

3D PRINTING FOR CULTURAL HERITAGE INCLUSIVITY & ENTREPRENEURSHIP



Erasmus+ “St.A.R.T.UPtoEU”



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3D PRINTING FOR CULTURAL HERITAGE. INCLUSIVITY & ENTREPRENEURSHIP

A catalogue to introduce the 3D printing for Cultural Heritage and to present the results (OUTPUT 3) of employing 3D printing technology during St.A.R.T.UPToEU Project

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3D PRINTING FOR CULTURAL HERITAGE

INCLUSIVITY & ENTREPRENEURSHIP

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Introduction

This text is the result of research carried out within the framework of the partnership St.A.R.T.UptoEU, the ERASMUS+ K2 project *Storytelling Ancient Roman Traces Up to Europe*.

This project involved four schools member of European Union, from Germany (Europaschule Langerwehe Gesamtschule), Czech Republic (Gymnazium, Praha 4), Spain (IES Jaime II el Just) and Italy (High School of Science Giancarlo Siani), project coordinator.

Three Italian organizations (BIMED; Royal Palace of Caserta, Pegaso Telematic University).

The meeting between different sectors and different professionals has allowed us to work on the realization of the intellectual output programmed in the design phase through the synergy of the different partners who have contributed by putting into play the professional and managerial skills.

The purpose of the Project was to implement a process of consolidation of cultural awareness in young people through *Storytelling*, declined in its different forms, starting from retracing the traces of the ancient Romans in the perspective of rediscovering the common European identity, in the diversity and specificity of each country.

In the ERASMUS + St.A.R.T.UptoEU Project (*Storytelling Ancient Roman Traces up to Europe*) among the outputs realized was also included the design and reproduction of ancient art objects or cultural gadgets to be printed in 3D in perspective of consolidating the entrepreneurship spirit in the field of cultural heritage, also thinking of the creation of a startup evoked in the acronym of the project St.A.R.T.UptoEU.

This intellectual output required a simultaneous training of the participants, in addition to the acquisition of the printing machines for the realization of the products.

The activities related to the design and realization of objects in 3D printing have favored the encounter between creativity, technology and entrepreneurship by setting in a profitable process of interaction between knowledge.

This process has stimulated students to look at cultural heritage in a different perspective, which does not exclude employability but can be the engine of new professionalism. Scientific knowledge is combined with archeology and the arts and can even become a source for the tourist-cultural merchandising.

In the following pages h the words of experts on the technological sector and cultural heritage and the catalog of objects designed or produced through 3D printing show the achieved results.

The St.A.R.T.UptoEU project proves to be an incubator of possible startups in the cultural heritage sector, indicating the replicability of ideas and outputs and suggesting the possibility of its development well beyond the time limit of the project.

Storytelling by objects. From an idea to the realization of the objects

Stefania Febbraro, Liceo scientifico Statale Giancarlo Siani

The idea of creating objects through 3D printing to reproduce or rework art objects or archaeological finds was born for concretizing the phases of research and study of ancient objects of the Roman age through a creative reworking functional to the creation of cultural gadgets.

There is the possibility offering to young students a possible alternative to those who work in cultural fields. It would open up new professional entrepreneurial horizons to promote cultural tourism and enhancing cultural heritage also through a souvenir. A souvenir that is not an object without history but that he can talk to his possessor.

Think about the creation of cultural gadgets as an alternative way of storytelling. It's possible storytelling about ancient cultural heritage also through an object bought in a museum bookshop and stored on a shelf of a bookstore. Yes, because objects, even if in reproduction, speak to us. But to talk about their past and evoke history in memory, it must be the result of a philological and analytical process that starts from a real knowledge of the original object before transform it into a new object of art.

The use of a new technology, such as 3D printing, can ensure the faithful reproduction of objects at scale or offer technological alternatives for creative rework of ancient objects.

On these assumptions, a reconnaissance of the state of research on the use of 3D printing in the field of cultural heritage and school education was first carried out. Subsequently, short courses were held in all schools to bring students closer to 3D printing and its possible uses in the field of Cultural Heritage, a theme also proposed in the context of the 4th Learning, teaching and training activity carried out by Prague with the speech of Josef Souček. At the same time, the work of cataloguing cultural heritage carried out during the Learning, teaching and training activities, visiting archaeological sites and museums, as well as the study of the history and cultural heritage, material and intangible, of the member countries of the partnership, represented the humus within which to find material sources to be reproduced.

The development of this output can be summarized at the following phases, even if their succession has not always been linear:

- Survey on study and researchs on the use of 3D printing in the field of cultural heritage and cultural-touristic merchandising;
- Theoretical-practical courses about the use of 3D printer and on cataloguing of archaeological object to learn skills for the use of new technologies at the service of the enhancement and protection of cultural heritage;
- Cataloguing of archaeological object or artwork during Learning, teaching and training activities in Germany, Italy., Czech Republic and Spain;
- Acquisition images of objects or monuments trough photos or scanners to be processed with specific graphic software for the preparation of printing 3 D.
- Creative design or faithful reproduction in full size or in scale an object by h 3D printing
- Realization of the object in 3 D

- Cataloguing the object 3 D.

This process has led to different results depending on the different professionalism and on the objectives considered priority in the use of 3D printing.

3D Technology at the museum. New perspectives.

Paola Viola, Reggia di Caserta

The possibilities that 3D printing and new technologies offer for the use of Museums and the enhancement of Cultural Heritage, are increasingly reflected both by operators in the sector and by *different audiences*.

In museums, in fact, 3D printing confronts us with an unusual degree of interactivity and efficiency of the museum system. The experiences acquired in recent years have shown that the reasons for using it are varied and the first sector to have experienced its innovative and positive effects was the archaeological one for which 3D technologies allow to reproduce entire artifacts or archaeological sites giving life to the past and favoring its knowledge.

Furthermore, 3D scanning, and printing have introduced the concept of *virtual restoration*: a simple and safe technique, non-invasive or destructive towards works and artifacts, and essential for a richer museum offer that also includes immersive digital experiences at low costs. By offering visitors digital formats capable of making historical and archaeological content more attractive, a fruitful dialogue is also established with the groups of very young digital natives.

