



Final Report on ADVANCED  
DOCUMENTATION OF 3D DIGITAL  
ASSETS TASK FORCE

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## 1. Introduction

The digital documentation of CH assets is inherently a multimedia process, addressed through the digital representation of the shape, appearance and conservation condition of the heritage/cultural object for which 3D digital model is expected to become the representation. 3D representations should progress beyond current levels to provide the necessary semantic information (knowledge/story) for in-depth studies and use by researchers and creative users, offering new perspectives and understandings. Digital surrogates can add a laboratory dimension to on-site explorations originating new avenues in the way tangible cultural heritage is addressed.

The generation of high-quality 3D models is still very time-consuming and expensive, not least because the modeling is carried out for individual objects rather than for entire collections and formats provided in digital reconstructions are frequently not interoperable and therefore cannot be easily accessed and/or reused or sustained.

Many projects and studies have investigated aspects related to 3D Cultural Heritage assets and highly elaborated theoretical approaches, principles and guidelines are proposed for data schemes and infrastructures. On the other hand, in practice, 3D reconstruction projects are often based on unique and prototypic semantics, workflows, and infrastructures and are customized for a specific purpose. Therefore, our TFG focused in the second half of its period on the user needs and requirements and on the quality of the 3D data and metadata available in different repositories in



Europe and in Europeana especially. The results are very promising and for the first time in the EU we are giving a holistic overview of what is needed to be done in the area of 3D CH documentation

### Meeting

In September 2017, a second one-day meeting was organized in Vienna, Austria at the Austrian Institute of Technology (AIT), where the majority of the TFG members participated and contributed actively.

## 1.1 Goal of the Task Force

The Task Force group focused its work during the second half of the project on the users and stakeholders needs and demands. We paid special attention to qualitative comments on the 3D objects already in Europeana, together with suggestions for the development of standard guidelines and formats, intended for cultural heritage communities. To this end, an online survey was circulated to around 3500 professionals, users and stakeholders of 3D-CH assets. The foci included digitisation methods, metadata extraction, post-processing, modelling, harvesting, the quality of the EDM information and the accuracy of 3D objects (including Intangible Heritage), and covering semantically-aware 3D objects with a view to improving their archiving, retrieval, reusability and sustainability, enriching the geometrical structure(s) with related knowledge, considering the range of devices, models and software applications involved and the ongoing revolution in technology.

In addition, all the members of the TFG presented and discussed during the Vienna meeting their ideas and positions through specific presentations intended to crystallise current problems in 3D documentation and to propose some solutions. The presentations are available on the TF Basecamp.

## 1.2 The problem

The acquisition, processing, archiving and exchange of 3D Cultural Heritage assets and information has been investigated by many projects in Europe (e.g. EPOCH, 3D-COFORM, FOCUS K3D, CARARE, EU-CHIC, 3D ICONs, CLIMATE-CHANGE, 4D-CH-WORLD, INCEPTION, etc.); organizations (e.g. Getty, Europeana, the Smithsonian); Scientific Committees (e.g. ICOMOS/CIPA, ISPRS and ICOM/CIDOC and others) and various professionals and experts. At present, many highly elaborated theoretical approaches, principles and guidelines are proposed for data schemes and infrastructures (e.g. London and Seville Charters, CIDOC-CRM, CityGML, Web3D consortium) aiming to foster quality, compatibility and sustainability of 3D Cultural Heritage objects. On the other hand, in practice 3D reconstruction projects are often based on unique and prototypic semantics, workflows, and infrastructures and are customized for a specific purpose (e.g. the CyArk 500 project).



## 2. Detailed approach

The main objective of this report is to describe how we can implement an effective, cross-disciplinary and collaborative work methodology to define data collection process, case study setup, selection and utilization of systems and instruments, knowledge management and implementation of semantically enriched models, especially for 3D Cultural Heritage assets such as artefacts and monuments. for exploitation in education and business or in the creative industries in general. The multidisciplinary demands of this TFG lead us to examine procedures and models on e-documentation of 3D-CH objects. However, the definition, for example, of the term ‘3D-CH asset’ (3D object and memory/story) appears increasingly complex. In the field of Documentation of CH there is much misunderstanding and many misconceptions about ‘what is a 3D-CH object’. Unfortunately, this is the current situation visible with the 3D objects available in Europeana. At the same time the classification of what 3D- CH assets are complicated due to the plethora of (frequently unclear) criteria used by specialists. Likewise, users and other stakeholders, together with the data itself, introduce variables that affect the decision-making procedure for e-documentation.

Combining the above highly-complicated environment with the variety of digital heritage data formats, archiving methods, modelling reconstructions, semantics and metadata classification, it is obvious that we are dealing with a very complex challenge, which had to be considered in detail and clarified in the first stage of this TFG

Therefore, in the early stages, the TFG experts worked on defining “3D-CH asset”, since this is needed for the proper classification of a CH asset before proceeding to its taxonomy, based on different criteria varying from type, dimensions, use etc. to technology used in its production, manufacture/construction and maintenance, and focusing on collaboration work and aspects essential to the needs of e-Documentation. Also, stakeholders and policy makers were analyzed, since it is they who interact with the (re-)use and legislation of CH data. These data are intended for (re-) use by specific user groups which are further sub categorized into: experts (e.g. researchers, scientists etc.); and non-experts (e.g. students, tourists etc.). Furthermore, the interaction of a potential user with the system upon its object was investigated, taking account of different users’ needs.

Disciplines differ both in terms of users and of methodologies and needs for the documentation of each 3D-CH asset. For this reason, the use and results of a multidisciplinary approach are seen as necessary for modelling knowledge documentation, before conducting a cost analysis to check that the proposed system is a feasible way to produce the desired results. In addition to the categorization/taxonomy of each 3D-CH asset, different forms of CH data give rise to a need for analysis before decisions about various methodologies for data collection and discrimination (depending, for example, on whether 3D-CH assets are tangible or intangible).

During data collection, a risk analysis is necessary to avoid consistency issues that may be encountered especially in the accuracy of the collected data imported to the system. For the data to be accessible by everyone in an open repository, various copyrights, property rights and standards were examined thoroughly in accordance with WIPO treaties as well as their metadata, para-data



and semantics, since their interrelationships constitute the ontology of the system. Moreover, the team conducted a cost/quality assessment of the data depending on the level of access, complexity, size, maintenance and cross-sectoral origins as well as the future need for re-use.

The experts involved in this TFG also have extensive experience in the development of tools and methodologies that engage users actively through the presentation of CH assets. Compliance with standards for object description will offer compelling benefits for CH documentation such as the implementation of semantically-enriched models, by establishing the right semantic rules for the data and enabling searches on the Semantic Web. Not only an analysis of semantics formats has been conducted, but also of the archiving methods and their relative advantages and disadvantages, towards the optimal preservation and visualization of the archived content and the levels of data/metadata access that users should be granted.

To cover these objectives, we followed a specific analysis path (below):

## 2.1 Collaborative work for e-Documentation

- a. **Possible Stakeholders & Policy Makers.** There are different stakeholders, with different needs. At the same time, we took into account the Policy Makers that give directions and apply legislation on tangible and intangible preservation.
- b. **Users** have a huge diversity; from professionals on 3D-CH asset conservation to scientists and simple users (tourists, students). The analysis took into consideration all known possible users.
- c. A **General Classification of 3D-CH assets** such as: use, materials, time period, conservation state, civilization, architectural and historic value etc.
- d. **Taxonomy of 3D-CH assets** according to holistic e-documentation needs: holistic e-Documentation is the main variable that determines the Taxonomy of the object.
- e. **Understanding User Needs.** Following standard methodology, we can define User Needs through a Human Centered Approach, to be included in Holistic approach methodologies
- f. **Multidisciplinary Analysis – Comparison.** Different experts have followed different methodologies on documentation of 3D-CH assets. Comparison between these methodologies and needs gives us useful feedback for modelling the knowledge from 3D-CH assets e-documentation.
- g. **Cost Analysis & Feasibility Study.** The cost of documentation is an important decision-making variable that should be carefully analysed, targeting the best result for the least cost. The documentation should be economically and technically feasible to give us the desired, high quality results.
- h. **Data and Format Analysis.** Today there is a variety of formats for documentation data. It is important to have a full knowledge of the options in order to answer the question: “what kind of data do I need?”



- i. **Copyrights, Standards and Formats, Metadata, Para-data and Semantics** addressing copyright issues is a crucial step to e-documentation. At the same time, defining interrelationships between data will provide the Metadata, Para-data and Semantics.
- j. **Planning - Architectural Design of documentation.** At the end of the documentation procedure, we need to conclude with a Plan and an Architectural Design.

## 2.2 Methodology for data collection (GIS, 2D, 3D, - Multimedia form)

- a. **Forms of CH Data.** Depending on the forms of CH data, the documentation approach will be different. At this point we distinguish the forms of Tangible & Intangible e-documentation methods.
- b. **Data collection for Tangible Heritage.** The methodology of Tangible Heritage e-documentation is an important part of the methodology and of the corresponding results. We need to know the different methods and the results which we can achieve.
- c. **Data collection for the corresponding Intangible Heritage.** In relation to 3D-CH assets there is a lot of intangible information that could be documented (the memory), like productions techniques, untold stories, liturgies, lyrics, literature, uniforms, manufacturing knowledge, events, etc.
- d. **Methodological problems and risks collecting the data.** During data collection difficulties and problems can be encountered. A risk analysis would help to predict these problems. In this area, it is important to analyse the correctness of the collected data, especially for the intangible forms of heritage.
- e. **Quality assurance: data, metadata, knowledge, story and all related costs.** In this area we examine the European standards that ensure quality during documentation, including the cost of keeping the quality and the variety of the collected information high in standard.
- f. **Certification/Verification of the end results by users** (Policy Makers/ Owners/ Independent authorities etc.). The end results should be verified by the users. It is necessary to examine the tools that they could be used to certify the end results of the e-documentation. On other hand, the level of their understanding and knowledge needs to be assessed in order to help them to "fill the gaps".

## 2.3 Demonstration Cases set-up

- a. **Sample.** The way to choose the sample and all other information depends on the e-documentation needs and demands.





- b. **Size sample and criteria.** The Size of the sample (1,2...100 3D objects) depends on statistical methodology and on the place, environment, conditions, materials, size etc., to produce a solid research result.



## 2.4 Selection and utilization of systems -> modelling of know-how / big data

- a. Selection of the methodological & technological tools for modelling of knowledge: according to the data and the methodology that is followed in each case.

