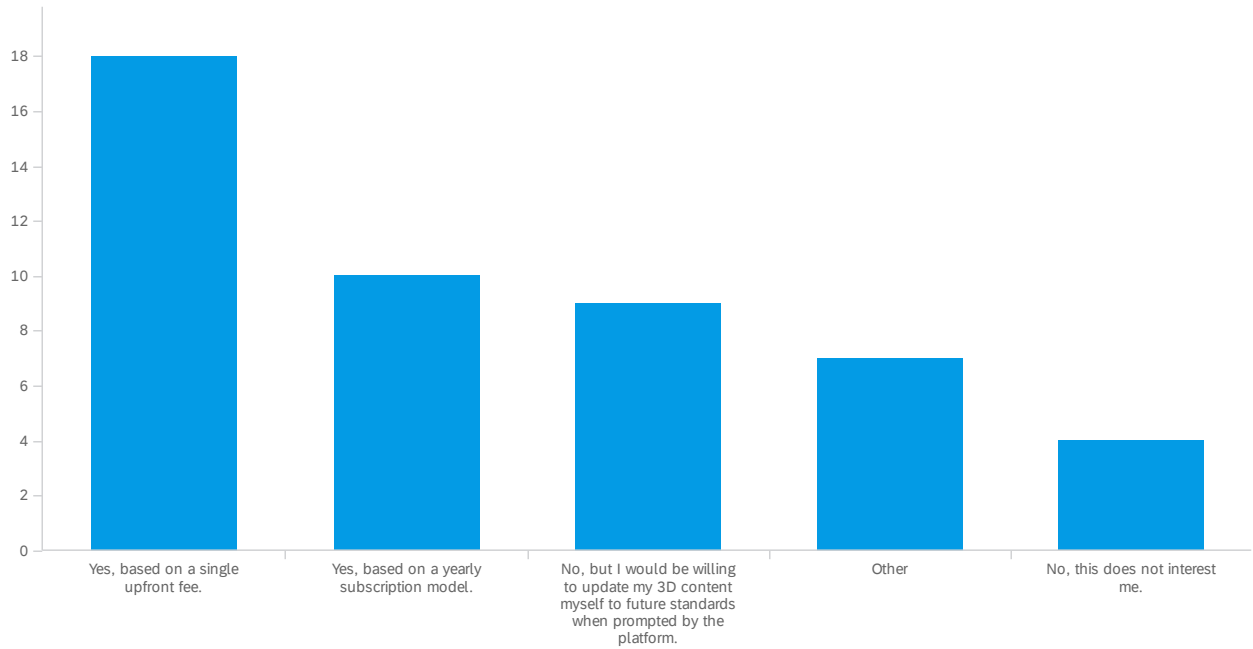
If allowable, yes

It depends on what that cost is, and how it would be paid for -- yes if it was a one-time fee that was in proportion to the rest of the project budget

I don't know what a funding module is.

Q16 - With either personal funding or project funding, would you be willing to pay for

perpetual care of the models?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	With either personal funding or project funding, would you be willing to pay for perpetual care of the models? - Selected Choice	1.00	5.00	2.52	1.50	2.25	48

#	Field		Choice Count
1	Yes, based on a single upfront fee.	37.50%	18
2	Yes, based on a yearly subscription model.	20.83%	10
3	No, this does not interest me.	8.33%	4
4	No, but I would be willing to update my 3D content myself to future standards when prompted by the platform.	18.75%	9
5	Other	14.58%	7
			48

Showing rows 1 - 6 of 6

Q16_5_TEXT - Other

Other

I would love to have a pay per view option for the creator sharing the revenue between him and related parties e.g. the project maintainers.

Core functionality should be integrated into existing (and funded) open research data platforms

Depends on the fee

yes but with the donation/wikipedia model

Any of these models are potentially of interest. My most important feature would be that the platform itself is stable long term.

Yes, with project funding based on a yearly or perpetual fee.

If I was an end user with funding, I would be open to paying either a single fee or a yearly subscription fee, depending on who was offering it and what services came with it.

Q17 - Does your organization or institution recognize and reward this type of atypical scholarly output?

12.50%

14.58%

16.67%

56.25%

Yes   No   This does not apply to my case   Other
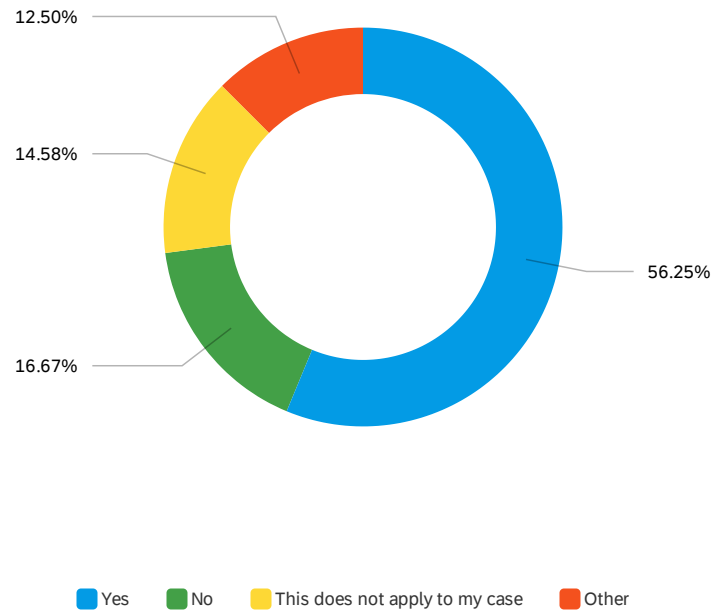
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Does your organization or institution recognize and reward this type of atypical scholarly output? - Selected Choice	1.00	4.00	1.83	1.09	1.18	48

#	Field		Choice Count
1	Yes	56.25%	27
2	No	16.67%	8
3	This does not apply to my case	14.58%	7
4	Other	12.50%	6
			48

Showing rows 1 - 5 of 5

Q17_4_TEXT - Other

Other

not sure

They're working on standards for this now. I expect that they will in ~3 years.

They do not grasp the significance of 3D modelling (although they are getting the general idea)

Depends on who asks for it

This output may be recognized on an ad hoc basis, but it is not considered scholarly output on a policy level

Not sure as I'm ECR and don't count for most things at my Uni!

Q18 - Should projects be peer-reviewed before being published on the platform?

29.17%

29.17%

41.67%

29.17%

■ Yes ■ No ■ Other
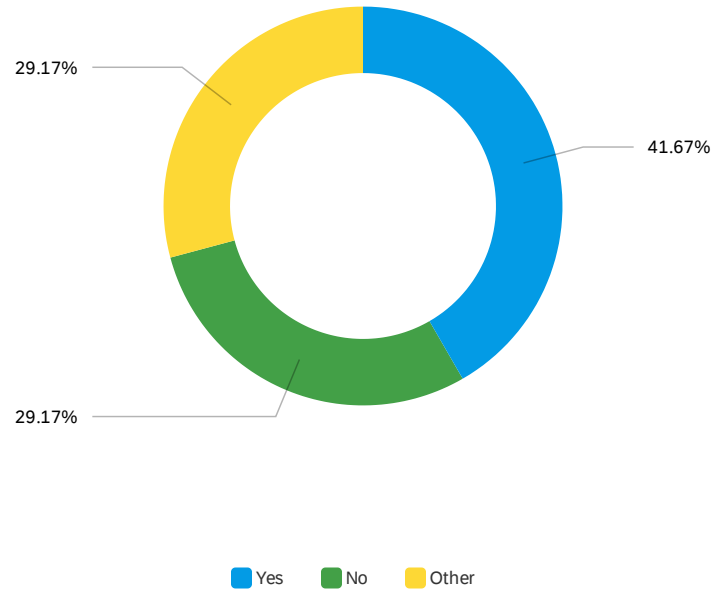
#	Field		Choice Count
1	Yes	41.67%	20
2	No	29.17%	14
3	Other	29.17%	14
			48

Showing rows 1 - 4 of 4

Other

Depends on the object and purpose.