And again, 3D surveying, virtual reconstructions and 3D printing for museums are a resource for future generations, being able to complete over time entire databases of 3D models, suitable for historical and scientific study, or even to create real virtual museums able to preserve artifacts and historical sites difficult to reach and preserve or in danger. The online 3D Museums to visit in virtual reality and to recreate with 3D printing in schools around the world, for example, represent a constructive reading key and an added value for cultural heritage.

A further application of 3D to museum management consists in the possibility of building alternative visit routes such as tactile ones, to correctly bring children and blind people closer to the cultural heritage: with modern 3D scanning and printing instruments it is possible to create solid, safe and long-lasting plastics and models, at relatively low costs. In this way the artifacts are preserved without compromising their knowledge. Few museums such as the Museo Real Bosco di Capodimonte in Naples or the Uffizi in Florence and the Royal Palace of Caserta offer exploratory itineraries with the touch of some original works (with disposable gloves). More frequent are, however, the visit routes built with the help of 3D printed reproductions of archaeological finds, sculptures, architectural elements and even paintings. (as for the *3D Virtual Museum* project, the first virtual museum that houses 3D models of almost 600 works from over 100 Italian museums, available online and for free).

Although 3D printing has been used since the 80s, the interest on the part of museums was accompanied by a strong skepticism and difficulty in perceiving change, until its usefulness was recognized: the first requests concerned the tactile paths linked to the first concepts of accessibility and some museums commissioned copies faithful to the originals to be touched in the exhibitions.

Today, museums use 3D for several reasons:

1. **replace the original fragile:** as in the case of the reproduction in 1:1 scale and in real colors of an immovable statue or a walled bas-relief or ancient marble busts in archaeological museum areas and, therefore, open to the public;
2. **reproduce statues, archaeological finds and architectural elements;**
3. **replace works on temporary loan for exhibitions,** thus avoiding leaving the stations empty;
4. **carry out virtual integrative restorations** to recreate missing portions of an object and digitally visualize the original appearance of a damaged work;
1. **produce copies** for study and research purposes or to be used in educational laboratories with schools;
1. **set up** tactile paths for the blind and visually impaired;
2. **propose innovative sensory experiences linked to paintings of particular value and fragility** usable through touch such as the Mona Lisa and the Sistine Madonna by Raphael;
3. **create static renderings and textured models** to be included in websites, apps or videos;
4. **create 3D models of stolen or lost works** starting from photographs;
5. **carry out 3D reconstructions of buildings and individual elements in the architectural field** starting from graphic documentation (plans, elevations, sections) or 3D reliefs, to obtain digital 3D models;
6. **make reproductions of Cultural Heritage using different materials and techniques based on the characteristics of the object and its use:** reproductions in monochromatic plastic materials for economic reproductions, reproductions in real colors, reproductions in materials similar to the originals, such as ceramics, marble, stone and metal.
1. **promote museum merchandising.**

The choices depend on the goals and of course the budget. Setting up parallel museum itineraries for the visually impaired and providing additional space for copies of originals, in fact, involves additional costs.

Compared to the techniques of the past - such as casts in siliconized or plaster form on the original (technique still used in some areas) that often ended up damaging it and that for this reason for some years are no longer allowed - 3D printing allows the protection of the original and guarantees reproductions in a short time with different printing technologies, so as to best adapt to the object to be reproduced and the purposes of the intervention.

Of course, highly trained and specialized professionals are needed for the use of techniques such as automatic photogrammetry, structured light scans, digital sculpture, finishing prototypes with manual post-processing techniques, etc.

In line with the new directions of museum management and fruition, the *Erasmus Plus KA2 Storytelling Ancient Roman Traces up to Europe 2018-2021* Project provides, among its intellectual *outputs*, the creation of gadgets - through 3D printing - inspired by the archaeological heritage that students have learned to know.

Role of 3D printing in modern museum practice

Josef Souček, National Museum, Czech Republic

During the past 10 years various 3D printing technologies have found their use in many areas of human endeavor and became a part of the next industrial revolution. The ability to produce and reproduce items from various materials with minimal need for human skilled labor is truly revolutionary. From all the various methods of automatic manufacturing, two became so common and low-cost that they found their way to people's homes and workshops. It made its way also to the heritage sector, which is usually quite conservative and often lacks the necessary material and human resources to keep up with the latest technological developments.

The two technologies mostly used in museum environments are the fused deposition modelling (FDM) and the digital light processing (DLP). FDM operates by melting a filament made of various materials (generally classifiable as plastic) and extruding the liquified material in thin layers from the printing head. The result is non-toxic and does not require any postprocessing, though the prints can be sanded, painted and generally dealt with as any other plastic. DLP works with a liquid material called resin, which hardens when exposed to light of a certain wavelength. This light is produced by a simple LCD display placed on the bottom and shining at the liquid through a clear plastic sheet. The objects printed by a DLP printer can achieve much higher resolution and much lower layer height (for museum applications we normally use 0.15-0.1 mm layer height for FDM and 0.03 mm for DLP). Prints from DLP are toxic and have to be cured under UV light before acquiring their final strength and in order to lose their toxic properties. They can then be handled the same way as the FDM prints. Acquisition prices of the hobby grade printers of both types vary significantly roughly from 300 to 2000 EUR, while the average price for the most common PLA filament is around 30 EUR/kg, for the standard FDM resin the price is roughly 35 EUR.

The physical limitations of the printer size and layer height determine each of the introduced technologies for slightly different use. The most obvious use which many museums already adopted is making "replicas" of real objects. To acquire a 3D model of an object, it is no longer necessary to have special equipment, structure from motion technology (commonly referred to as photogrammetry) needs only a digital camera and software to create model from the photos (open-source options are rather widely available). By using the FDM and DLP printers, it is possible to print even very large objects (in pieces later glued together) and also models of small items with fine

details such as jewelry. These printed objects do not retain the physical characteristics of the original, they do not have the same weight, texture, the surface can have the typical layered look and while most of these problems can be solved by appropriate post processing (sanding and painting the print), they cannot solve the lack of intrinsic sense of preciousness and historicity which the original object has. The prints cannot replace the originals in the vitrines, but since they are durable and cheap to produce, it is possible to allow the visitors to physically engage with them. This means that the 3D prints have a great potential in improving accessibility and interactivity of museums and they have become a common solution to presenting the artefacts to the visually impaired.