## 2.5 Implementation of semantically enriched models for 3D objects/Heritage Building Information Model (HBIM) application

- a. **Semantic rules.** At this stage the TFGs simple Semantic Rules can be established and implemented in order to get useful results on the holistic e-documentation approach.

## 2.6 Archiving, preserving and visualising the content

- a. **Local Repository or Europeana.** The results of the 3D e-documentation could be archived on a Local Repository (server) or on Europeana for a more open access. In connection with this, IPR issues should be addressed.
- b. **Classification of Access to Metadata and Data:** different users will get different levels of access to data (results), depending on the user needs already analysed.
- c. **Data Formats** will vary depending on user needs, repository capabilities and archiving possibilities.

## 2.7 Use and Re-Use of data

- a. **Example: Exploitation in Education.** Reusing data from holistic e-documentation for Education is one of the main objectives because it provides growth to the documentation and feasibility to the system.
- b. **Example: Exploitation in Tourism.** The tourist sector can benefit from 3D- CH asset e-Documentation since helps promote sites and raises the interest in them.
- c. **Example: Exploitation in Creative Industry (Games Industry).** Creative industry is a major economic sector of the European Union and 3D- CH asset e-Documentation data reuse could add value to creativity, gaming, installations, museums and other parts of the cultural economy.



### 3 Definition of 3D-CH asset Users

Users have a huge diversity; from professionals on artefacts or monument conservation to scientists and ordinary users (tourists, scholars, etc.). Analysis should take into consideration all possible users.

Apart from the possible stakeholders and policy makers, users can range enormously in their degree and type of expertise: many professionals and non-professionals interact regularly with CH. Some are central to defining and creating the set of data used in a knowledge-based system of documentation of historic monuments, while others only make use of these sets of data.

The following definitions are instructive to understanding and grouping potential users:

- An Expert is someone who both creates and uses data.
- A Non-expert is someone one who only uses/re-uses, or consumes, these data.

**Table 1. Expert and Non-Expert user examples**

<i>Experts</i>	<i>Non-Experts</i>
Anthropologists/sociologists Archaeologists Architects, city and urban planners Archivists, librarians Biologists Civil Engineers Chemical Engineers Computer scientists Collections Curators Geologists Geographers Geomatics Engineers Glossologists Historians Lawyers - Legal studies Mathematicians Material Specialist/Engineer Musicians, Artists Neuroscientists-Psychologists Physics, Quantum Physics Restorators/Conservators/Curators Structural Engineers Sites managers Surveyors Theologists	Administrative and territorial institutions Artists/Animators Church Commune/Municipality Creative industries Decision Makers Economists Electrical, Acoustic, Thermal Engineers Exhibition designers Games industry General Public Guides Lawyers Local Associations Owners Police and Fire Brigade Public Relations, Advertisers Scholars/Fellows Students Surveyors Teachers Tourists Travel agencies Traditional Communities Tourist Guides



### 3.1 The on-line Survey

Following several online discussions (eight Skype teleconferencing sessions in total) among the TFG members, a questionnaire was developed using Google-forms. The online survey was tested by several local stakeholders in three EU countries (Cyprus, Greece and Slovenia) and distributed to 3,500K professionals, stakeholders (Experts) and non-Experts, as indicated in table 1. **836 responses** answering all the questions and a further 53 responses answering 80% of the questionnaire have been received and have been excluded from our analysis.

### 3.2 3D objects in Europeana selected for the survey

The following 3D objects from Europeana have been taken into consideration in the survey:

1. A model of Etruscan Oinochoe with small wheel-shaped handle:  
[https://www.europeana.eu/portal/en/record/2048703/object\\_HA\\_690.html](https://www.europeana.eu/portal/en/record/2048703/object_HA_690.html)
2. A model of statue of heroic Claudio  
[https://www.europeana.eu/portal/en/record/2048703/object\\_HA\\_1799.html](https://www.europeana.eu/portal/en/record/2048703/object_HA_1799.html)
3. Coronation medallion  
<https://goo.gl/gNn1a5>
4. Nuage de points de l'église de Fontains  
<https://goo.gl/4GciUu>
5. Saint Salvator abbey of Ename around 1595 (high res 3D)  
[https://www.europeana.eu/portal/en/record/2048716/object\\_HA\\_2087.html?q=Ename](https://www.europeana.eu/portal/en/record/2048716/object_HA_2087.html?q=Ename)

This variety of objects available in Europeana give us a good overview of the current situation so far as digitisation technologies are concerned: their metadata quality, the geometrical accuracy of the 3D data, and the possibility of wide use and re-use of the data.

### 3.3 Analysis of the Survey

**Table 2. Respondent's level of studies.**

Level of Education	% of users
1. BSc	10
2. MSc	28
3. PhD	59
4. None of the above	3

87% had an MSc or PhD. It means that 727 experts, hat the highest level of education.



**Table 3. Respondent's years of experience in digital documentation.**

Years of Experience	% of users
1. 0-5	12
2. 6-10	15
3. 11-15	23
4. 16-20	17
5. More than 20	33

73% had more than 10 years' experience in digital documentation, which is resulting to more than 610 experts

**Table 4. Categorisation of users by occupation (see Table 1) - summary**

Archaeologists	13% equal to 108 experts
Engineers (all types)	12% equal to 100 experts
Architects	11.19% equal to 93 experts
Historians	9.03% equal to 78 experts
ICT specialists	7.53% equal to 63 experts
Teachers/trainers	7.53% equal to 63 experts
Archivists/librarians/ museologists	4.64%.equal to 33 experts
All others	32% equal to 267 experts

In order to get a general impression of user satisfaction with currently available metadata schema in Europeana and information available to describe particular objects, we are illustrating here the results for the objects described under 3.2.



### 3.3.1 Museum Artefact - Pottery

This is an object type which can be found in most of the museums in Europe and is relevant to the work for most of the users listed in Table 1 above.

*A model of Etruscan Oinochoe with small wheel-shaped handle:*

[https://www.europeana.eu/portal/en/record/2048703/object\\_HA\\_690.html](https://www.europeana.eu/portal/en/record/2048703/object_HA_690.html)



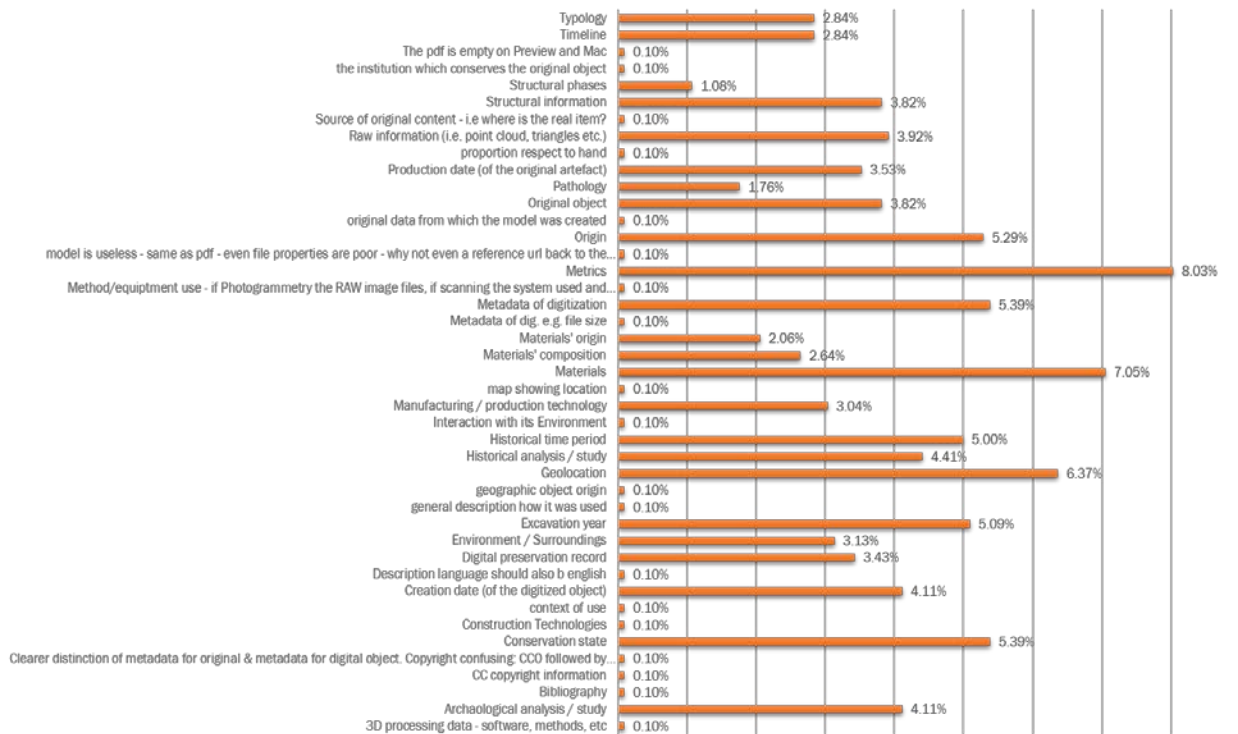
28.79% of the experts were not satisfied or expressed adequate satisfaction overall, 39.39% were neutral and only 31.82% satisfied or very satisfied.