Peer-reviewed projects should be identified

only if end-user is not member of a university

I would love for this to be an option, and to make it possible to search only peer-reviewed models. I would not want that to be the only way to upload and share, especially given the turnaround time for peer review.

provide the option

it depends on the context

Not as a condition of publication, but certain models could be submitted for review.

The content should be curated, but only so the content is relevant.

I'd say it depends on the mission of the platform.

If the projects meet the standards defined by the platform it shouldn't

Let creators choose if they want peer review.

Not necessarily, but the option is interesting and good to add

It depends on what stipulations the institution is making about the content and who the audience is. (young school age education, academic, or "life-long learning")

End of Report

Appendix 3: Quantitative Report

Q21 - Project Start Date:

Project Start Date:

2020

2019

2000

2012

late 2018

2020

September 2018

2009

01.01.2019

2020

11/20

1/8/20

Oct 2018

Fall 2020

May 2001

01/07/2014

2015

June 2014

01/01/2019

February 2011

2011

01 Oct 2015

Project Start Date:

2018

Q22 - Project end date or estimated end date:

Project end date or estimated end date:

no end date - always ongoing

2003

2015

NA

2025

July 2022

2015

31.12.2023

On-going

1/21

24/5/21

None

N/A

December 2023

2022

December 2019

01/01/2024

July 2015

June 2019

ongoing

Q24 - What country is the project institute/organization based in?

What country is the project institute/organization based in?

Germany

Canada

Germany

Italy

US

Belgium ULB

Netherlands

USA (previously Germany)

Cyprus

USA

US

Ireland and UK

Kenya

USA

USA

France

Indiana University Bloomington

United States

Cyprus

Netherlands

Spain

United Kingdom

What country is the project institute/organization based in?

United States

Q25 - If different from the organization, what country is the project itself based in?

If different from the organization, what country is the project itself base...

Germany

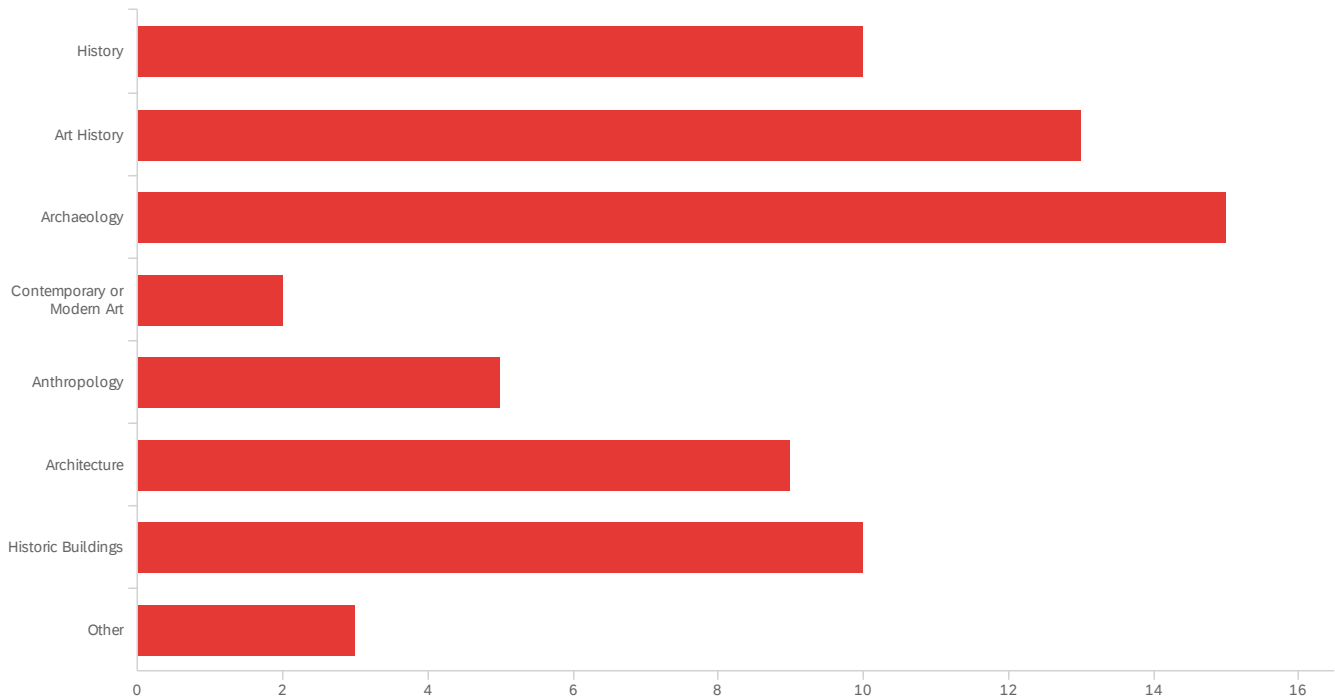Ireland

US

USA

US

Ukraine (Russia -- Crimea)

France

Florence, Italy

Netherlands

Italy

Same

Q26 - What discipline(s) would your project fall under?

Data source misconfigured for this visualization.

#	Field	Choice Count	
1	History	14.93%	10
2	Art History	19.40%	13
3	Archaeology	22.39%	15
4	Contemporary or Modern Art	2.99%	2
5	Anthropology	7.46%	5
6	Architecture	13.43%	9
7	Historic Buildings	14.93%	10
8	Other	4.48%	3
			67

Showing rows 1 - 9 of 9
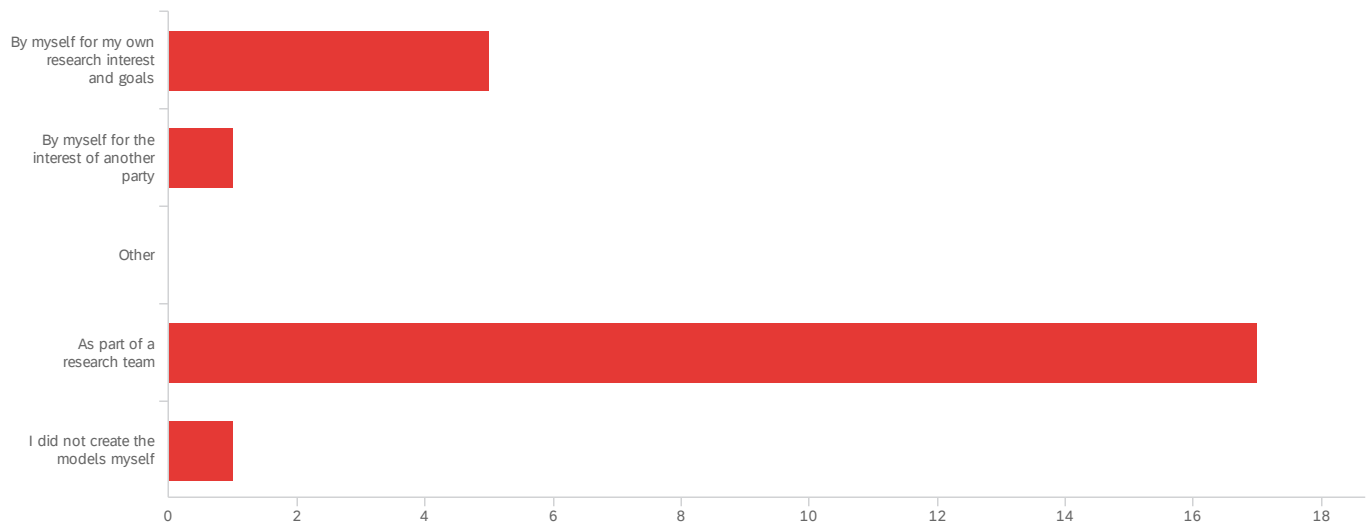
Q18_8_TEXT - Other