Curators often have to deal with replicas and copies. Artefacts can be too fragile or valuable to be put on display or they can be damaged but reconstructed in their whole. It is common to use services of artisans for such tasks and keep the same materials (ceramics, metal). However, 3D print of the original artefact can be used by the artisan as a visual reference but can also be used as a base for lost wax casting or to create a mould. There is a large selection of materials which can make this task easier, ranging from filament which can endure high temperatures to wax resin specifically intended for lost wax technique.

3D printing in museums is not limited to simply copying the artefacts, it can be also connected to them. Adjustment of the artefacts for viewing is always a tiresome task which involves a lot of experience and often improvisation. Curators can be relieved by using models of the artefacts and designing their final positions in 3D software, then creating custom supports, stands and constructions to be printed. It is easy to imagine a collaboration with artists in order to create special supports complementing or completing the artefacts. This is also closely related to the possible use of 3D printing in restoration labs, where missing pieces can be digitally designed, materialized and then attached to the original in a reversible way.

The final uses in scope of this paper are towards the general public. Spread of 3D printing in home environment means also higher demand for models to be printed. While there are certain unresolved questions regarding the legal matters, many museums create 3D models of their exhibits, publish them on the internet and some even choose to allow download of these models (Scan the World initiative) and encourage the public to interact with them in a creative way, to tamper with them, mix them or give them new contexts. Some museums also choose to offer 3D prints in their gift shops, sometimes giving them a modern twist for example by using colourful

materials. It is a much cheaper option than the souvenir “replicas” made of traditional materials while the less conservative look is also attractive to many people.

Museums are organizations which need many custom-made objects. As I have shown in the previous paragraphs, various methods of 3D printing are a highly economical solution for many of these needs and while it cannot completely replace the traditional artisans, it can certainly work alongside them and help them, streamlining the processes and ultimately enhancing the visitor’s experience.

Technical aspects of 3D printing

What is 3D scanning?

The process of capturing 3-dimensional data from an object using structured light or lasers: shape, appearance, colour, texture

What is 3D Printing?

With the help of 3D printers, we can create 3D models from scan or CAD data, we can also print colour and texture, which is great for archaeology

How is it used in archaeology?

3D Archives: artefacts may be not accessible to everyone, they may be stored in different collections, this is a way to make them available to everyone and to improve the organization and global collaboration of academic research.

Virtual museums: it permits to expand the audience to the entire web, creation of virtual tours.

Restoration and repair: restore broken artifacts, replacement of missing components, production of replacement molds if you need your replica to be of a specific material, custom stands or joints for artifacts.

Preservation: duplicate fragile artifacts which can be damaged by excessive handling and transportation, hands-on learning for students and categories of the population with disabilities, scale models for large artifacts that can be passed around and contemplated by students (better than just looking at pictures in a book)

3D SCAN PROCESS

- 1) **Capture the scan data:** pick the right scanner and scanning environment according to your needs, prepare the artifact, scan/save raw data
- 2) **Process the scan data:** merge scans together, fix holes in the data, remove imperfections, obtain a clean file

The aim of 3D scanning is to create a representation of the object in digital space, most basically using simple XYZ coordinates for each point. The set of points is called a point cloud and can be generated by several basic methods:

- **Structure from motion / Photogrammetry**
 - o Cheap, there is even open source software, but needs high quality photos and lots of control points in order to match the photos correctly.
 - o You only need a camera – suitable for greatest range of sizes from microscopic objects to landscapes.
- **Laser scanning**
 - o Principle of a laser distance measuring, but millions of times per second.
 - o Basically LIDAR, gathers extreme amount of points.

- Very expensive
- **Structured light scanning**
 - Light with a geometric pattern (e.g. Lines) is projected on the object and the resulting deformation of the pattern is used to calculate the shape of the object. The simplest case is our new laser aided profiler – two-line lasers and two cameras to capture section of the pottery shard.
- **Probe on an arm** (contact scanning)

So what can be done with scan data?

- **Searchability** – all digital data should be easily searchable, prepared for machine processing. comparability, collaboration, analytics, reuse.
- **Comparability** – comparing point clouds can tell us about the relationship between originals and copies, between artefacts from the same series etc.
- **Collaboration** – no need for physical presence of the artefact nor the researchers.
- **Analytics** – various geometric and topographic analyses, multiscale integral invariant analysis, unwrapping decorations.
- **Reconstruction** – missing parts of the object can be modelled and the object thus “virtually restored” without any damage to the original.

Some obstacles: the texture of the object, it may be too shiny and then it is difficult to scan it.

3D PRINTING METHODS

Additive manufacturing adds layer by layer instead of removing excess material from a block of raw material.

- **FDM** – Fused deposition modelling – filament gets heated in the hot end and extruded through a small nozzle (in our case 0,4 mm) and lays one thin layer of material on top of each other.
- **DLP** – Digital light process – liquid resin hardens after exposure to a certain wavelength of light (405 nm) created by a simple LCD display. Way better resolution, good speed, the whole tray gets printed at once.
- **SLA** – Stereolithography – liquid resin hardens after exposure to localised laser beam
- **SLS** and similar – selective laser sintering – box full of powdered material melted together by laser, electron beam, glue etc.

Materials for the filaments:

- 1) PLA (polylactid acid)
- 2) ABS (Acrylonitrile Butadiene Styrene)
- 3) PET-G (Glycol Modified version of Polyethylene Terephthalate)
- 4) Nylon
- 5) PLA with addition of wooden or metallic powder

Each type has its own peculiarities. For example, ABS can be smoothed by acetone vapours. The resins also have different physical properties, they are also mildly poisonous when in uncured state. Curing happens under UV light.

Castable resin – lost wax method directly with the print – perfect for making replicas. Otherwise castable forms enduring up to 200°C can be made of Lukopren and then be used for tin, wax, soap, resin, or any other material that melts or on the contrary hardens under 200°C.