The types of extra information listed in Table 5 were identified as needed (by percentage of respondents)

**Table 5. What additional information should be provided?**

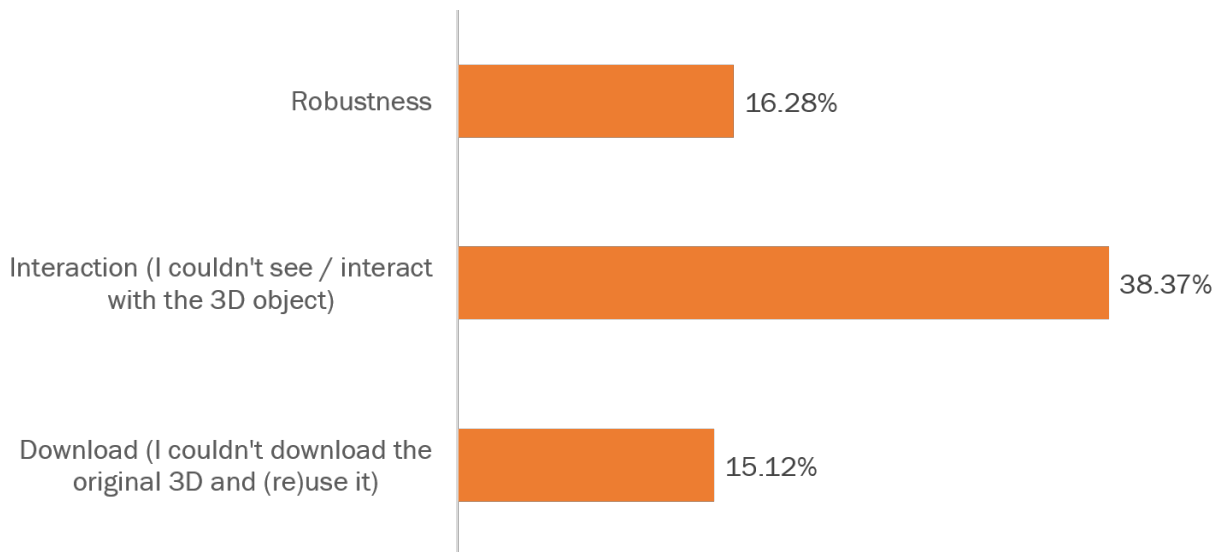


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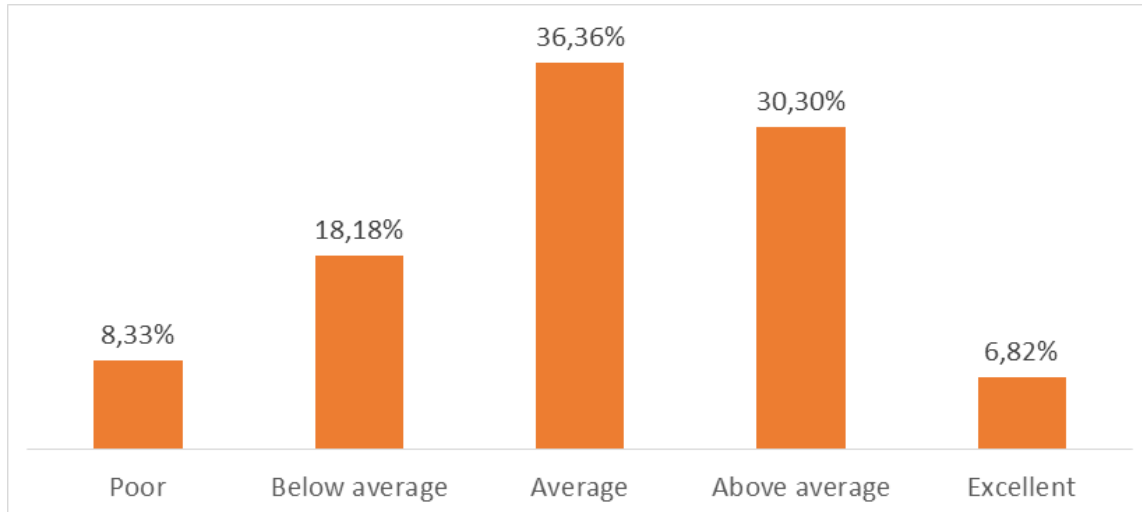
Respondents also rated their experience on robustness, on-line interactivity and downloading the object on their smart devices (see Tables 6).

**Table 6. Respondent's rating of experiences with this 3D object from Europeana.**





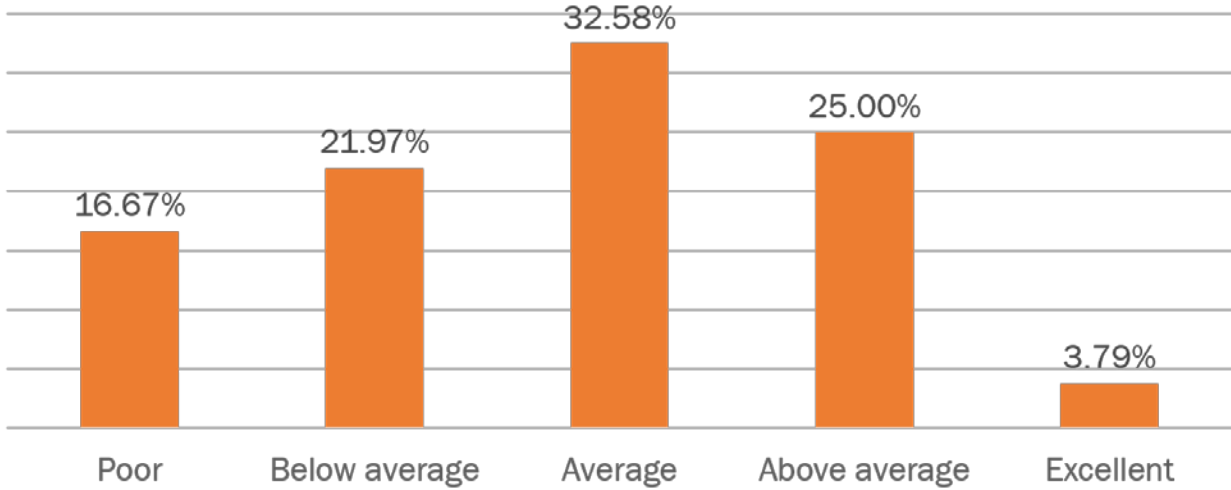
**Table 7. How would you rate the example model in terms of Quality (data, metadata, texture, etc.)?**



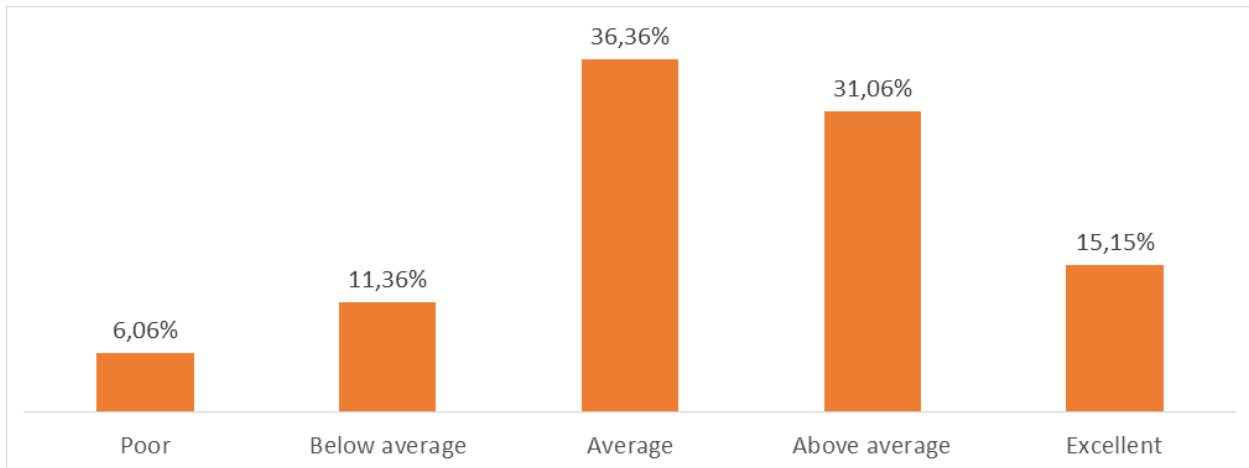




**Table 8. How would you rate this example in terms of Efficiency?**

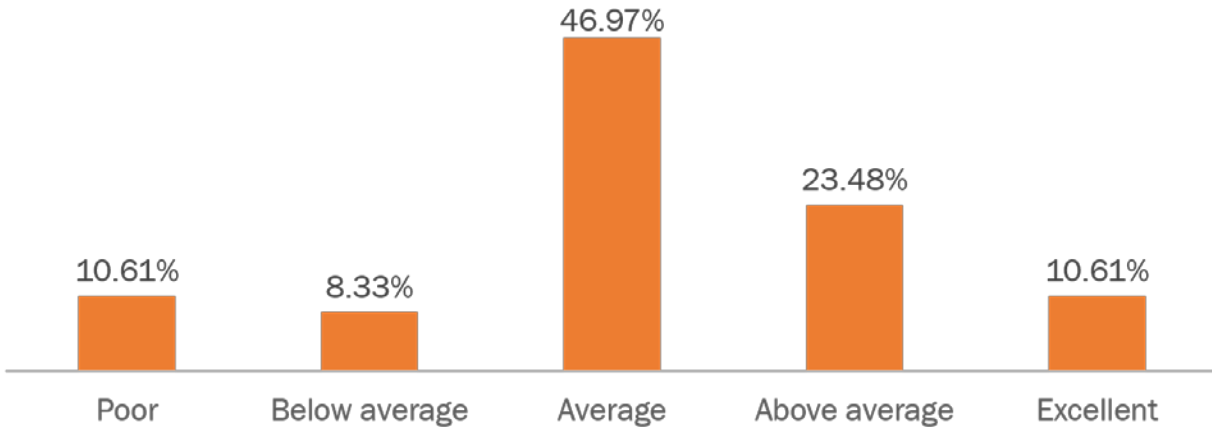


**Table 9. How would you rate the example models in terms of Accuracy?**





**Table 10. How would you rate the example models in terms of Authentication?**



### 3.3.2 Museum Artefact - A statue

A second example was the 3D model of statue of heroic Claudio recorded in Europeana. This is again a very typical museum's object, which can be found under the following link:

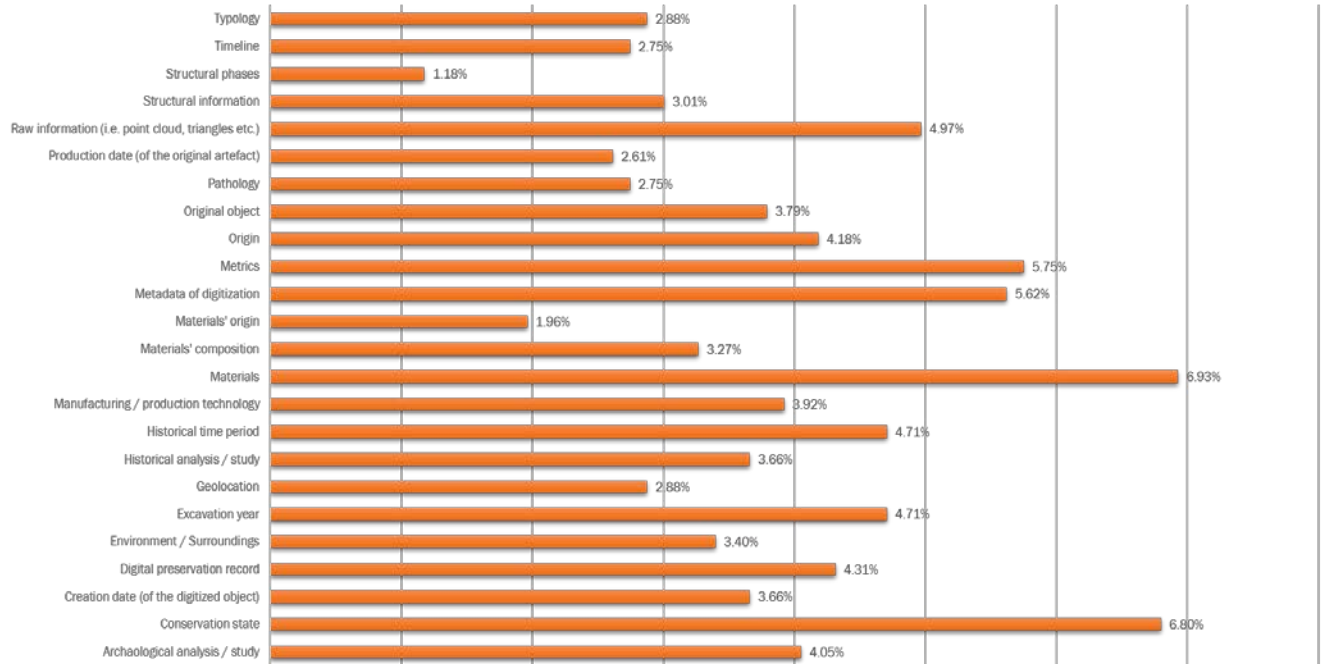
[https://www.europeana.eu/portal/en/record/2048703/object\\_HA\\_1799.html](https://www.europeana.eu/portal/en/record/2048703/object_HA_1799.html)



18.02% were not satisfied or expressed adequate satisfaction overall, 41.67% were neutral and 40.92% satisfied or very satisfied.

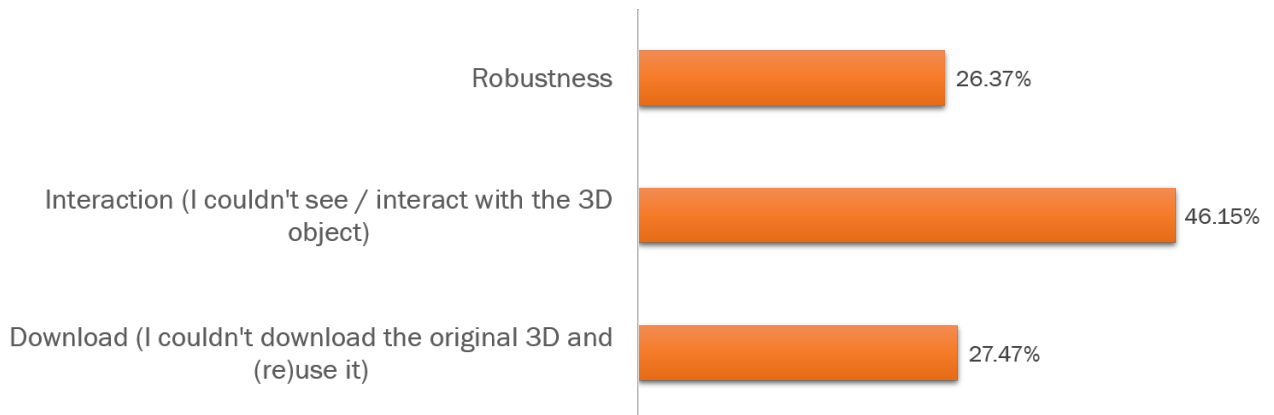


**Table 11. What additional information should be provided?**



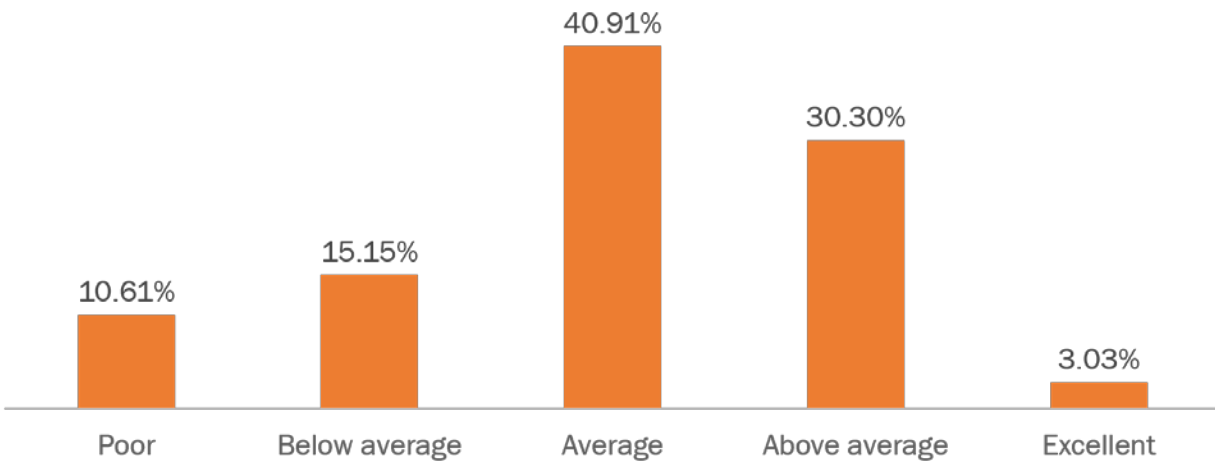
Respondents also rated their experiences of robustness, on-line interactivity and downloading the object on their smart devices (see Table 12).