Other

Art- & Science

Museology

science

Q27 - Was this 3D project executed by yourself or as part of a larger team?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Was this 3D project executed by yourself or as part of a larger team? - Selected Choice	1.00	5.00	3.33	1.28	1.64	24

#	Field		Choice Count
1	By myself for my own research interest and goals	20.83%	5
2	By myself for the interest of another party	4.17%	1
3	Other	0.00%	0
4	As part of a research team	70.83%	17
5	I did not create the models myself	4.17%	1
			24

Showing rows 1 - 6 of 6

Q27_3_TEXT - Other

Other

Q28 - What was your role on the project?

What was your role on the project?

Lead of XR and 3D incl. all tech

researcher, cofounder

student researcher first, 20 years later still ongoing research

Coordinator of the 3D acquisition phase

Archaeologist, Specialist in topography and photogrammetry

Everything

Photogrammetrist

Researcher and 3D modeller

original co-founder as archaeologist with art historian and primarily GIS and LIDAR

Data Acquisition

PI

Scanning and modeling

Early Career Researcher

Lead advisor

Project manager

Excavation Co-Director

Coordinator of the development
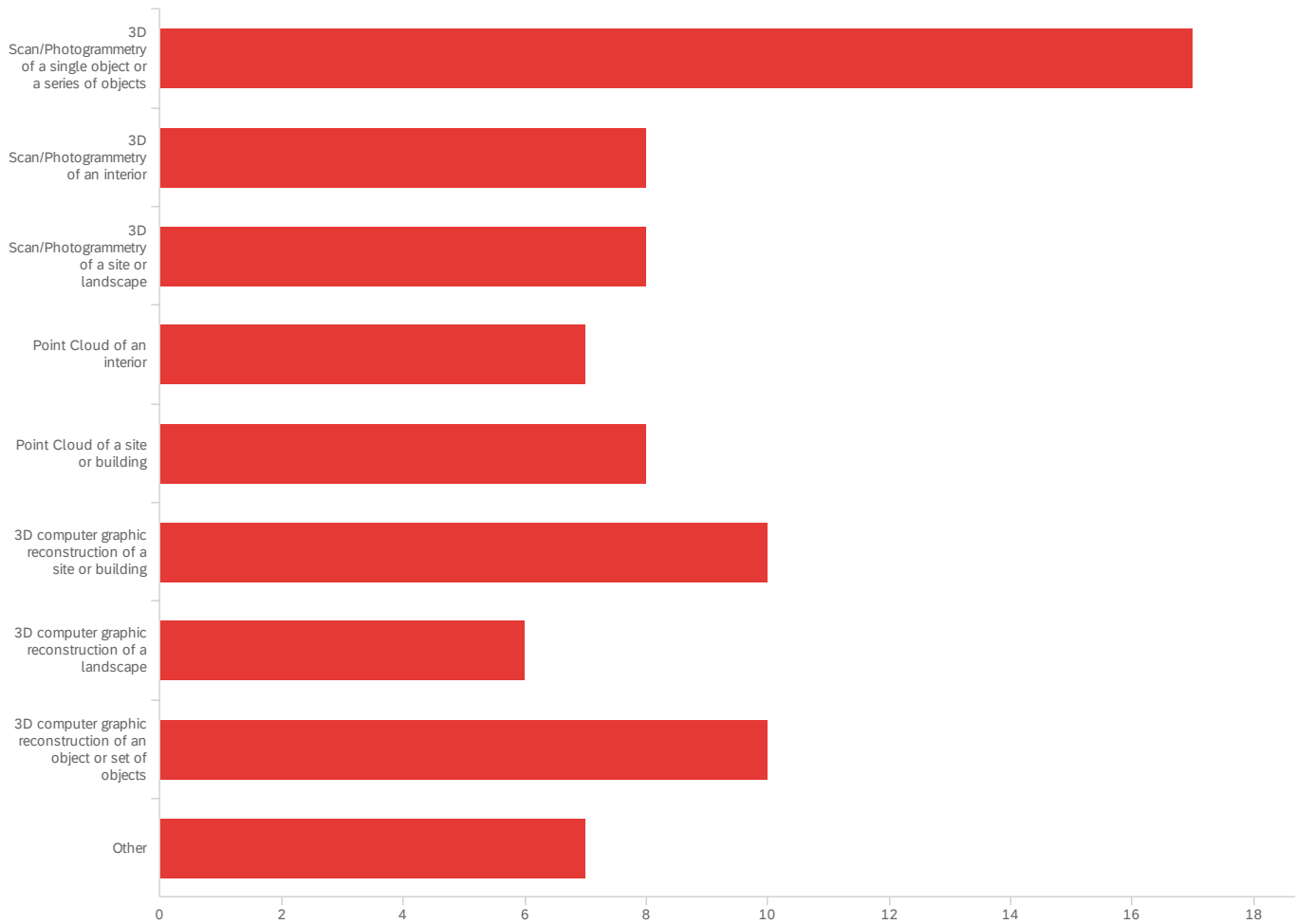
Digitizer and data steward

3D scanning, data processing, data management and curation

Director

It was my PhD project, so I created all 3D and RTI outputs and the related research.

project leader / PI

Q29 - What type of 3D models did the project produce?

#	Field	Choice Count	
1	3D Scan/Photogrammetry of a single object or a series of objects	20.99%	17
2	3D Scan/Photogrammetry of an interior	9.88%	8
3	3D Scan/Photogrammetry of a site or landscape	9.88%	8
4	Point Cloud of an interior	8.64%	7
5	Point Cloud of a site or building	9.88%	8
6	3D computer graphic reconstruction of a site or building	12.35%	10
7	3D computer graphic reconstruction of a landscape	7.41%	6
8	3D computer graphic reconstruction of an object or set of objects	12.35%	10
9	Other	8.64%	7
			81