Interesting links

PRACTICAL PRESENTATION OF ARTEC SPIDER SCANNER:

https://www.youtube.com/watch?v=TjRy5lf2AmY&t=47s&ab_channel=GoMeasure3D

https://www.youtube.com/watch?v=5hr5-HwRigA&ab_channel=Artec3DArttec3D

SCAN OF ROMAN OBJECTS:

https://www.youtube.com/watch?v=7ZWboN2YFuk&ab_channel=JohnMcCarthyJohnMcCarthy

LOST WAX METHOD:

https://www.youtube.com/watch?v=pOM6gUp42EY&ab_channel=NationalGeographicNationalGeographic

https://www.youtube.com/watch?v=XZHLmG8DRbY&ab_channel=SmarthistorySmarthistory

Interesting projects:

<https://www.myminifactory.com/category/museo-archeologico-nazionale-di-napoli>

<https://gigamesh.eu/?page=home>

<https://africanfossils.org/>

<https://sketchfab.com/>

The "scalillo" and the enhancement of the intangible heritage.

Michele Autiero



The Scalillo

Liceo Scientifico Statale "G. Siani" - Aversa (CE)

The traditional cultivation in Alberata for Asprinio has Etruscan origins but it was also one of the elements that marked the Roman era when it was customary that the boundary between two properties was marked with a row of poplars as a kind of windbreak. This custom has outlined the landscape of the Aversano countryside since the Romans, when they conquered a territory, assigned portions of land to new settlers and veteran legionaries recruited for their conquest, who settled in those areas and, in fact, remained in garrison of the newly conquered areas. The territory was divided into small plots, according to the centuriation method: one hundred steps by one hundred steps, with the sides orthogonal and generally facing south / north and east / west. The cultivations of these fields produced cereals and other products sufficient to support a family. The vines were planted among the poplars, placed on the borders, to exploit them as tutors and to save land for the benefit of other crops. Ancient history tells that Cinea, ambassador and friend of Pliny, sent by the latter to Rome after the battle won in Ercolano in 280 BC, to dictate the conditions of peace, when he arrived in Ariccia, on the Via Appia near Rome, he marveled at the height that the vines reached and commented that the wine produced was so sour for "... just punishment of Jupiter for hanging his mother of that wine on such a high cross".

Starting from these assumptions, as part of the START project. UP. TO EU, one of the symbolic elements of tree-lined cultivation, namely the Scalillo, was created with the help of the 3D printer. The prototype represents this particular scale in a gadget and / or souvenir version.

The "Scalillo" is a narrow and high ladder for all the processes involving the vine: pruning, treatments and harvesting. For the grape harvest, done strictly by hand, they cannot use shears and scissors and the only way they can hold themselves up is to cross their legs between the rungs of the stairs. To harvest the grapes they use the Fescina, a wicker basket with a wooden handle and pointed ends suitable for lowering it with the rope, once filled, it could be stuck in the ground without dropping the harvested bunches. The suggestive "Posta" is the moment in which four vine growers work simultaneously on a row of "Alberata" placed between two poplars and, therefore, cover the entire surface of the vine. When they have to move the stairs they make the "pass" by lifting them up into the sky challenging the common concept of balance. The movement of the Scalillo can take place with three techniques: "A Spalla"(by shoulder), "a Braccia"(by arm), a "Rrecchia"(by ear). In the first, the ladder is placed on the shoulder and held with one hand, the second consists in holding the ladder with both arms placed in front of the body; while in the last, the ladder is held up with the hands and placed on the ear in order to keep balance by listening to the vibrations. What might seem like an easy operation becomes instead a somewhat complex mixture of strength, balance and will.

Currently these ladders are built largely manually, strictly in wood (Chestnut), with the distance between rungs that is customized according to the height and therefore to the size of the leg of the Harvester in order to be able to safely manage the positioning of the legs during the workings (an extended leg and a bent leg). Since the processing is carried out essentially with the aid of the Scalillo, a "V"-shaped groove is made in the center of the peg which allows the feet to be placed in different ways, to moderate the effort on the joints of the operators during the processing phase.







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La tradizionale coltivazione ad Alberata per l'Asprinio ha origini etrusche ma è stata anche uno degli elementi che ha contraddistinto l'epoca dei Romani ove vigeva l'usanza che il confine fra due proprietà era segnato con una fila di pioppi a mò di frangivento. Tale consuetudine ha delineato il paesaggio dell'agro aversano poiché i Romani, allorquando, conquistavano un territorio, assegnavano porzioni di terra a nuovi coloni e ai legionari veterani reclutati per la loro conquista, che si stabilivano in quelle zone e, di fatto, restavano a presidio delle aree appena conquistate. Il territorio veniva suddiviso in piccoli appezzamenti, secondo il metodo della centuriazione: cento passi per cento passi, con i lati ortogonali e generalmente orientanti a sud/nord ed est/ovest. Le coltivazioni di tali campi producevano cereali e altri prodotti sufficienti al sostentamento di una famiglia. La vite veniva piantata fra i pioppi, posti sui confini, per sfruttarli come tutori e per risparmiare terreno a vantaggio delle altre coltivazioni. La storia antica narra che Cinea, ambasciatore ed amico di Plinio, inviato da quest'ultimo a Roma dopo la battaglia vinta a Eraclea nel 280 a.C. per dettare le condizioni di pace, quando arrivò ad Ariccia, sulla via Appia nei pressi di Roma, si meravigliò dell'altezza che raggiungevano le vite commentò che il vino prodotto era così aspro per "...giusta punizione di Giove per aver appeso la madre di quel vino su una così alta croce".

Partendo da questi presupposti, nell'ambito del progetto START. UP. TO EU, è stato realizzato con l'ausilio della stampante 3D uno degli elementi simbolo della coltivazione ad alberata, ossia lo Scalillo. Il prototipo rappresenta appunto questa particolare scala in versione gadget e/o souvenir.

