

T4.0 Technical Guidelines:

Digitisation of Cultural Heritage - version 1.2

Young people between the ages of 15 and 25 spend an average of 35 hours a week online - twice as much as it was a decade ago. With the development of technologies, the field of augmented and mixed reality is expanding and containing more and more digital elements. A future in which digital elements will coexist with the real ones, i.e. mixed reality, is no longer that far away. The cultural heritage sector must prepare for this, should it wish to ensure that the realities of young (and increasingly older) generations are inhabited not just by imaginary characters (e.g., bots or avatars like Pikachu from Pokémon Go) but also elements of cultural heritage - in the form of new quality tourism experiences (augmented reality, holograms ...), new educational content (mobile or online applications ...), research materials and building blocks for use in the creative industries (in films, computer games ...).

Various initiatives have already begun with the digitisation processes, mainly for storage purposes (see, for example, Europeana as Europe's largest collection of cultural heritage materials), and less for new tourism experiences. While any initiative and activity in this direction is welcomed, it is for further use, comparison, the exchange and development of related products a very important to follow uniform guidelines and standards.

With the speed of technological change and the continuous improvement of accessible technologies, the quality of digital documents is constantly increasing, which **requires continuous monitoring of advancement and the following of up-to-date guidelines and technological standards** to ensure that the materials meet modern requirements.

On 9 April 2019, the Republic of Slovenia signed a declaration on cooperation in the field digitisation of cultural heritage, which predicts the development of common standards, methodologies and guidelines for comprehensive documentation of three-dimensional cultural heritage across Europe.

Until the establishment of common European guidelines with the purpose to unifying the activities of the digitisation, the **Tourism 4.0 Partnership** has established **T4.0 Technical Guidelines: Digital Innovation of Cultural Heritage** that represent the **basic technical standards in the process of digitisation of cultural heritage**.

The guidelines offer a technical framework to all actors involved in digitisation processes - **heritage institutions, local and national governments, public services, technology companies and other stakeholders**.

Guidelines are updated by the expert team of the Tourism 4.0 Partnership at least once a year, according to the technology development, accessibility of technological solutions, broader practice and other criteria for the digital material.

In the first edition of the guidelines we cover the processes of digitisation of audio materials, video materials, 3D models, image materials and 360° photos and videos. We also add a reference to the metadata preparation guidelines.

The purpose of the document is not to give precise and comprehensive instructions for digitising the material, but to define key guidelines and minimum requirements that are necessary to ensure the use of materials for enriching the experience of cultural heritage.

Technical guidelines complement the Guidelines for capture, long-term preservation and access to cultural heritage in digital form (Issue: 6202-1 / 2013-MIZKS / 17 Version 1.0) prepared by a Ministry of Culture working group in 2013 for the long-term preservation of cultural material in digital format (hereinafter referred to as e-material) within the agenda of the European Digital Si EU Ti.

The largest contribution of this document is in the field of digitisation of three-dimensional objects and structures (in the form of 3D models) and video materials. This is the area that has changed and developed the most since the last update of Guidelines for the capture, long-term preservation and access to cultural heritage in digital form from 2013. Although clear standards are not yet in place, we can define key technical guidelines based on industry practice. The T4.0 technical guidelines also set the bar higher for minimum standards for digitisation of image, video and audio materials - mainly due to better and more easily accessible equipment.

In addition to digital capture, it should be noted that **long-term preservation procedures and access to materials are also required**. Here we recommend the pursuit of the fore-mentioned Guidelines by the Ministry of Culture and uniform technology standards by the Archives of the Republic of Slovenia (Enotne tehnološke zahteve" - ETZ).

NOTE:

The Guidelines are a living document and are complemented and upgraded by and in collaboration with various stakeholders.

Terms used:

Digitisation - the process of making a digital copy of the material

Digitalisation - the process of changing business processes using digital technologies

ATTENTION!

Digitisation is the process of making digital copies of cultural heritage units. That means that the digital copies must have the same characteristics as objects in nature - two-dimensional objects (manuscripts, photographs...) become two-dimensional digital documents and three-dimensional objects become three-dimensional digital documents. Therefore a 360-degree 2D photography cannot be considered a digitisation of three-dimensional objects.

Three-dimensional objects:

We digitise three-dimensional objects into 3D models. This set of guidelines thus concerns three-dimensional works of art, archaeological finds, art installations, immovable cultural heritage ...

GNSS-RTK measurement, i.e. measurement of starting points and control points in the national coordinate system for georeferencing needs has to be made for all a digitised 3D immovable objects of cultural heritage. A GNSS-RTK measurement report is also needed.