Q30 - Was the development of the 3D content the primary output of the project?
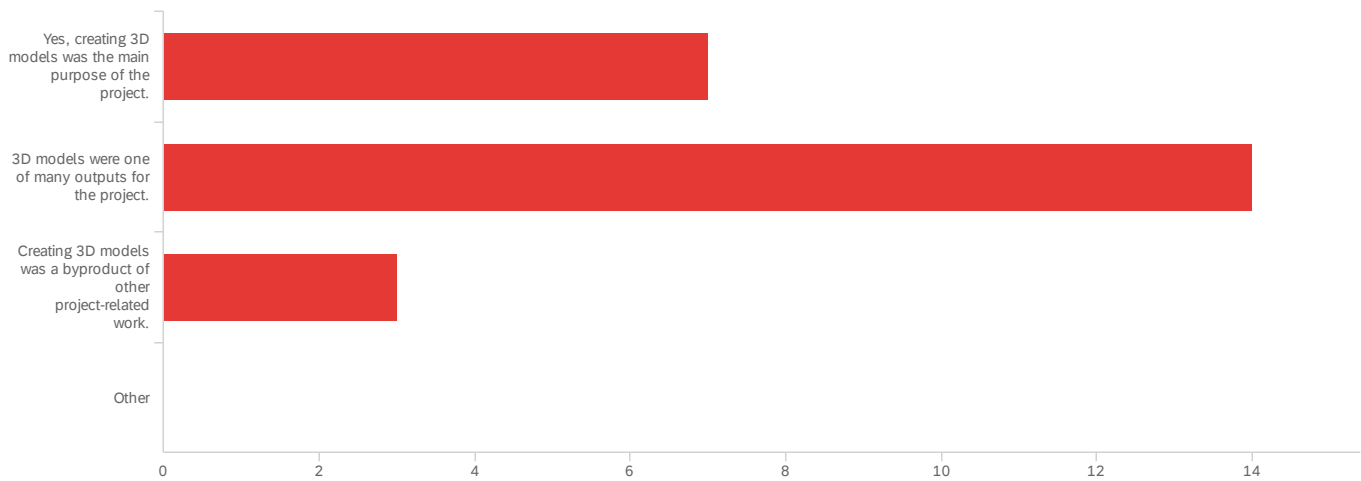
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Was the development of the 3D content the primary output of the project? - Selected Choice	1.00	3.00	1.83	0.62	0.39	24

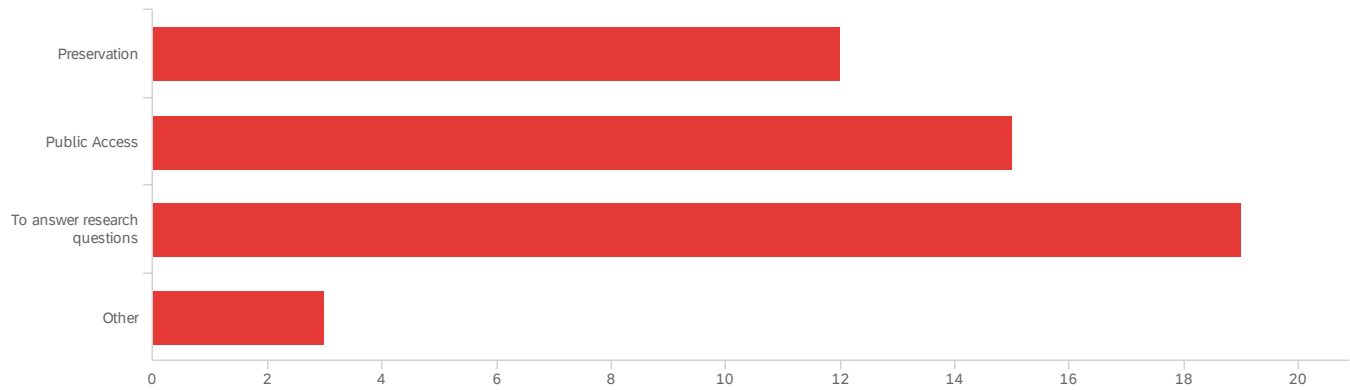| #	Field	Choice Count	
1	Yes, creating 3D models was the main purpose of the project.	29.17%	7
2	3D models were one of many outputs for the project.	58.33%	14
3	Creating 3D models was a byproduct of other project-related work.	12.50%	3
4	Other	0.00%	0
			24

Showing rows 1 - 5 of 5

Q30_4_TEXT - Other

Other

Q31 - What was the intended purpose of creating 3D content for this project?

#	Field	Choice Count	
1	Preservation	24.49%	12
2	Public Access	30.61%	15
3	To answer research questions	38.78%	19
4	Other	6.12%	3
			49

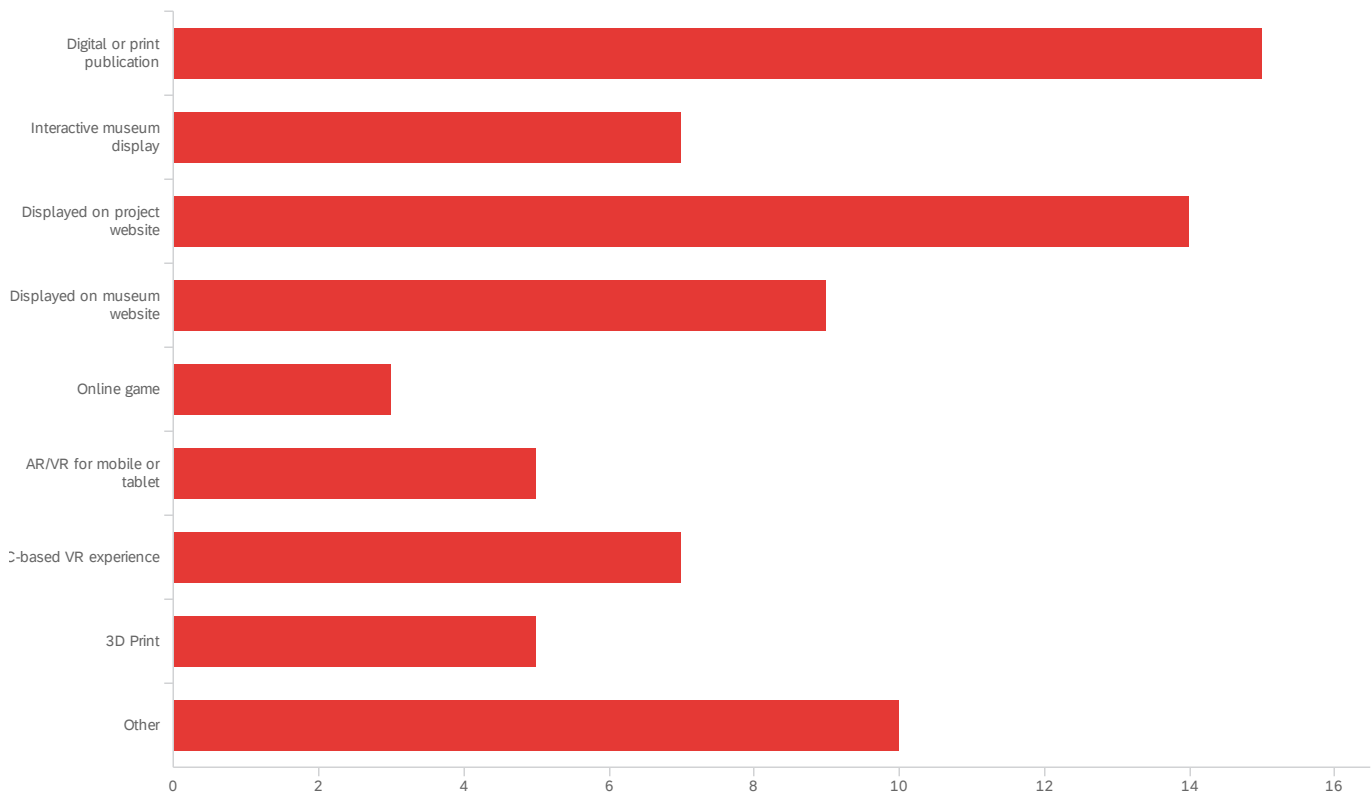Showing rows 1 - 5 of 5

Q31_4_TEXT - Other

Other
having a mozilla hubs space for events to share more 3D in the future
Student research
Interface to explore contextual resources (e.g. Linked Data))

Q32 - What were the outputs (or the intended outputs) of the project?