**Table 12. Respondent's rating of experiences with the statue from Europeana.**

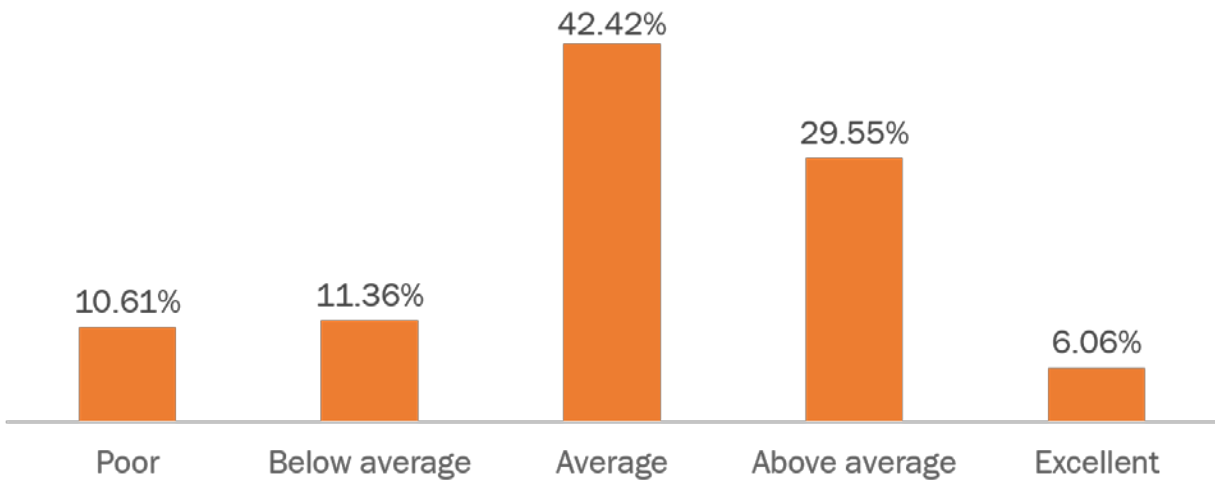




**Table 13. How would you rate the example models in terms of Quality (data, metadata, texture, etc.)?**

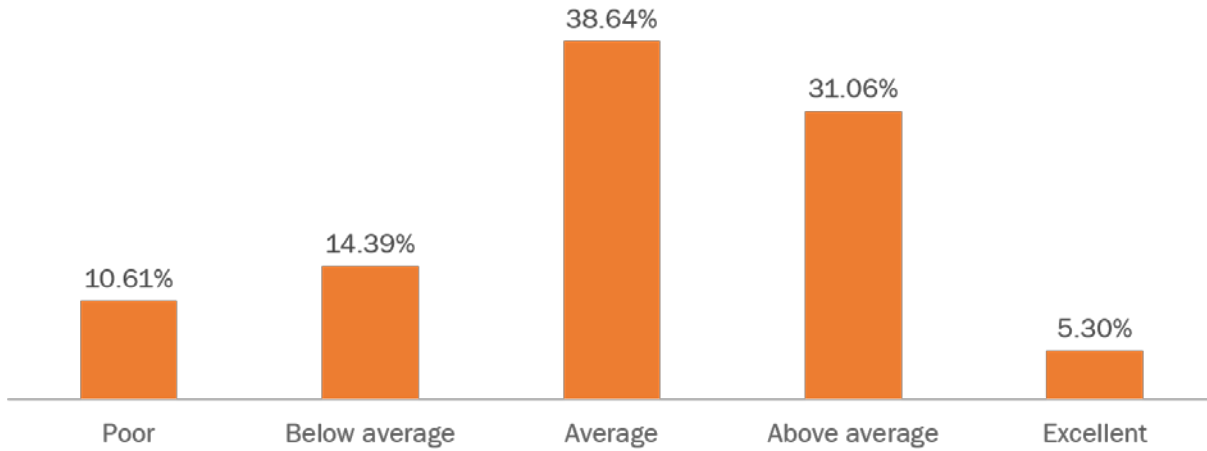


**Table 14. How would you rate the example models in terms of Efficiency?**

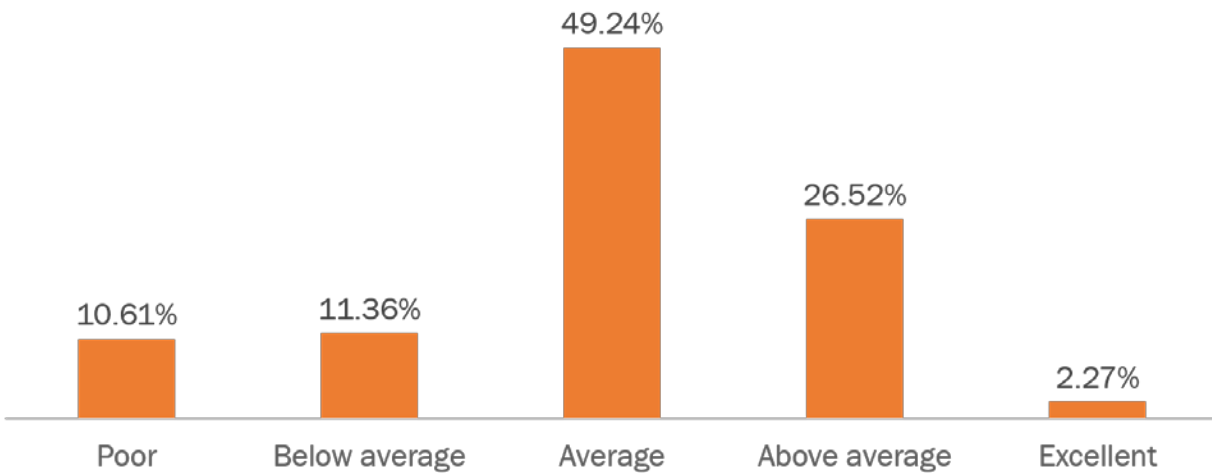




**Table 15. How would you rate the example models in terms of Accuracy?**



**Table 16. How would you rate the example models in terms of Authentication?**





### 3.3.3 Museum Artefact - A coin

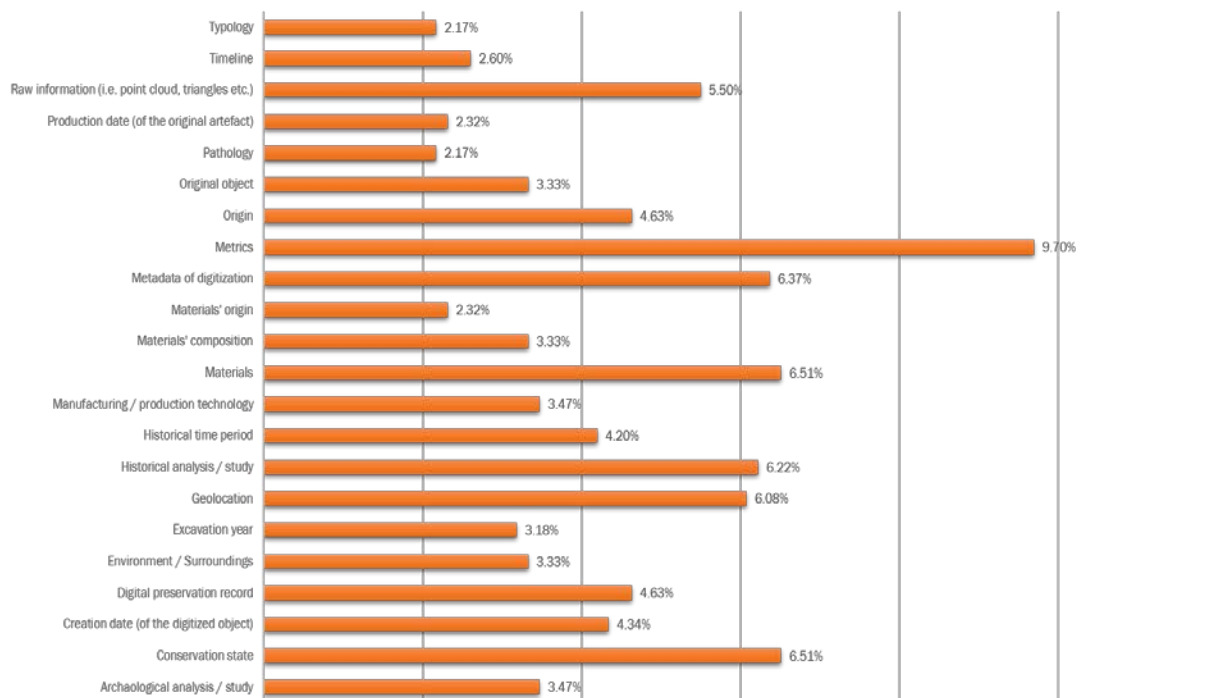
A third example was the 3D model of Coronation medallion harvested in Europeana under the following link:

[https://www.europeana.eu/portal/en/record/2026101/Partage\\_Plus\\_ProvidedCHO\\_Manx\\_National\\_Heritage\\_1954\\_5298.html](https://www.europeana.eu/portal/en/record/2026101/Partage_Plus_ProvidedCHO_Manx_National_Heritage_1954_5298.html)



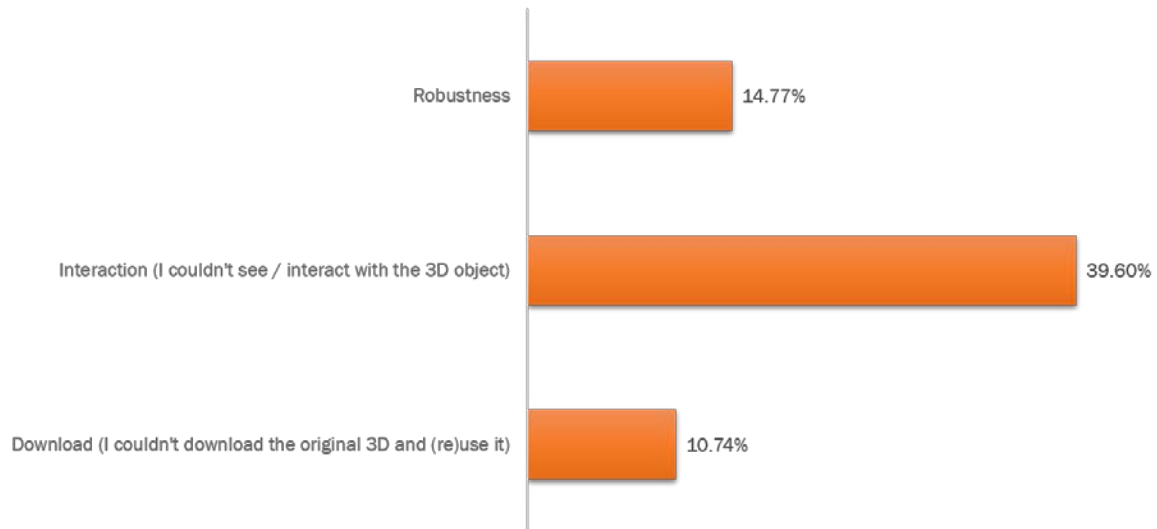
27.28% were not satisfied or expressed adequate satisfaction overall, 35.61% were neutral and 37.12% satisfied or very satisfied.