When scanning cultural heritage sites, the scanning accuracy should be 18 mm when using photogrammetry and 8mm using laser scanners. When scanning urban and cultural landscape up to 10 ha, the recommended accuracy is up to 60 mm. A report on the measurement of accuracy (both for photogrammetry and laser scanning) has to be made. For larger areas it is necessary to treat each case individually and adjust the scanning accuracy to the intended use of a 3D model - however, we recommend that the elevation accuracy of relief in larger areas is 1.1 m for plains, 2.3 m for hills with relative height up to 500 m, 3.8 m for hills with relative height up to 1500 m and 7.0 m for mountains.

In preparation of 3D models, the goal is to aim for as much realism as possible in addition to the technical guidelines written below and present the model as authentic as possible comparing to the original. The model should be in scale of 1:1. During the scanning process an even adequate illumination (to avoid deformation due to shadows) should be provided and all the changing elements (humans, vegetation, shadows, dirt, other distractions) removed. In the event that changing elements define the original (e.g. distinct vegetation on the castle rock), it makes sense to prepare two models – one uncleaned and one cleaned. The model should be solid to enable 3D printing. A scale should be included.

3D model preparation

- | No 3rd party plug-in
- | Attached preview renderings in .jpg format with 1200x1200 pixels
- | Export recommended in multiple supported 3D formats (see below)
- | Attached optimised textures in supported formats
- | It is advisable to use as few textures as possible
- | Recommended optimisation of the model grid with polygon reduction
- | Model structure: mesh

Saving a digital 3D model

- | Compression formats: 3DS (.3ds), Alias Wavefront (.obj), Autodesk Filmbox, FBX (.fbx), Blender (.blend), Stereolithography, Standard Tessellation Language (.stl, .sta)
- | File Compression: zip, rar, 7z

For inclusion in digitised cultural heritage portals (e.g. portals with 3D models), it is recommended to produce more models of different qualities, but always with the aim of preserving key heritage characteristics of the original (e.g. model preparation with 60% less polygons, model preparation adapted for use in computer games ...).

Information on 3D scanning technology in cultural heritage is well presented in the brochure by Historic England: »[3D Laser Scanning for Heritage Advice and Guidance on the Use of Laser Scanning in Archaeology and Architecture 2018](#)«

Visual material:

Visual material means material whose digitisation results in a digital image (photograph) without texts: photos, pictures, graphics, artworks, postcards, posters, drawings, engravings / prints, maps, music prints and other two-dimensional works of art.

It is recommended that each scan is accompanied by colour and grey scale and a scale.

Digital image capture (minimum requirements)

- | Image Size: 16 MP
- | Colour Depth: 8 bit, Recommended: 24 bit

Saving a digital image

- | Compression formats: JPEG (Minimum compression factor recommended), TIFF (recommended lossless LZW compression algorithm)

360 ° photos

360 ° digital image capture (minimum requirements)

- | Combined image size: 15 MP
- | Colour Depth: 8 bit
- | FOV: 360 ° horizontal field of view
- | Additional requirements: without image stabilisation software, GPS: position accuracy up to 2.5 meters

Digital 360 ° image storage

- | Compression formats: JPEG (Minimum compression factor recommended), TIFF (Recommended lossless r LZW compression algorithm)

Video:

Digital Video Capture (minimum requirements)

- | Image Size: 1920 x 1080 pixels
- | Image refresh rate: 25 frames per second
- | Aspect Ratio: 16: 9
- | Aspect Ratio: 1: 1 (square pixel)
- | Colour Depth: 10 bit
- | Data rate: 50 Mbps
- | Compression formats and codecs: ProRes 422, AVC-Intra, DNxHD
- | Image Composition Mode: 1080p (progressive)

Digital video storage

- | Compression formats and codecs: DNxHD, ProRes, MPEG-1, MPEG-2, MPEG-4, H.264, CinemaDNG
- | Final digital video format: MOV, MPEG, MP4

360 ° video:

360 digital image capture (minimum requirements)

- | Combined image size: 8K
- | Image refresh rate: 25 frames per second
- | Colour Depth: 8 bit
- | FOV: 360 ° horizontal field of view

Additional requirements:

- | Adequate exposure of the image
- | Relevant content
- | No dark edges on both poles (zenith and nadir)
- | Straight horizon in the image
- | No stitching errors
- | No unlicensed music background

IMU:

- | 6-axis accelerometer (resolution: ≥ 16 bit, range: $\geq \pm 8G$ with ≥ 4096 LSB / g, sampling:
 - . ≥ 200 Hz with $< 1\%$ vibration)
- | Gyroscope (resolution: ≥ 16 bit, range: $\geq \pm 1000$ deg / s with ≥ 32 LSB / dps, sampling:
 - . ≥ 200 Hz with $< 1\%$ vibration)

GPS: Sampling: ≥ 4 Hz, positioning accuracy up to 2.5 meters

Digital 360 ° image storage

- | Compression formats and codecs: DNxHD, ProRes, MPEG-1, MPEG-2, MPEG-4, H.264, H.265, CinemaDNG
- | Final digital video format: MOV, MPEG, MP4

Manuscripts, books and publications

When digitising text materials (manuscripts, books, publications ...) it is crucial to digitise units in the whole - that is, including the covers and any blank pages (and not just individual sections or single pages). In doing so, it is necessary to preserve the sequence from the original and in the metadata mark any missing pages or no numbering.

Digital image capture (minimum requirements)

- | Resolution: 300dpi (600dpi recommended)
- | Colour Depth:
 - 1 bit - text pages, raster (halftone) image for illustrations
 - 8 bit - greyscale digitisation
 - 24 bit - colour digitisation

Saving a digital image

- | Compression formats: PNG, JPEG (Minimum compression factor recommended), TIFF (recommended lossless LZW compression algorithm)

Audio:

Digital audio capture (minimum requirements)

- | 44.1kHz sampling rates
- | Sample Accuracy: 16 bit
- | Data rate: 192 kbps
- | Digital audio storage
- | Compression formats and codecs: MPEG-2, PCM, AAC
- | Final digital audio format: MP3, WAV, FLAC

As far as possible, transcription of spoken text (e.g., for broadcasts, interviews) as well as sung or spoken text (in the case of vocal and vocal-instrumental works) is also recommended.

Metadata:

A key component of digitisation, which is particularly important for the long-term preservation and sharing of materials in digital collections, it is to equip materials with metadata. Rules on the [Register of Cultural Heritage](#) require the use of metadata descriptions, especially descriptive metadata according to the [Dublin Core metadata standard](#)

In addition to the Dublin Core metadata standard for storage and sharing we recommend pursuing the [specifications of Europeana Professional and Europeana Data Model \(EDM\)](#):

However, for the purposes of using the materials for commercial use, it is reasonable to supplement the metadata following [the guidelines from Tourism 4.0 Partnership](#)

Ensuring accessibility:

In digitisation of cultural heritage, and especially in the presentation and the use of digitised units, it is necessary to ensure that information is made available to the widest possible population, including people with disabilities. In doing so, it is essential to work with professionals to ensure accessibility, e.g. [Dostop Institute](#)

WCAG recommendations could be of help:

Digital image accessibility

- | See WCAG guidelines 2.1, recommendation 1.1.1 (level A).

Digital audio accessibility

- | See WCAG Recommendations 2.1, Guidelines 1.2
- | See WCAG guidelines 2.1, recommendation 1.2.1

Digital 3D model accessibility

- | See WCAG Recommendations 2.1, Guidelines 1.2
- | See WCAG guidelines 2.1, recommendation 1.2.1
- | See WCAG guidelines 2.1, recommendation 1.2.3
- | See WCAG guidelines 2.1, recommendation 1.2.5

Digital video accessibility

- | See WCAG Recommendations 2.1, Guidelines 1.2
- | See WCAG guidelines 2.1, recommendation 1.2.1
- | See WCAG guidelines 2.1, recommendation 1.2.3
- | See WCAG guidelines 2.1, recommendation 1.2.5
- | See WCAG2.1 guidelines, recommendation 1.2.2

Licensing Equipment and Compliance with the law:

The use of licensed software, regulated copyright and related rights, and compliance with the law (e.g. regarding the use of drones or the right to use the name and image of a cultural monument) with appropriate evidence, should be an obligation in procurement procedures for digitisation of cultural heritage.

It is important to follow the changes in legislation and to select stakeholders who act responsibly. When working with different contractors, it is important that they first commit themselves to comply with the law and the use licensed software.

Long-term storage:

For each project it is necessary to define a method of permanent storage in accordance to the [Guidelines for capture, long-term preservation and access to cultural heritage in digital form](#)

It should be noted that [Tourism 4.0 technical guidelines for multimedia content, portals and reservation systems](#) were created in the same spirit.

A support site is available for all interested to ask questions:
tourism4-0.org/support

More about the project at:
tourism4-0.org

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