#	Field		Choice Count
1	Digital or print publication	20.00%	15
2	Interactive museum display	9.33%	7
3	Displayed on project website	18.67%	14
4	Displayed on museum website	12.00%	9
5	Online game	4.00%	3
6	AR/VR for mobile or tablet	6.67%	5
7	PC-based VR experience	9.33%	7
8	3D Print	6.67%	5
9	Other	13.33%	10
			75

Showing rows 1 - 10 of 10

Q21_9_TEXT - Other

Other

sensitive cultural research collections (osteology)

Non-interactive museum display

Made available for EUROPEANA

Micro Traces analysis and thesaurus

In the longer term, it is hoped that an interactive museum display and an AR/VR experience for both mobile and PC can be produced.

Forward models to assist in archaeological interpretation

PhD thesis

displayed in academic library repository

Q33 - Do you have a plan for the sustainability of the project? If so, please provide a short description below. By sustainability we mean long-term use, upkeep and/or preservation of the digital models and the data associated with them.

Do you have a plan for the sustainability of the project? If so, please pro...

Yes - just do it. Support is welcome, but we are used to self-fund our projects without any external support.

general backup workflow, planing on stable file formats, keeping original raw data for future reprocessing in cas of data lost, file format no more compatible or if advances in reconstruction method in photogrammetry. For this we archive both JPEG and RAW files from the camera, the work files and the output in multiple formats.

There is a concept how to archive the model, including the concepts and sources guiding the reconstruction, as well as the processes and resulting data. However this has not been implemented yet.

Unfortunately there are no plans of that kind

We store all data coming from the fieldwork locally, in a bought web-domain and we use the current 3D platform available online.

Hoping to expand/streamline the workflow and then incorporate something like a gaming environment that would allow the (lighting-interactive) juxtaposition of different objects.

A developement platform to held the models and lets users make segmentations

This aspect is still to be fully worked out. For the moment: deposit the models in DANS and convert the data into Linked Data/RDF and host it within the Golden Agents infrastructure.

The project ended in 2015 and we recently received a planning grant to determine the best options to revitalize the 3D WebGIS component. We already transferred the website and reinstated the 3D single object viewer (although not with database link yet) and we plan to submit a follow-up grant proposal to continue to revitalize and expand the system for interoperability.

Plan in discussion

We are uploading the data to the UVA library system, which has a cloud based storage for 3D models that is currently being expanded. The library is developing a Digital Humanities team within the program to ensure models are kept up to date.

The project Co-PIs were responsible for the implementation of the data management plan. Going forward, in potential future phases, they will also be responsible for its periodic review, for updating it throughout the life of the project and while project data is retained. This data is currently organised using a standardised naming convention, in shared files within folders on the institutional drives of the participating institutions and partners. Data deposited in TARA are described according to qualified Dublin Core metadata and are OpenAIRE-compliant; including funder name, programme name and grant number as well as links to associated publications. The repositories used are open systems, harvestable via OAI-PMH

Archive "matterpak" (downloadable .xyz data + materials) on NextCloud platform for preservation and re-use.

3D models made with PhotoModeler in 2006-2008 and georeferenced in ArcScene were exported from ArcScene as 3D PDFs; the 3D PDFs are associated with XML sidecare documents containing contextual and preservation metadata, and these files will all be deposited in the UT Dataverse repository. The models are available as attached files in a dynamic (php-based) and, in the future, static (html only) web database environment, where they are individually identified by Archival Resource Key (ARK) ids with suffix pass-through.

The project is based on long-term national funding and infrastructures.

The photographs are stored in the scholarly data archive https://kb.iu.edu/d/aiyi.

Project is archived on my University's data repository.

The project has its own website. The Digital Models are going to be available in Europeana (European Digital Library) We also host all the data to our internal servers.

Yes, the data were produced in archivable formats and were archived with the rest of the project digital data

The initial plan was to make digital models available within the project website, linked with the 2D interactive map and with annotated data as each 2D object already has.

Historic Environment Scotland has said that they will preserve the digital outputs - I need to finish up the metadata and finish putting the lower resolution 3D models on Sketchfab for access/download. Depending on HES, I may make the original resolution 3D models available for download on Zotero.

Yes, we are part of 2 digital preservation consortia that include both LOCKSS and cloud storage, as well as governance, security, PREMIS metadata, bag-it specification, and other NDSA Levels of Preservation requirements and we are also currently undergoing CoreTrust seal auditing.

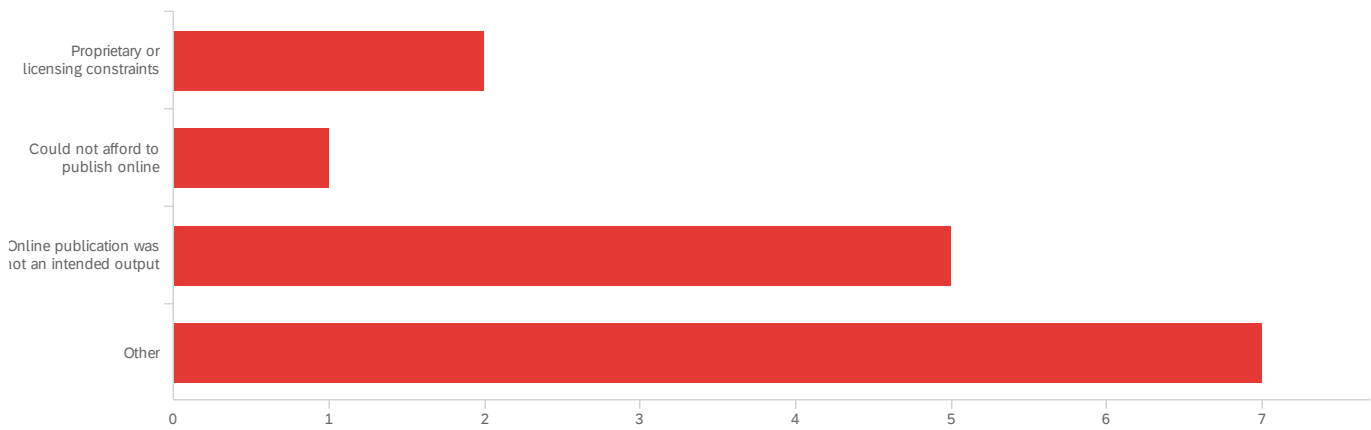## Q34 - Did you use a web viewer for displaying the 3D content online?
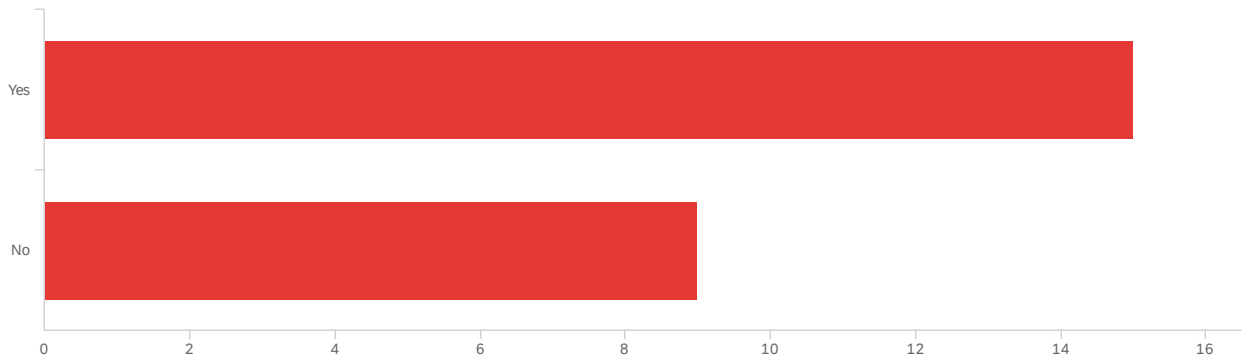
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Did you use a web viewer for displaying the 3D content online?	1.00	2.00	1.38	0.48	0.23	24