Lo "Scalillo" è una scala stretta e alta per tutte le lavorazioni che interessano la vite: la potatura, i trattamenti e la raccolta. Per la raccolta dell'uva, fatta rigorosamente a mano, i viticoltori non possono utilizzare cesoie e forbici e l'unico modo che hanno per reggersi è incrociare la gamba tra i pioli delle scale. Per raccogliere l'uva usano la Fescina, una cesta di vimini con manico in legno ed estremità a punta adatta a far sì che calandola con la fune, una volta riempita, si potesse incastrare nel terreno senza far cadere i grappoli raccolti. Suggestiva è la "Posta" ossia il momento in cui quattro vilignatori lavorano contemporaneamente su un filare di Alberata posta tra due pioppi e, quindi, coprono l'intera superficie del vitigno. Quando devono spostare le scale effettuano la "passata" innalzandole su nel cielo sfidando il comune concetto di equilibrio. Lo spostamento dello Scalillo può avvenire con tre tecniche: "A spalla", "a Braccia", "a Rrecchia". Nella prima la scala viene appoggiata alla spalla e mantenuta con una mano, la seconda consiste nel reggere la scala con entrambe le braccia poste dinanzi al corpo; mentre nell'ultima la scala viene retta con le mani ed appoggiata all'orecchio in modo da tenere l'equilibrio ascoltandone le vibrazioni. Quella che potrebbe sembrare un facile operazione, diventa invece un misto alquanto complesso di forza, equilibrio e volontà.

Attualmente queste scale sono costruite in gran parte manualmente, rigorosamente in legno (castagno), con la distanza tra pioli che è personalizzata in base alla statura e quindi alla misura della gamba del vendemmiatore al fine di poter gestire in modo sicuro il posizionamento delle gambe durante le lavorazioni (una gamba di stesa ed una gamba piegata). Visto che le lavorazioni si effettuano essenzialmente con l'ausilio dello Scalillo, al centro del piolo viene fatta una scanalatura a "V" che consente di poggiare i piedi in diversi modi, per moderare lo sforzo delle articolazioni degli operatori in fase di lavorazione.

Lo Scalillo



fonti e foto a cura di



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Erasmus+ KA2 Project - Innovative Strategic Partnership - 2018-1-IT02-KA201-048538

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The catalog of 3D objects

1. Comic theatre mask



Terracotta

Unknown provenance, 3rd – 2nd century BCE

National museum, H10-8546

Ancient theatre used several fixed personalities of characters which the actors portrayed by wearing different masks. This example is a mask worn to portray comical characters. It is a bearded male face with wide open mouth. The exaggerated features allowed the audience to recognize the character from afar, while the large openings for mouth and eyes allowed the actor to make use of exaggerated mimics.

2. Weight in form of a bust of Mercury



Bronze

Roman work, 1st century CE

National museum, H10-1238

Roman figural weights sometimes took a figural form. In this case it is a form of a bust of Mercury, the patron god of merchants, symbolically supervising the weighing and the transaction. Later, the weights took form of the emperor's or empress's bust with the same symbolic role. A particular weight was achieved by casting the outer shape by lost wax technique and then filling it by a certain amount of lead.

3. Portrait of a young girl

Marble

Roman work, 1st – 2nd century CE

National museum, H10-8552

This marble head was originally part of a larger statue (either a bust or a full figure) and is a smaller than life portrait of a young girl. It was a common practice for Romans to create somewhat standardized bodies for statues separately from their heads which had more portrait features. Roman art of the early 1st century CE departed from the aggressive verism of the older works, but it is still obvious that the face is not too idealized, and the girl has very full lips and double chin.



4. Drunken Silenus

Terracotta

Egypt, beginning of the 2nd century CE

National museum, H10-2127

Silenus was the eldest and drunkest from Dionysus' companions. Even though this figurine misses its lower half, the main attributes are obvious – big belly, bald head, long beard and a bunch of grapes in his hand.

The figurine was made from two piece form, the seam being visible on its sides and on its back a protrusion with a hole so it could be hanged.



5. Tintinnabulum

Bronze

Possibly from Pompeii, 1. century CE, or a 19th century copy

National museum, H10-2194

Phallic symbols had a special place in ancient Roman culture, they protected against evil eye and evil spirits. Bells had a similar function. By combining these two symbols wind chimes were created, which were hanged near doors to draft and the seemingly vulgar symbolic of which make them popular museum exhibits. In this case the bells were hung on chains from the phallus' paws and the rider's feet.



6. Head of Athena-Minerva

Marble

Roman work, 2nd century CE

National museum, H10-1884

Though the statue's body is missing, the corinthian helmet, in this case decorated by curled ram's horns, clearly identifies this head as that of Athena-Minerva. It is a Roman work, probably from the Antonine period.

Museum, GR 1877.0515.8

During the Hellenistic period a new market emerged for mass-produced small sculpture. The technology of making terracotta

sculptures by molding originates in massively spread votive terracottas and while this group of figurines is called "Tanagras", they were made in many places of the Hellenistic world. They got their name from the site of Tanagra where they were first found in large quantities. Although in Tanagra they were found in burials, finds from other sites point to the figurine's use in sacred contexts as well as home decorations.

The choice of themes testifies for their more secular use – they often show men and women in formalized poses, but also for example characters from theatre plays.

The statuettes often preserve traces of polychromy, which probably copied real world colors.