**Table 17. What additional information should be provided?**

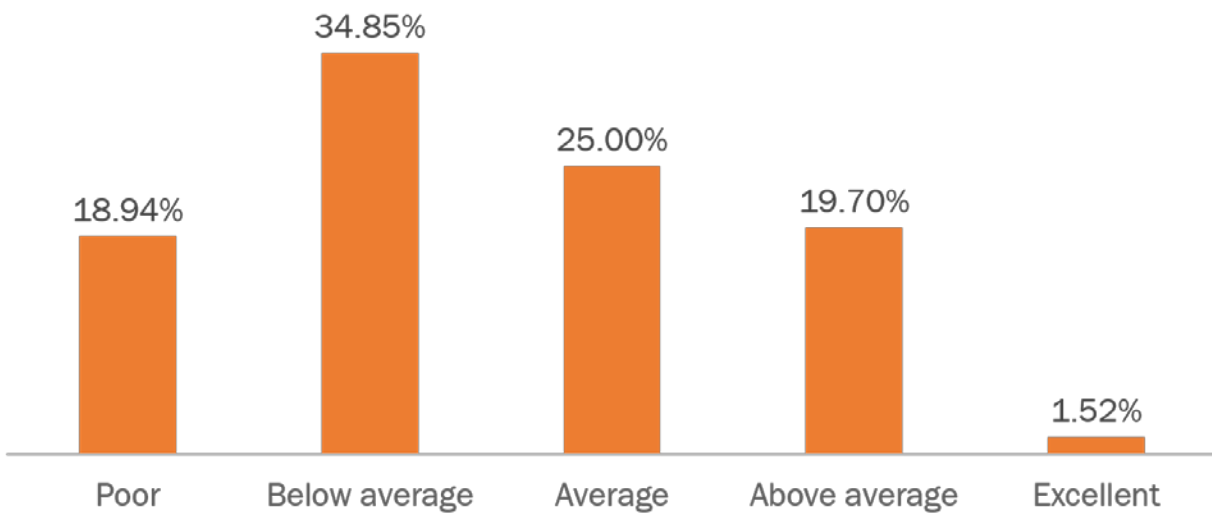




**Table 18. Respondent's rating of experiences with the coin from Europeana.**

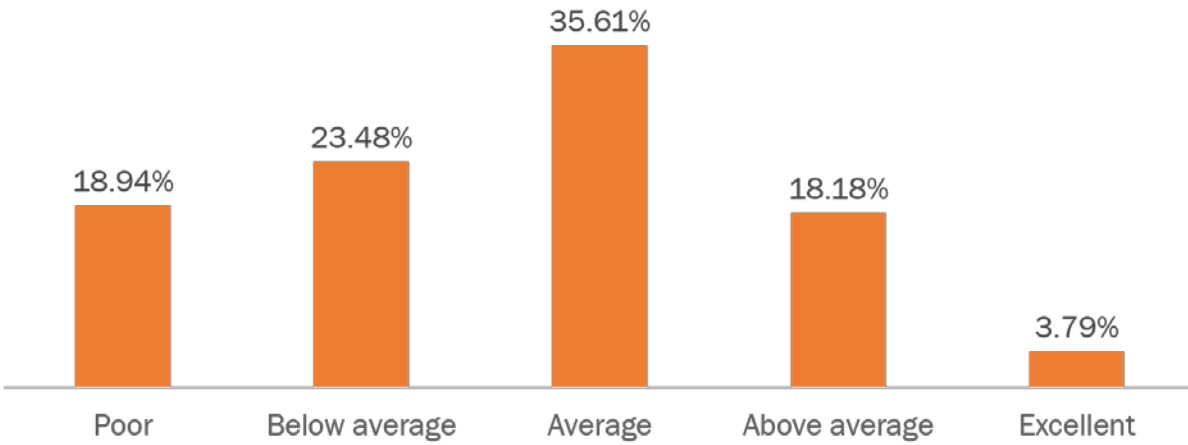


**Table 19. How would you rate this example in terms of Quality (data, metadata, texture, etc.)?**

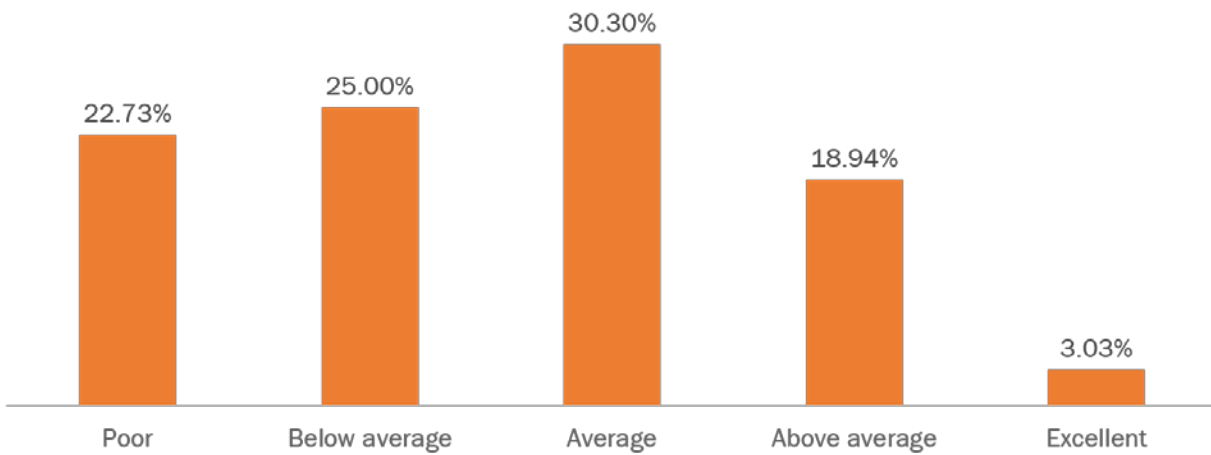




**Table 20. How would you rate this example in terms of Efficiency?**



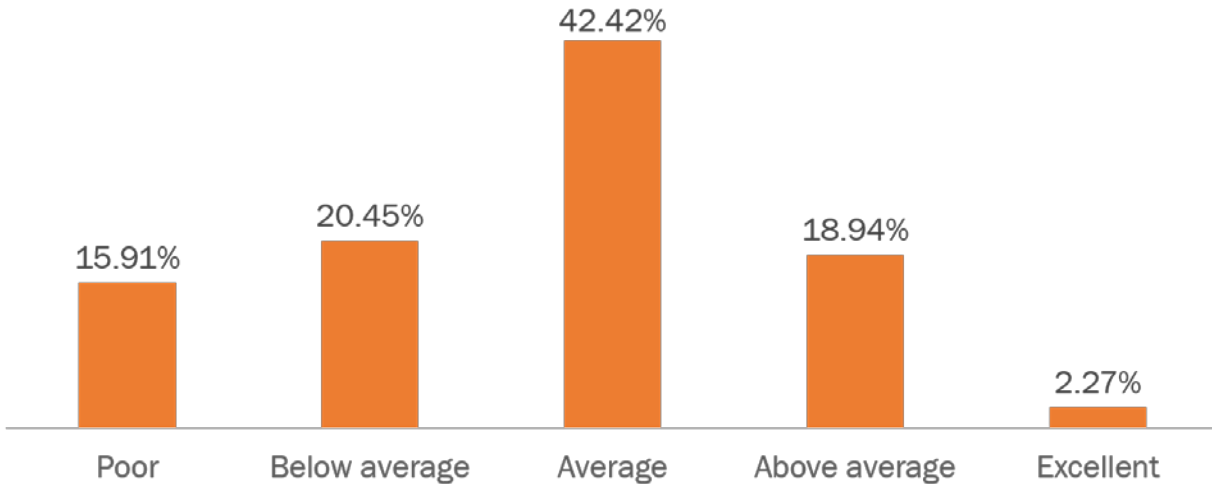
**Table 21. How would you rate this example in terms of Accuracy?**







**Table 22. How would you rate this example in terms of Authentication?**



### 3.3.4 A monument

The fourth example represents a common monument in Europe: a Church

Nuage de points de l'église de Fontains recorded in Europeana under the following link:

[https://www.europeana.eu/portal/en/record/2048708/TAPENADE\\_Fontains\\_nuage.html](https://www.europeana.eu/portal/en/record/2048708/TAPENADE_Fontains_nuage.html)

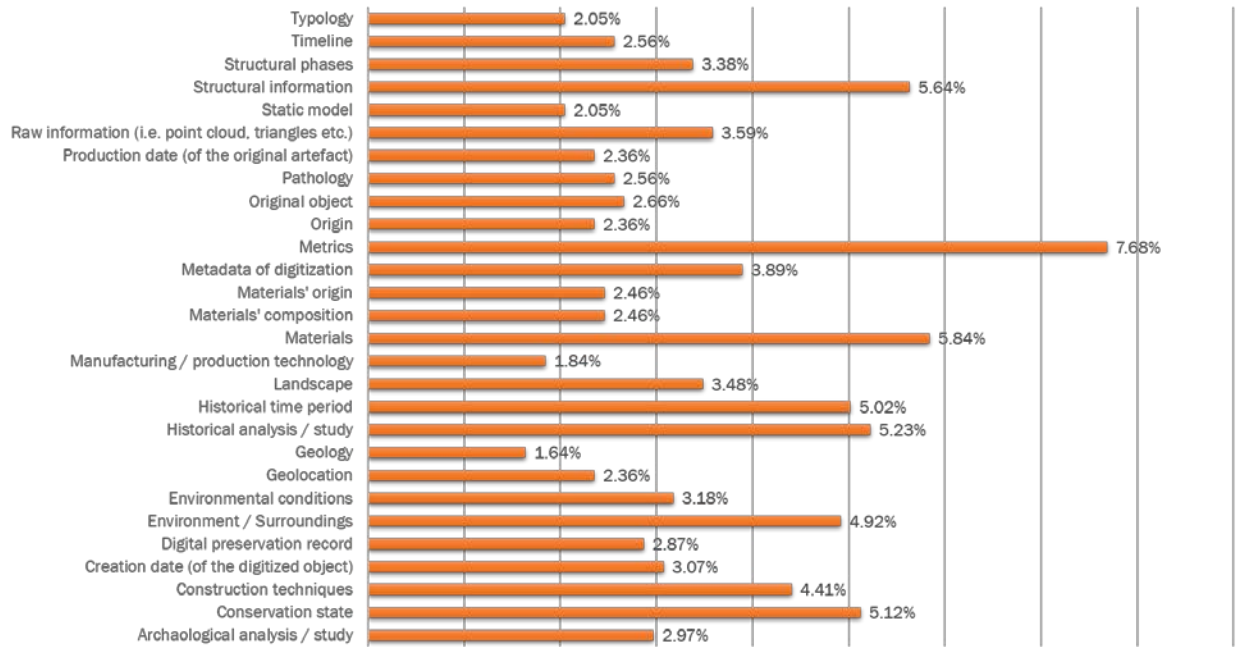


43.94% were not satisfied or expressed adequate satisfaction overall, 30.30% were neutral and only 25.76% satisfied or very satisfied.

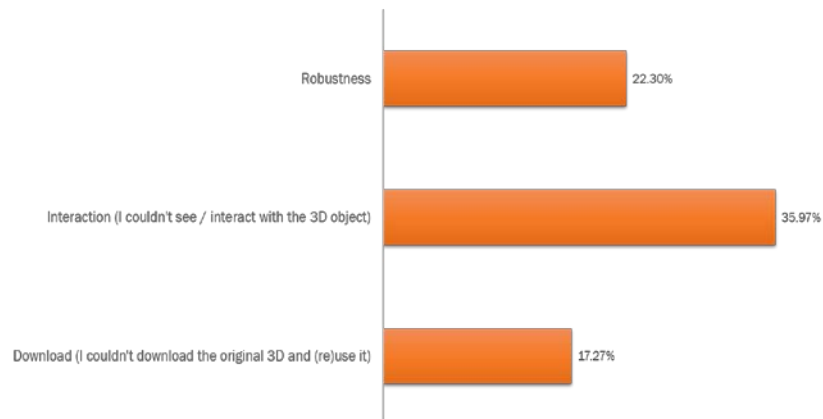
We then asked what additional information should be provided. The results are presented in Table 23, below.