#	Field		Choice Count	
1	Yes		62.50%	15
2	No		37.50%	9
				24

Showing rows 1 - 3 of 3

Q35 - Why did you choose not to publish your 3D content online?

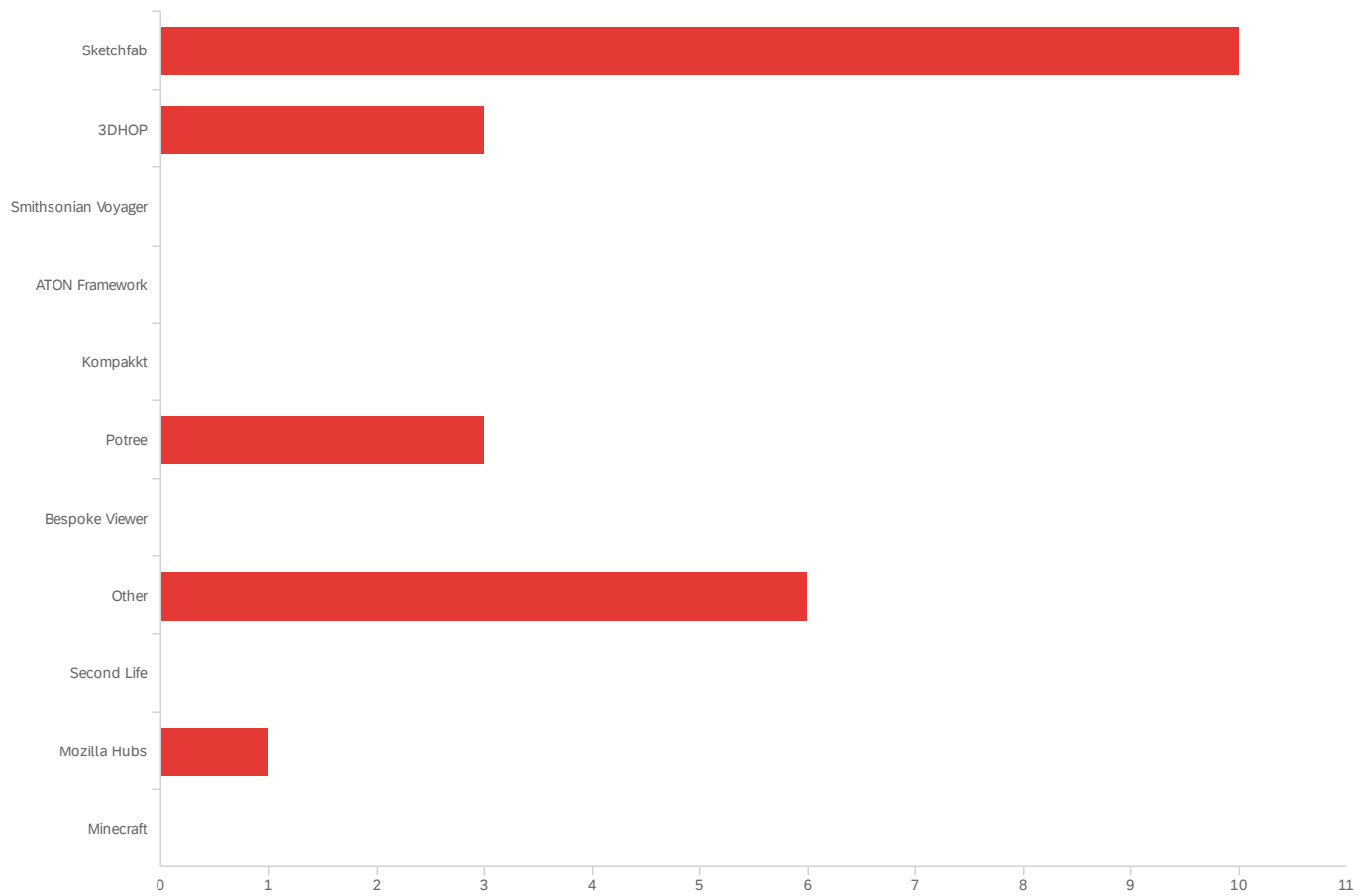| #	Field	Choice Count	
1	Proprietary or licensing constraints	13.33%	2
2	Could not afford to publish online	6.67%	1
3	Online publication was not an intended output	33.33%	5
4	Other	46.67%	7
			15

Showing rows 1 - 5 of 5

Q36 - Which viewer did you use?

#	Field	Choice Count	
1	Sketchfab	43.48%	10
2	3DHOP	13.04%	3
3	Smithsonian Voyager	0.00%	0
4	ATON Framework	0.00%	0
5	Kompakkt	0.00%	0
6	Potree	13.04%	3

#	Field		Choice Count
7	Bespoke Viewer	0.00%	0
8	Other	26.09%	6
9	Second Life	0.00%	0
10	Mozilla Hubs	4.35%	1
11	Minecraft	0.00%	0
			23