8. Terracotta figurines, so called Tanagras



Terracotta

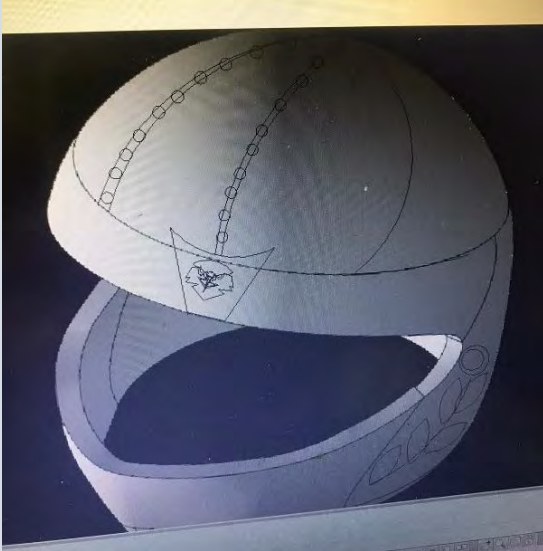
1. Tanagra (Greece), 3rd century BCE, National Museum, H10-1912
2. Tanagra (Greece), 3rd. century BCE, National Museum, H10-1913
3. Corinth (Greece), 2nd half of 4th century BCE, British Museum, GR 1895.1029.7
4. Tanagra (Greece), 1st half of 3rd century BCE, British Museum, GR 1875.1012.13
5. Tanagra (Greece), 1st half of 3rd century BCE, British Museum, GR 1877.0515.8

During the Hellenistic period a new market emerged for mass-produced small sculpture. The technology of making terracotta sculptures by molding originates in massively spread votive terracottas and while this group of

figurines is called “Tanagras”, they were made in many places of the Hellenistic world. They got their name from the site of Tanagra where they were first found in large quantities. Although in Tanagra they were found in burials, finds from other sites point to the figurine’s use in sacred contexts as well as home decorations. The choice of themes testifies for their more secular use – they often show men and women in formalized poses, but also for example characters from theatre plays. The statuettes often preserve traces of polychromy, which probably copied real world colors.







9. EQUEScouter

The helmet of the gladiators, which constitutes the significant part of the armor on which the category of combat depended, is taken as a design element to be converted into a helmet approved for mopeds.

His modeling borrows some details of the shell of the helmet of the *eques* and some decorative details present in the armor of the *Mirmillone*. This object perfectly interprets the mission of protection and defense of the person in the educational perspective of the generations of adolescent age as the young students of the Liceo are among the first users of road education.



10. GLADIATORADE

The particular diet of the Gladiator allowed the fighter to undergo intensive training that allowed him to have high combat performance.

The mixture of the so-called energy drink based on appropriately investigated and scientifically proven minerals is being studied in order to reproduce it and transform it into an edible product that can promote an adequate alternative to drinks with a view to a healthy diet for the promotion of sport.

On this occasion, the design of the container in recyclable material is also underway.

Research is currently underway on the possible models of Roman containers to be taken into account. understanding.

Particularly evocative is this glass container that proposes on the body a head with helmet.

11. Lo scalillo



The traditional cultivation in Alberata for Asprinio has Etruscan origins but it was also one of the elements that marked the Roman era when it was customary that the boundary between two properties was marked with a row of poplars as a kind of windbreak. This custom has outlined the landscape of the Aversano countryside since the Romans, when they conquered a territory, assigned portions of land to new settlers and veteran legionaries recruited for their conquest, who settled in those areas and, in fact, remained in garrison of the newly conquered areas. The territory was divided into small plots, according to the centuriation method: one hundred steps by one hundred steps, with the sides orthogonal and generally facing south / north and east / west. The cultivations of these fields produced cereals and other products sufficient to support a family. The vines were planted among the poplars, placed on the borders, to exploit them as tutors and to save land for the benefit of other crops. Ancient history tells that Cineas, ambassador and friend of Pliny, sent by the latter to Rome after the battle won in Eraclea in 280 BC. to dictate the conditions of peace, when he arrived in Ariccia, on the Via Appia near Rome, he marveled at the height that the vines reached and commented that the wine produced was so sour for "... just punishment of Jupiter for hanging his mother of that wine on such a high cross".

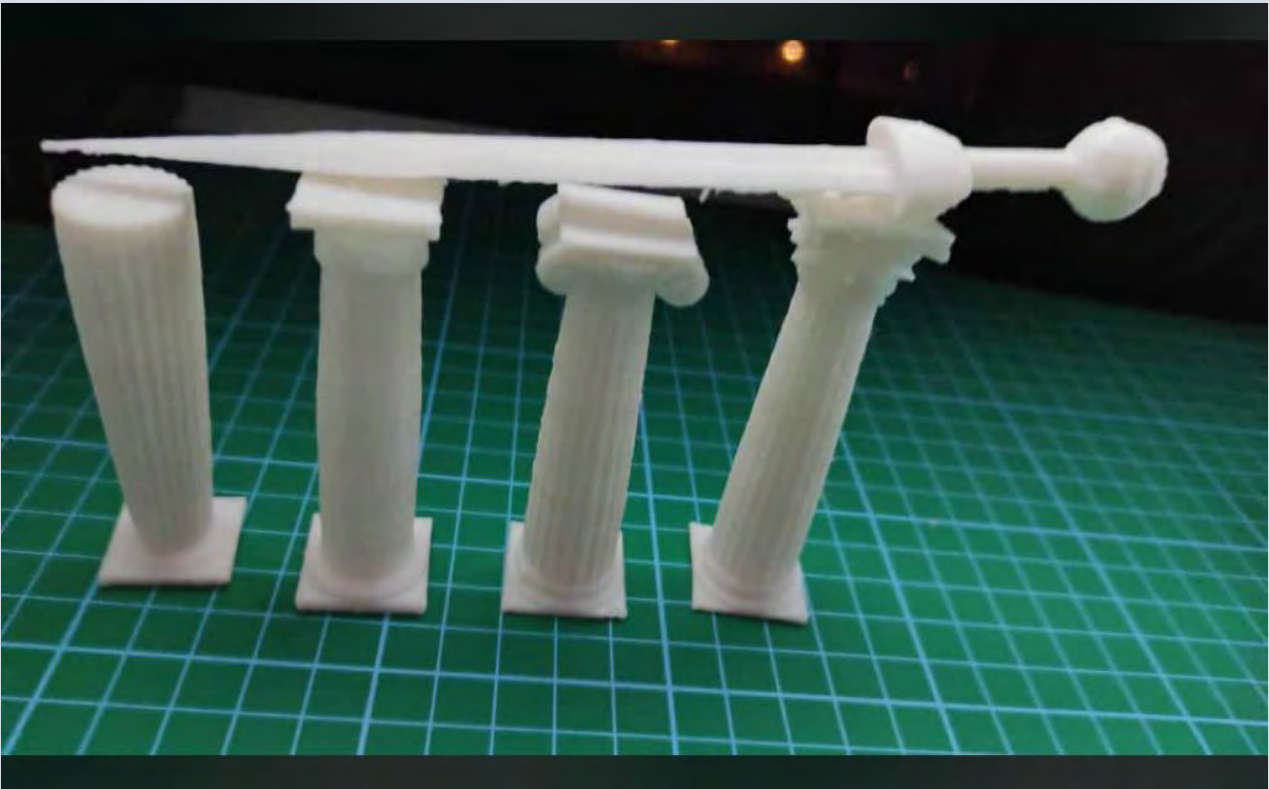
Starting from these assumptions, as part of the START project. UP. TO EU, one of the symbolic elements of tree-lined cultivation, namely the Scalillo, was created with the help of the 3D printer. The prototype represents this particular scale in a gadget and / or souvenir version.