**Table 23. What additional information should be provided?**

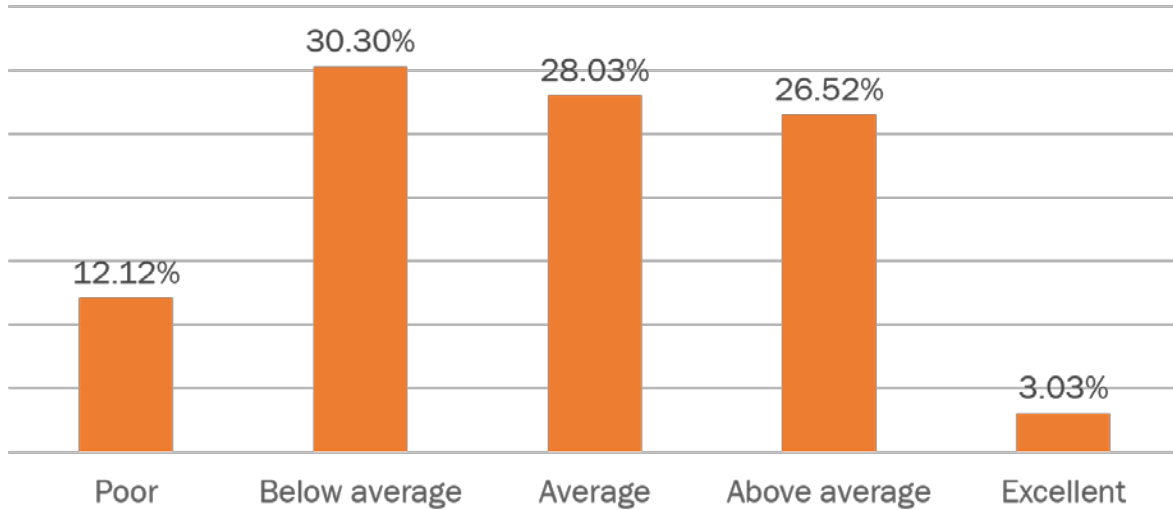


**Table 24. Respondent's rating their experience with this monument in Europeana.**

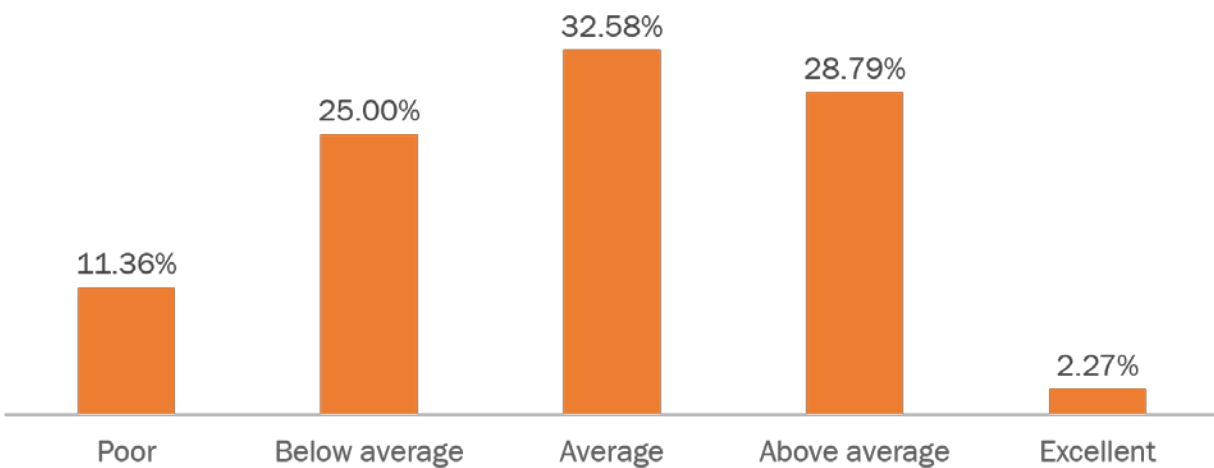




**Table 25. How would you rate this model in terms of Quality (data, metadata, texture, etc.)? [Example of monument]**

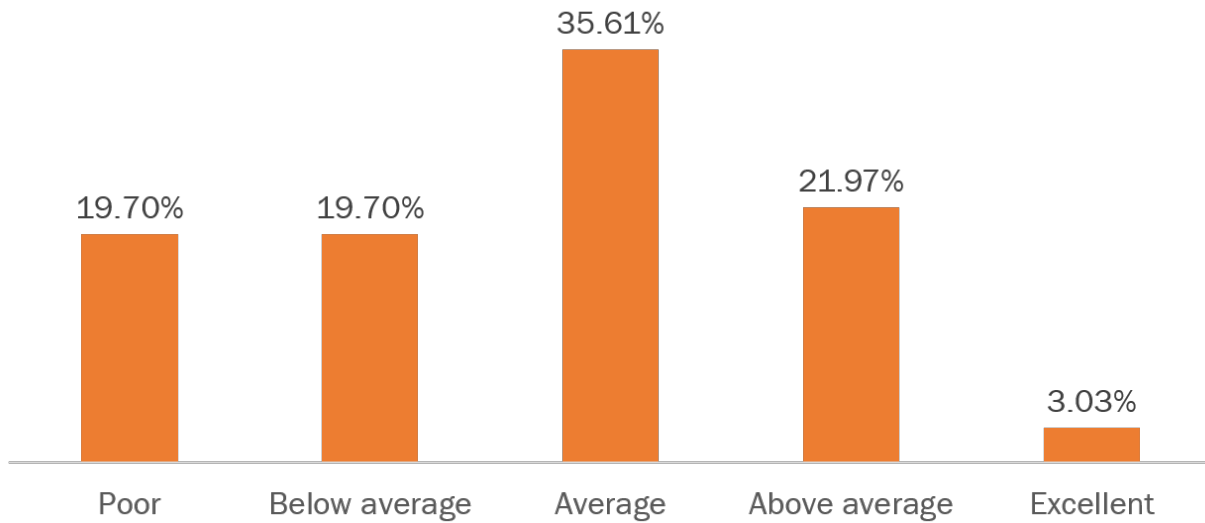


**Table 26. How would you rate this example model in terms of Efficiency?**

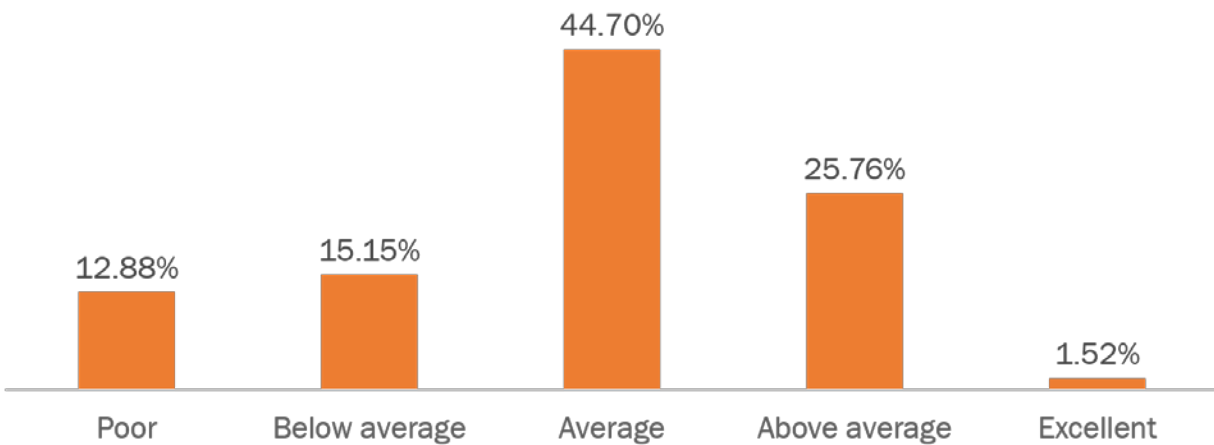




**Table 27. How would you rate this example model in terms of Accuracy?**



**Table 28. How would you rate this example model in terms of Authentication?**





### 3.3.5 An archaeological site

As a fifth example we selected a common archaeological site from Europeana

The Saint Salvator abbey of Ename around 1595 (high res 3D) is recorded in Europeana under the following link:

[https://www.europeana.eu/portal/en/record/2048716/object\\_HA\\_2087.html?q=Ename](https://www.europeana.eu/portal/en/record/2048716/object_HA_2087.html?q=Ename)

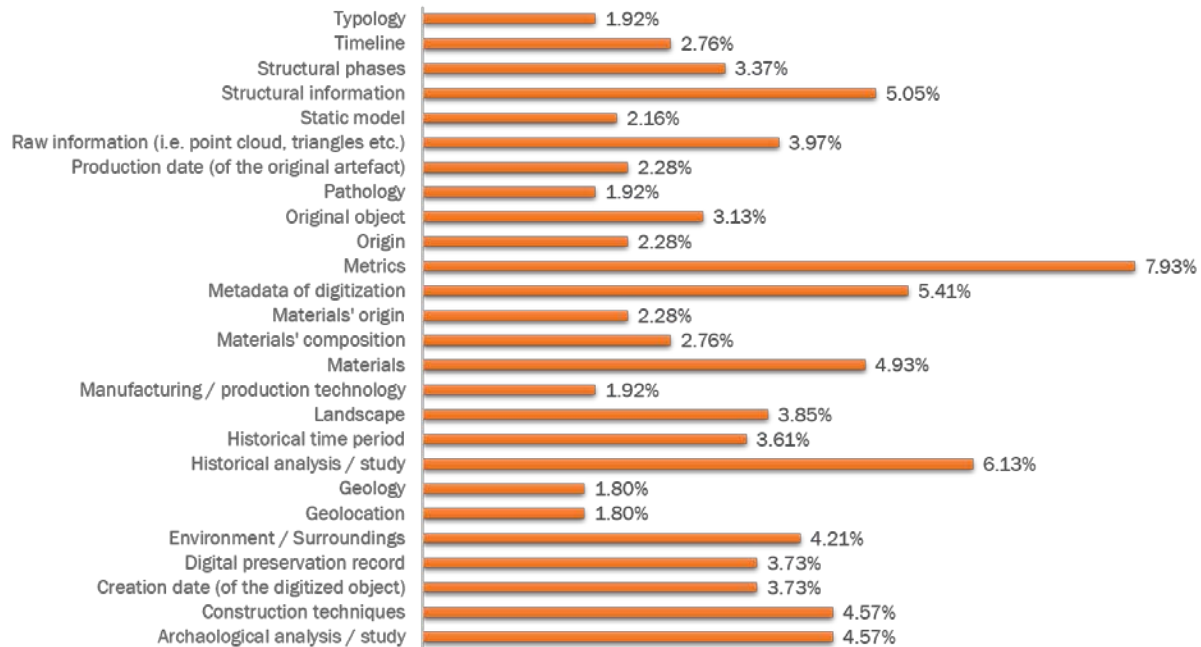


34.09% were not satisfied or expressed adequate satisfaction, 31.82% were neutral and only 35% satisfied or very satisfied.

We then asked what additional information should be provided. The results are presented in Table 29, below.