Showing rows 1 - 12 of 12

Q25_8_TEXT - Other

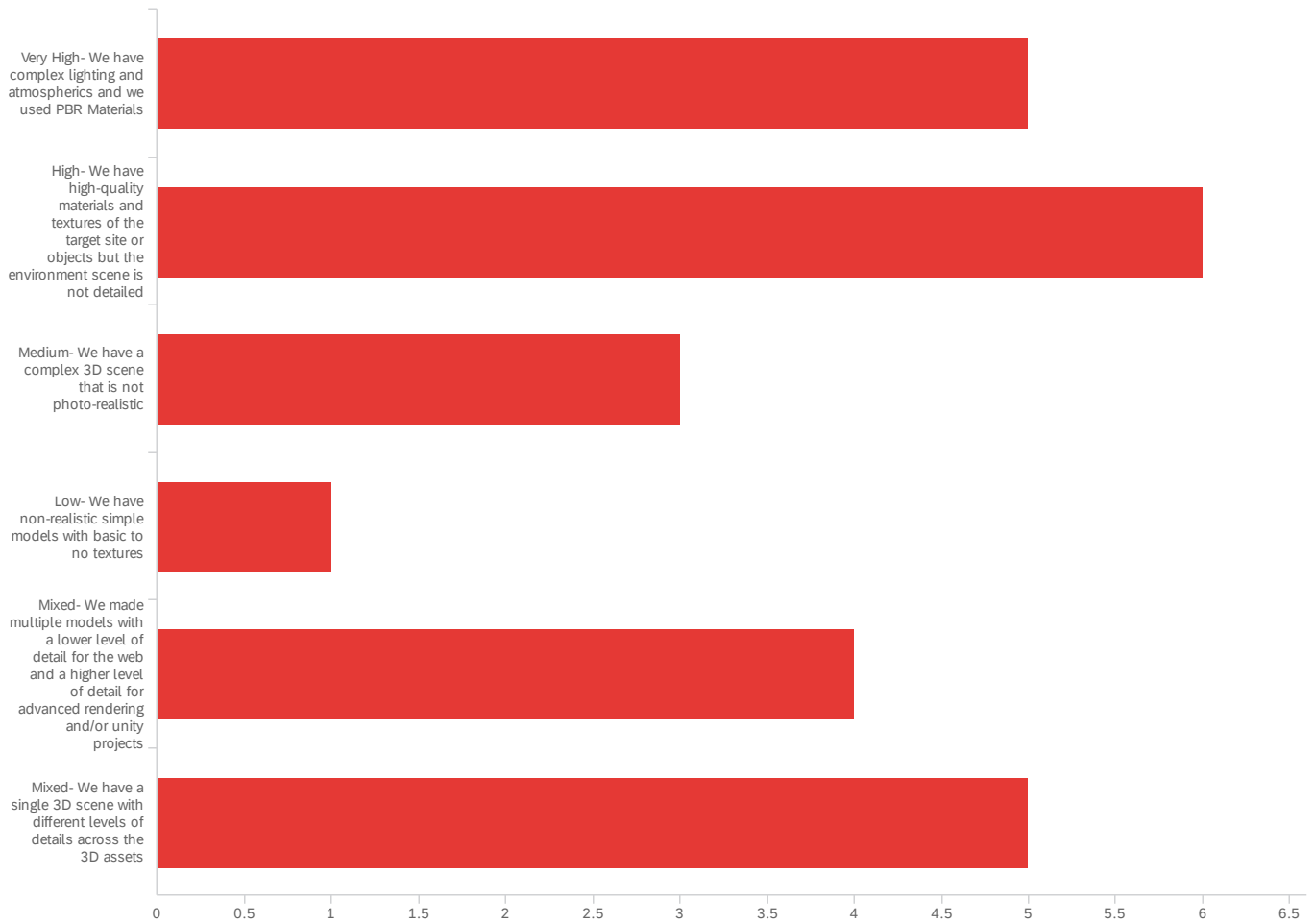| Other |
|---|
| Currently experimenting with output of UE5, Unity and TivoliCloud VR |
| A web-viewer designed within our project |
| open source- customized |
| Google Model Viewer |
| Matterport |
| working on local solution based on 3Dom |

Q37 - What is the level of detail for your 3D scene?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is the level of detail for your 3D scene?	1.00	6.00	3.33	1.89	3.56	24

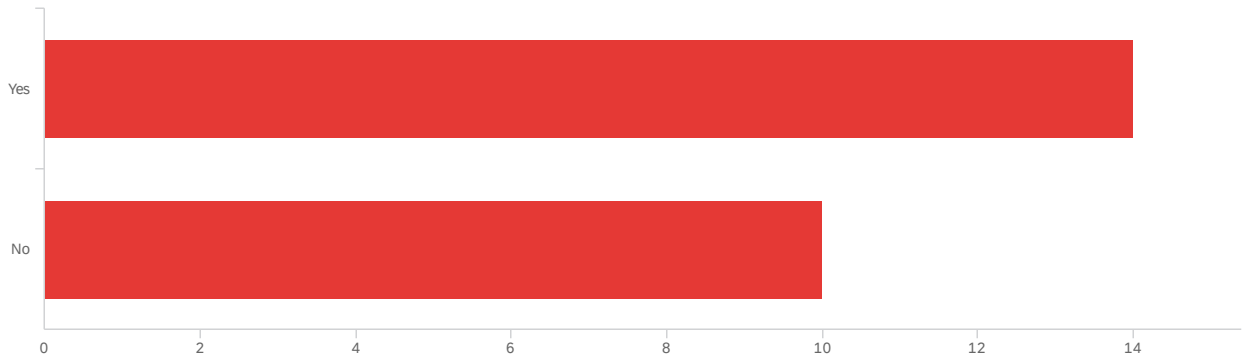| #	Field	Choice Count	
1	Very High- We have complex lighting and atmospherics and we used PBR Materials	20.83%	5
2	High- We have high-quality materials and textures of the target site or objects but the environment scene is not detailed	25.00%	6
3	Medium- We have a complex 3D scene that is not photo-realistic	12.50%	3
4	Low- We have non-realistic simple models with basic to no textures	4.17%	1
5	Mixed- We made multiple models with a lower level of detail for the web and a higher level of detail for advanced rendering and/or unity projects	16.67%	4

#	Field	Choice Count	
6	Mixed- We have a single 3D scene with different levels of details across the 3D assets	20.83%	5
			24

Showing rows 1 - 7 of 7

Q38 - Did you include annotations (such as information panels, pop-up boxes, etc.)

within the 3D scene?

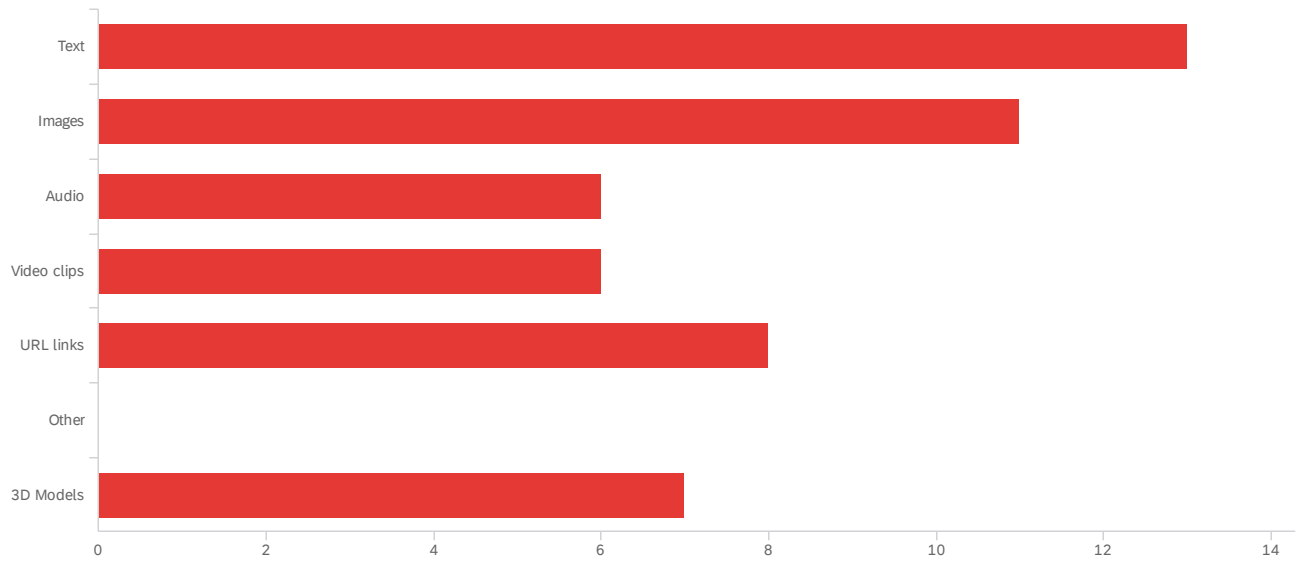| #	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Did you include annotations (such as information panels, pop-up boxes, etc.) within the 3D scene?	1.00	2.00	1.42	0.49	0.24	24

#	Field		Choice Count	
1	Yes		58.33%	14
2	No		41.67%	10
				24

Showing rows 1 - 3 of 3

Q39 - What media did you include in these annotations?

