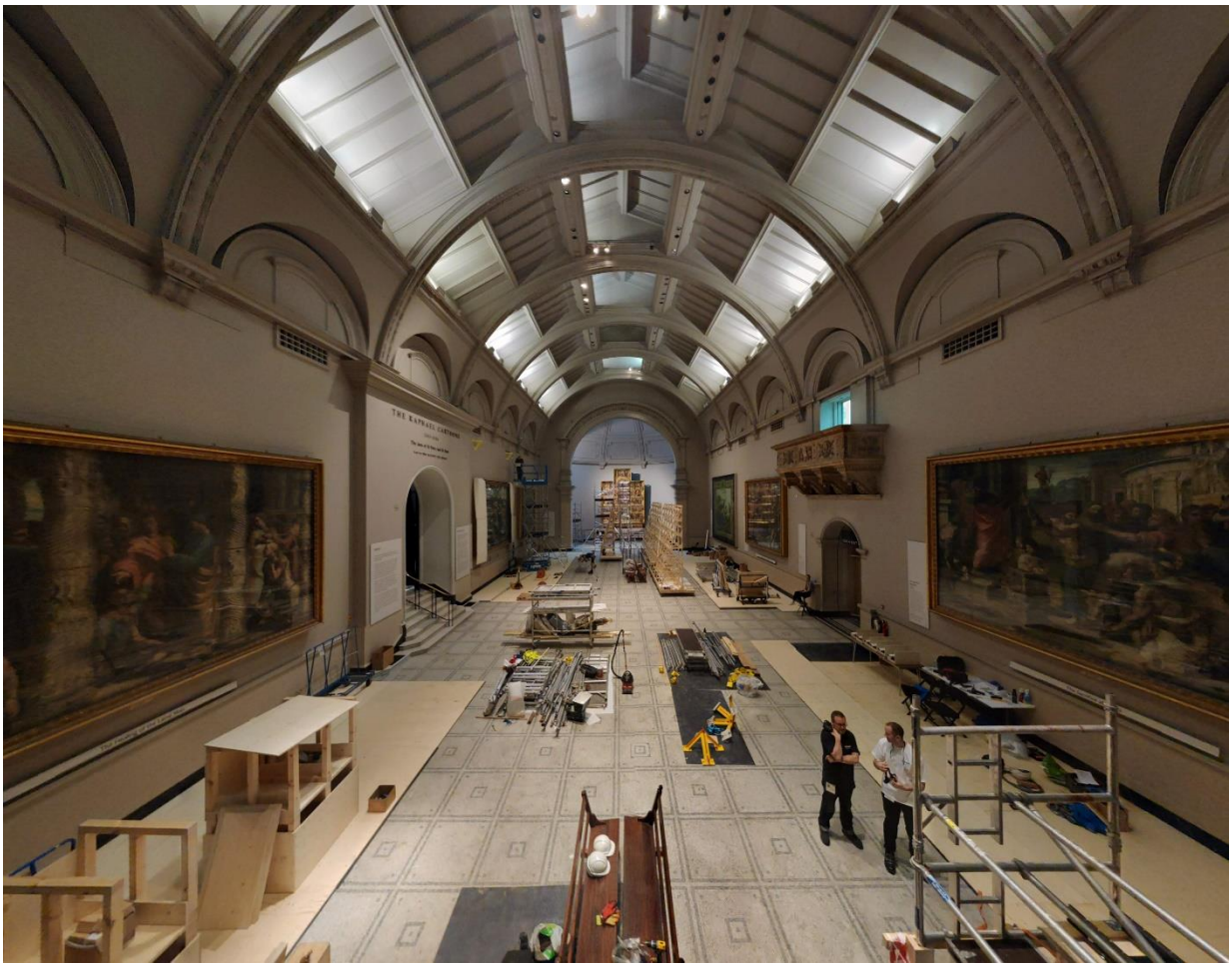
FACTVM
FOVNDATION
FOR DIGITAL TECHNOLOGY
IN CONSERVATION

**For immediate release – 24/09/2020**

# The high-resolution recording of the Raphael Cartoons

## Factum Foundation for the V&A and Royal Collection Trust



The Raphael Court at the V&A during the recording process © Gabriel Scarpa for Factum Foundation

In August 2019, a team of 3D-scanning and photography specialists from Factum Foundation carried out the recording of the Raphael Cartoons at the Victoria and Albert Museum in London. The Cartoons, lent to the V&A from the Royal Collection by Her Majesty The Queen, are among the greatest treasures of the Renaissance in the UK.

After his election in March 1513, Pope Leo X commissioned Raphael to create a set of ten full-scale designs for a series of tapestries for the Sistine Chapel in the Vatican Palace, illustrating scenes from the lives of Saint Peter and Saint Paul. Once complete, the Cartoons were sent to the workshop of merchant-weaver Pieter van Aelst in Brussels, which transformed the monumental designs into tapestries. Seven of

the Cartoons survive to this day and have been on public display in the South Kensington Museum – now the V&A – since 1865. In 2020 – to mark the 500th anniversary of Raphael's death – the V&A are transforming the way visitors experience the Cartoons through a refurbishment of The Raphael Court and a new interpretive approach, which uses Factum Foundation's recordings to reveal in-depth stories about the monumental works of art. The Raphael Court will reopen on 14 November 2020.