The "Scalillo" is a narrow and high ladder for all the processes involving the vine: pruning, treatments and harvesting. For the grape harvest, done strictly by hand, they cannot use shears and scissors and the only way they can hold themselves up is to cross their legs between the rungs of the stairs. To harvest the grapes they use the Fescina, a wicker basket with a wooden handle and pointed ends suitable for lowering it with the rope, once filled, it could be stuck in the ground without dropping the harvested bunches. The suggestive "Posta" is the moment in which four vine growers work simultaneously on a row of "Alberata" placed between two poplars and, therefore, cover the entire surface of the vine. When they have to move the stairs they make the "pass" by lifting them up into the sky challenging the common concept of balance. The movement of the Scalillo can take place with three techniques: "A Spalla" (by shoulder), "a Braccia" (by arm), a "Rrecchia"(by ear). In the first, the ladder is placed on the shoulder and held with one hand, the second consists in holding the ladder with both arms placed in front of the body; while in the last, the ladder is held up with the hands and placed on the ear in order to keep balance by listening to the

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vibrations. What might seem like an easy operation becomes instead a somewhat complex mixture of strength, balance and will. Currently these ladders are built largely manually, strictly in wood (Chestnut), with the distance between rungs that is customized according to the height and therefore to the size of the leg of the Harvester in order to be able to safely manage the positioning of the legs during the workings (an extended leg and a bent leg). Since the processing is carried out essentially with the aid of the Scalillo, a "V"-shaped groove is made in the centre of the peg which allows the feet to be placed in different ways, to moderate the effort on the joints of the operators during the processing phase.





12. The Doric Column

A column is a vertical architectural element that usually has structural functions, although it can also be chosen for decorative purposes. Ordinarily, its section is circular.

The Greco-Roman civilization used columns both inside and outside of buildings, especially in porticoes.

The Doric order is the most primitive and simple of the three orders. The capitals that belong to constructions of the Doric order are very little decorated. For this reason, Doric capitals are the easiest to recognize of the three different types of capitals, since they are smooth and without any embellishment or relief. The columns of the Doric order do not use a support surface between the column and the ground.

13. The Ionic Column

A column is a vertical architectural element that usually has structural functions, although it can also be chosen for decorative purposes. Ordinarily, its section is circular.

The Greco-Roman civilization used columns both inside and outside of buildings, especially in porticoes.

The Ionic order is more decorative than the Doric one. The Ionic capitals are characterized by having two volutes as decorative scrolls. The volutes are snail or spiral shapes that characterize the capitals of this style, instead of being smooth and flat. With the volutes, the capitals are not straight: they

protrude from the sides and give it a touch of ornament. The Ionic columns have a small construction under them, called the base, which means that they are not directly placed on the surface, unlike the Doric ones.

14. The Corinthian Column

A column is a vertical architectural element that usually has structural functions, although it can also be chosen for decorative purposes. Ordinarily, its section is circular.

The Greco-Roman civilization used columns both inside and outside of buildings, especially in porticoes.

Capitals of the Corinthian type are the ones with the slenderest order, in comparison with the other two architectural orders. The main characteristic of the Corinthian order is the great decoration that its columns and constructions have, also made in a very similar way. They are the most decorated; instead of having two large scrolls, they are adorned with two or three rows of acanthus leaf figures, and above them, four small scrolls. Corinthian columns also have a base under them, which separates them directly from the lower surface.

15. The Gladius Sword

The Gladius sword was the sword used by the legionaries of Ancient Rome. From the word "Gladius" comes the name Gladiator. The Gladius was a very effective sword and led the Roman Empire to victory in many battles. Legionnaires used this weapon from the 3rd century BC to the 2nd century.

The look of the Gladius sword is very simple and may vary slightly depending on the model, the era and the location. It is usually presented as a straight blade sword, sharp on both sides and pointed. Being a sword with one hand, it is usually about half a meter long, since the other one used to hold a shield (Scutum: praetorian shield or turtle shield).

The Hispanic Gladius, used especially in the Hispanic territory, was the most used.