#	Field		Choice Count
1	Text	25.49%	13
2	Images	21.57%	11
3	Audio	11.76%	6
4	Video clips	11.76%	6
5	URL links	15.69%	8
6	Other	0.00%	0
7	3D Models	13.73%	7
			51

Showing rows 1 - 8 of 8

Q28_6_TEXT - Other

Other

Q40 - What was the subject content of these annotations?
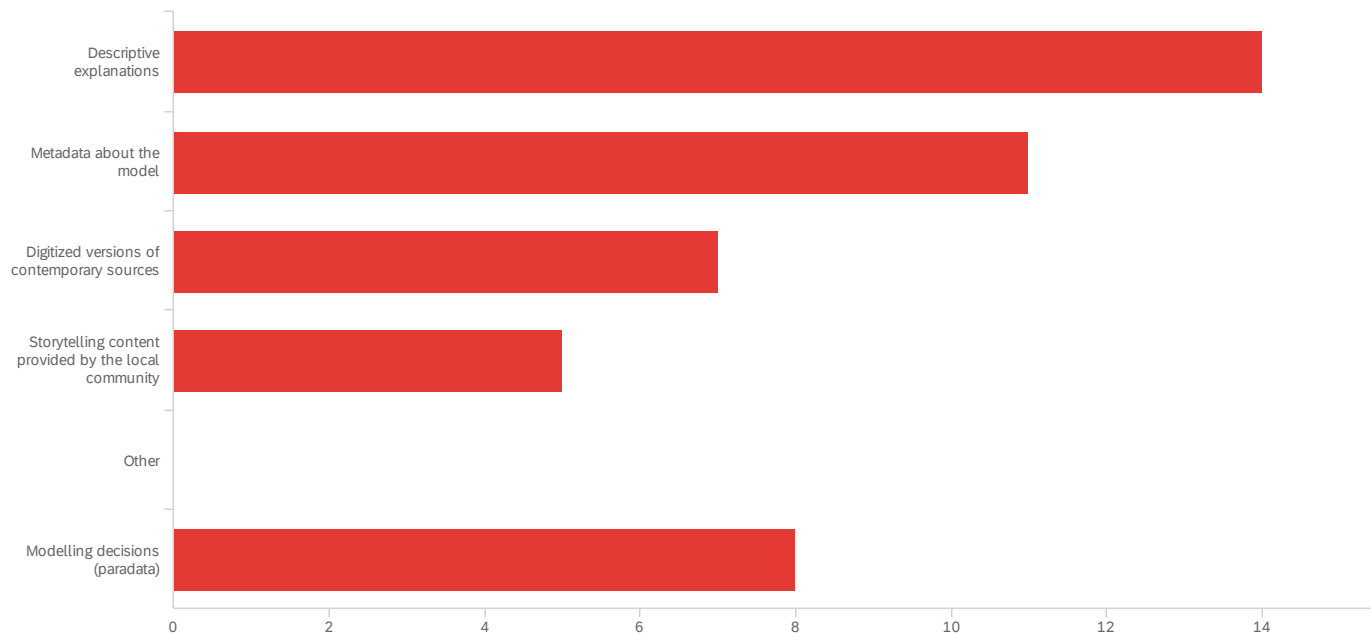
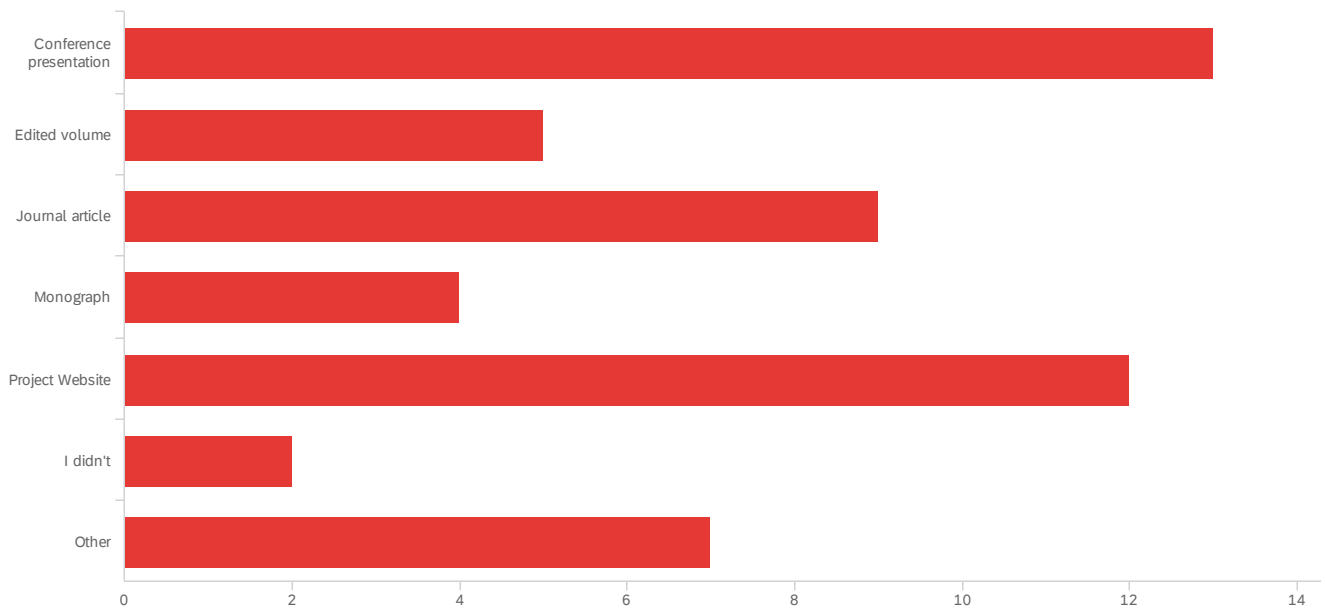| #	Field		Choice Count
1	Descriptive explanations	31.11%	14
2	Metadata about the model	24.44%	11
3	Digitized versions of contemporary sources	15.56%	7
4	Storytelling content provided by the local community	11.11%	5
5	Other	0.00%	0
6	Modelling decisions (paradata)	17.78%	8
			45

Showing rows 1 - 7 of 7

Q29_5_TEXT - Other

Other

Q41 - If not, how did you make available information associated with a project?

#	Field	Choice Count	
1	Conference presentation	25.00%	13
2	Edited volume	9.62%	5
3	Journal article	17.31%	9
4	Monograph	7.69%	4
5	Project Website	23.08%	12
6	I didn't	3.85%	2
7	Other	13.46%	7
			52

Showing rows 1 - 8 of 8

Q41_7_TEXT - Other

Other
Live moderation and explanaitons during events in realtime.
commit messages in version control, integrated documentation
Parts shared in a variety of conferences. Other work is still underway.

Other

Seminar

ReadMe and CSV file

Online PhD

many of the above in progress

End of Report