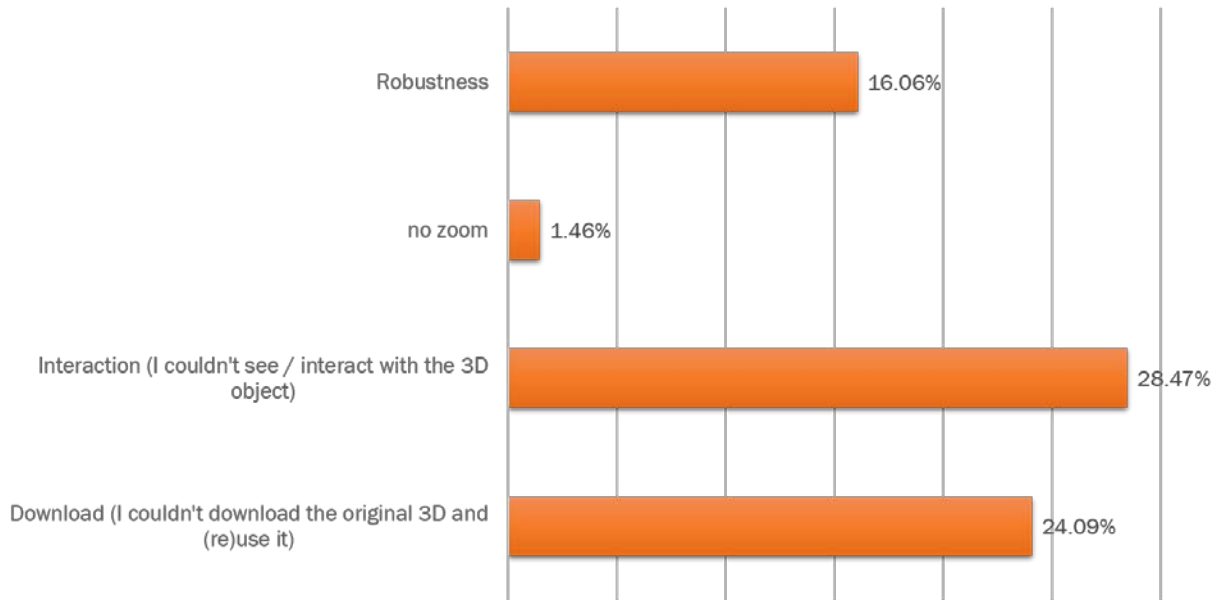


**Table 29. What additional information should be provided for such an object?**

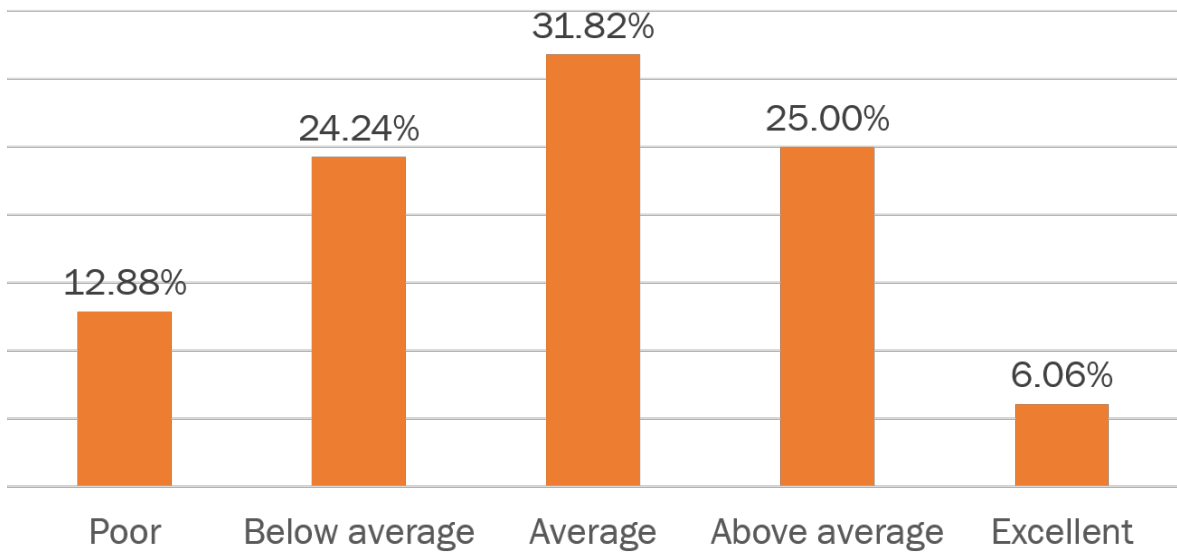


Respondents also rated their experiences of robustness, on-line interactivity and downloading the object on their smart devices (see Table 30).

**Table 30. Respondent's rating their experience with this 3D object from Europeana.**



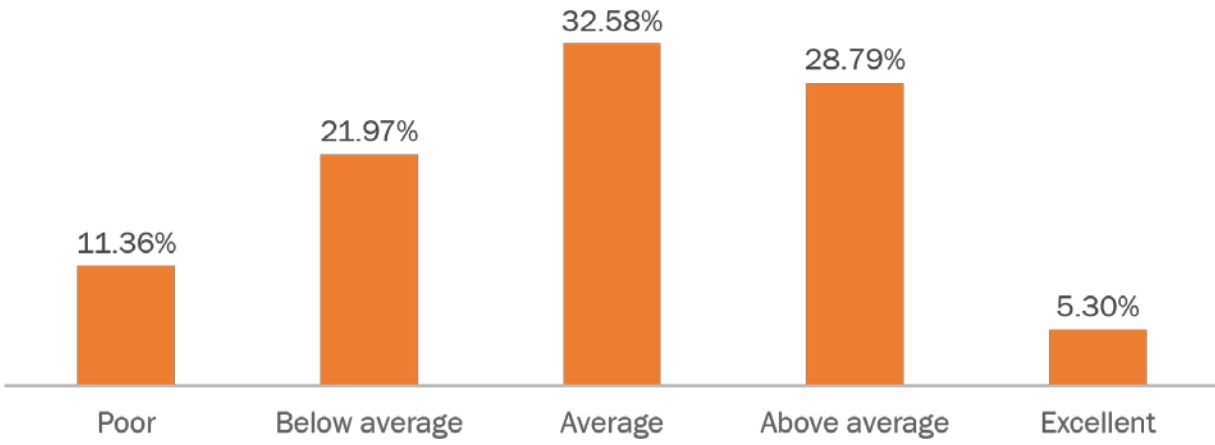
**Table 31. How would you rate the example of the site in terms of Quality (data, metadata, texture, etc.)?**



**Table 32. How would you rate the example of the site in terms of Efficiency?**



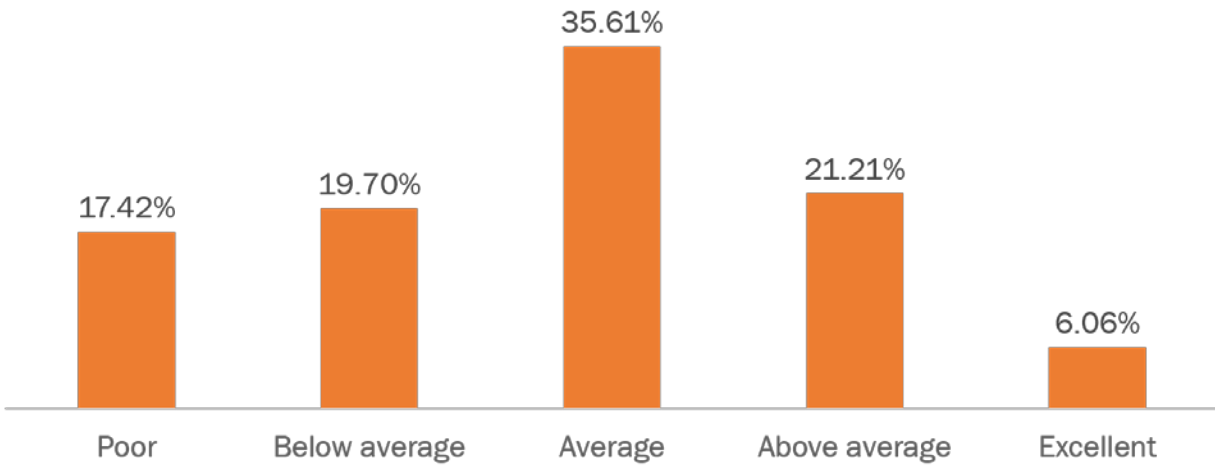
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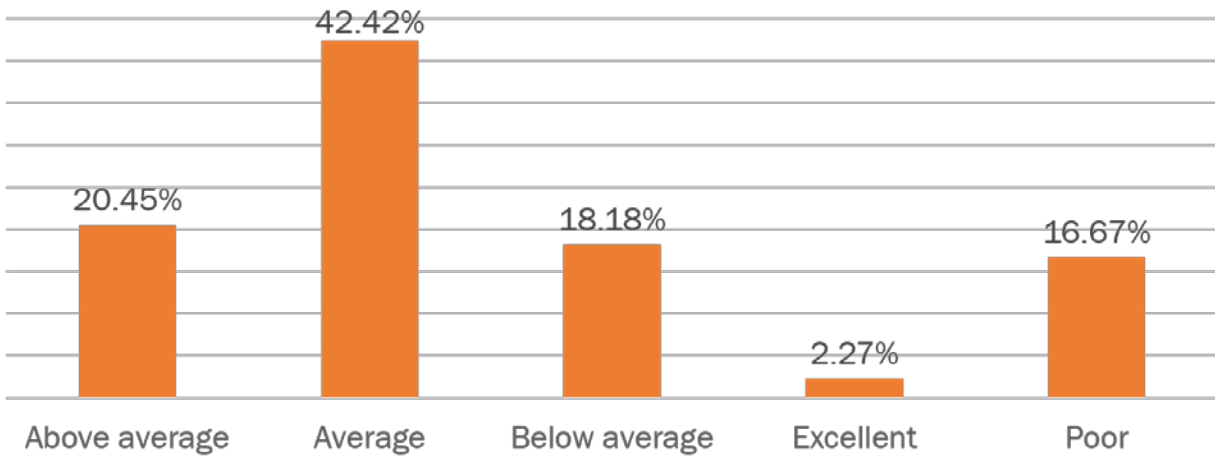




**Table 33. How would you rate this example terms of Accuracy?**



**Table 34. How would you rate this example in terms of Authentication?**





## 4 Dissemination Plan

The first draft version of Task3D results will be presented during EuroMed 2018 in Cyprus ([www.euromed2018.eu](http://www.euromed2018.eu)) and the second draft will be demonstrated and discussed at CIPA 2019 in Spain. The final results will be validated at the General Assembly of Europeana, with ICOMOS and ICOM, enabling decisions about the adoption of the guidelines and definition of future research and development work.

## 5 Conclusions and future steps

During the first period of this TFG, the experts focused their work on reviewing the results of different EU projects such as CARARE, 3D ICONS, plus the current systems /repositories for 3D CH-3D assets available and a literature review.

For the second period we focused on the following:

- 1) Definition and analysis of user and stakeholder needs supported by a survey.
- 2) The data and metadata quality of the available 3D content in Europeana.

We managed during this TF period to provide some information on the quality of metadata and the accuracy of the corresponding 3D data. In a further step we defined the possible group of users and their requirements and needs.

These findings will be presented to Europeana and an application will be considered to extend the work of the TFG for a second term so that new guidelines and effective methods for the processing, archiving and long-term preservation of 3D cultural heritage assets can be developed and proposed. This work will also 3.3. Final impact

We managed during this TF period to provide some information on the quality of metadata and the accuracy of the corresponding 3D data. In a further step we defined the possible group of users and their requirements and needs.

These findings will be presented to Europeana and an application will be considered to extend the work of the TFG for a second period so that new guidelines and effective methods for the processing, archiving and long-term preservation of 3D cultural heritage assets can be developed and proposed. This work will also promote interoperable standard formats for semantically-aware 3D modelling, analysis and representation of cultural heritage to allow easy retrieval, distribution, publishing and reuse of such models, which in turn will help ensure sustainable cross-sector collaborative work in future in both development and research. This will include suggestions for a possible modification of the EDM and improvement of the current 3D-CH assets in Europeana.

An additional outcome of the proposed second Task Force will be to gain further insight into daily practices, innovative approaches, and theoretical aspects to determine a scope of topics for further investigation.