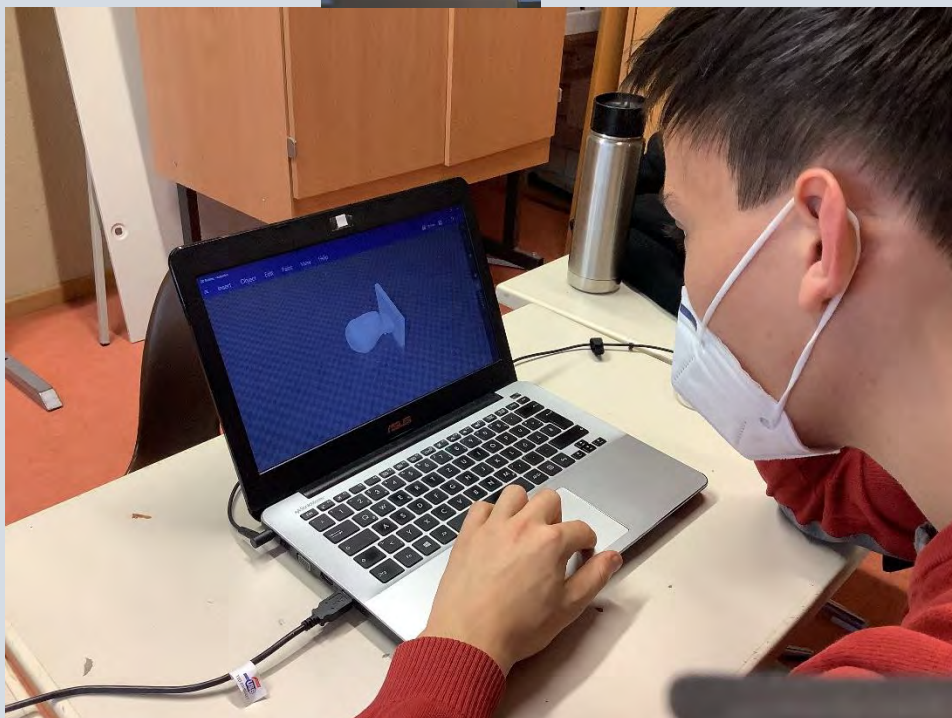
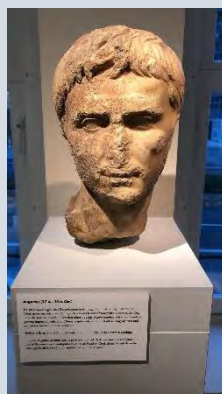
16. The Amphora

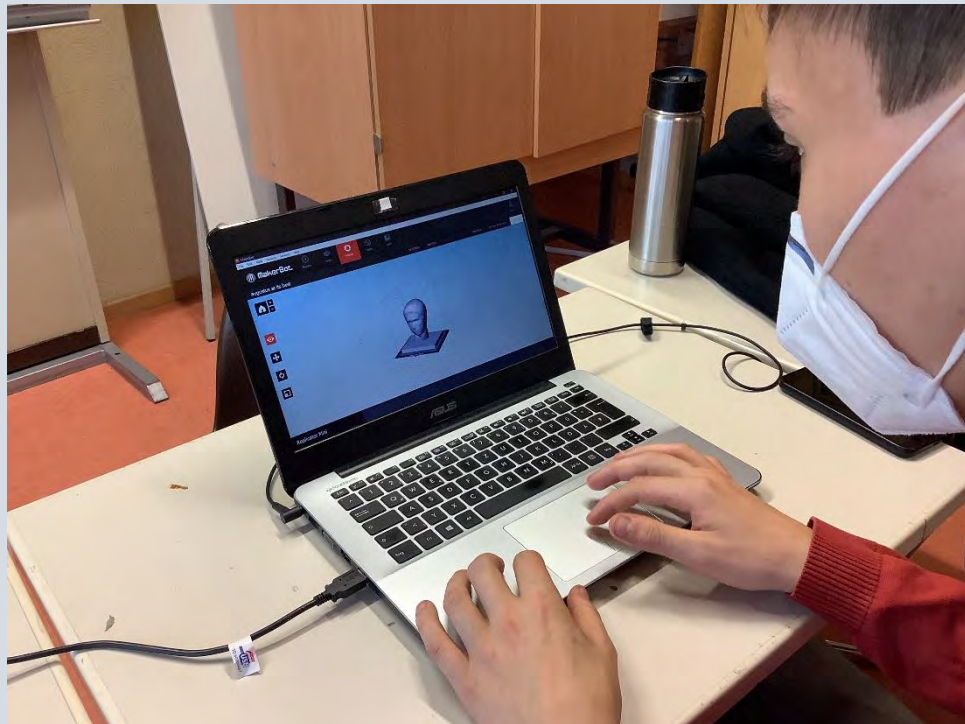
An amphora is a large ceramic container with two handles and a long narrow neck. Extremely common in the Mediterranean Basin, it was used to store wine. Since they had such a narrow base, they used to make a hole in the ground so that they were safe or they put them in a kind of sideboard or benches.



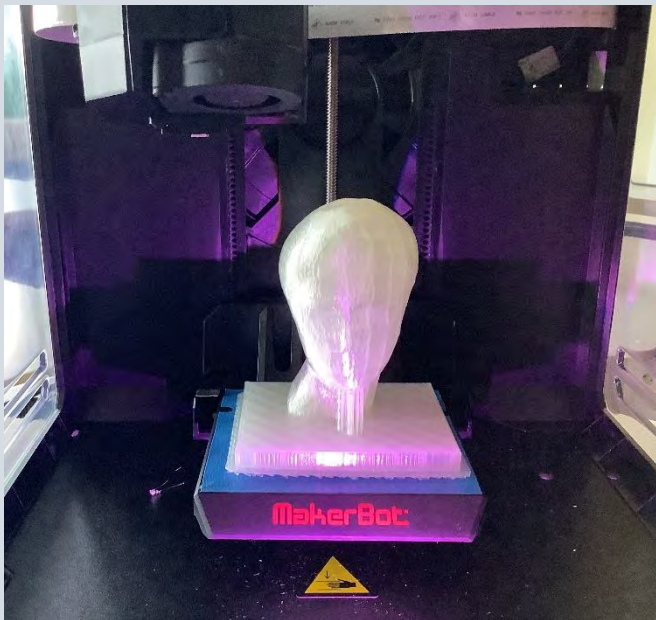
17. Bust of Augustus

The bust of Augustus is displayed in the Roman Germanic Museum of Cologne. This bust shows Augustus as a priest or somebody who sacrifices to the gods, because he is wearing his toga over his head. His benevolent features refer to his role as father of the fatherland (*pater patriae*). Under Augustus Germania was conquered and the oppidum *Ubiarum* – Cologne – was founded. The object is from the early first century and so it was built while Augustus still ruled as an emperor.





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18. Glass Vase with ornaments



Since the founding of the Colonia CCAA glass played an important role in the economics of the city. Glass manufacturers in Cologne date back to the first century a.D. The art grew from simple blue-green glasses to detailed structures with multiple layers. Many glass structures were found in Cologne from the roman period in excavations.

The object belongs to the world largest collection of roman glass in the Roman Germanic Museum of Cologne. It is decorated with blue glassfibres and has a small stem. It could have been a glass for drinking or for decoration.



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