The recording at high resolution in colour, 3D and infrared of all seven cartoons by Raphael is one of Factum Foundation's most ambitious digitisation projects to date and has set new standards for large-scale, high-resolution digital documentation of low-relief surfaces. In order to complete the recordings, a team of specialists from Factum Foundation worked around the clock in three shifts operating four Lucida scanners for a period of five weeks, during which time the gallery was closed to the public. By following a carefully planned schedule it was possible to coordinate the recording of the Cartoons with their unframing, the production of conservation condition reports, and other tasks carried out by the V&A staff. Fluent communication and coordination between the different teams was key to the success of the recording phase of the project, commissioned by the V&A and supported by the Royal Commission for the Exhibition of 1851.

The recording involved the use of non-contact digital scanning methods to capture detailed information of the surface of the monumental Cartoons. High-resolution 3D scanning technologies allow us to look at art and architectural elements under a new light, transforming the ways in which we study and preserve them. The possibility of documenting not only the colour, but also the surface details of artworks of such historical and material significance, in 3D at a resolution of one tenth of a millimeter, can provide invaluable information about the history of any work of art. It focuses attention on the way it has aged, how it has been looked after, and why it looks the way it does today. High-resolution surface data, in combination with other relevant diagnostic techniques, allows curators and conservators to learn more about the objects, providing forensically accurate data for condition reports.

The refurbishment of The Raphael Court is supported by Lydia & Manfred Gorvy, Julia and Hans Rausing, American Express, the Royal Commission for the Exhibition of 1851, Sir Michael and Lady Hintze, the Robert H. Smith Family Foundation, the American Friends of the V&A, and many other generous donors.

**RECORDING THE SURFACE IN 3D**

In the first phase of the project, a total area of about 115 square metres was digitised using two complementary non-contact methods: panoramic composite photography, which was used to record both colour and infra-red, and the Lucida 3D Scanner.

Conceived and developed by artist and engineer Manuel Franquelo with Factum Arte, the Lucida 3D Scanner is a close-range, non-contact laser recording system that captures high-resolution data of the topography and texture of any low-relief surface. It has made it possible to meticulously record the

surface of the Cartoons which, while apparently flat, are in fact remarkably complex, made up of composite sheets of paper and showing the evidence of the painting process, pouncing, folding, and previous restoration treatments. This coherent high-resolution data can be used for accurate condition monitoring and for study.


The Factum Foundation team using the Lucida 3D Scanner to record the surface of one of the Raphael Cartoons at the V&A.
© Gabriel Scarpa for Factum Foundation

Factum's Lucida records 3D data in 48 cm x 48 cm 'tiles' by projecting a moving laser beam onto the surface of an artwork. The system is entirely non-contact and the scanning head is always at least 8 cm from the painted surface. To produce accurate digital records of the Cartoons, four Lucida 3D Scanners were employed simultaneously to record the relief at a resolution of 100 microns (generating rendered images at 254 dpi at 1:1 scale). The scanners were mounted on scaffolding towers, reaching a maximum scanning height of about 5.5 m. The stability of the scaffolding, built by Momart, was essential to guarantee the highest level of safety for the cartoons and to produce optimal data quality.

FACTVM
FOVNDATION
FOR DIGITAL TECHNOLOGY
IN CONSERVATION

**For immediate release – 24/09/2020**

Detail of the Lucida 3D Scanner recording the surface of a Raphael Cartoon at the V&A. The technology operated by Factum Foundation is entirely non-contact and operates at safe distance from the artwork at all times.
© Gabriel Scarpa for Factum Foundation

**RECORDING THE COLOUR**

Factum's photography specialists have been perfecting the application of panoramic composite photography for the preservation of works of art creating high-resolution colour recordings of a flat or gently undulating surfaces. Panoramic photography, along with the Lucida 3D Scanner, have been employed by Factum Foundation in many institutions over the past years, including the Museo del Prado, the British Museum, the Vatican Museums, the National Galleries of London and Washington, the Pinacoteca Ambrosiana in Milan, the Musée du Louvre among others.

FACTVM
FOVNDATION
FOR DIGITAL TECHNOLOGY
IN CONSERVATION

**For immediate release – 24/09/2020**

Panoramic photography consists of taking overlapping photos that are then stitched together to create a composite image at sub-pixel accuracy. Factum uses panoramic photography to produce images of cultural heritage objects with resolutions of up to 900 dpi, following a protocol that ensures the objectivity and accuracy of the colour and tone.

The process involves both digital checks using X-Rite colour checking method, and physical colour checks using Pantone charts and specially made 'colour sticks', which are matched to the colours on the painting. These checks are especially important in the production of facsimiles, ensuring accurate colour and tone and a close correspondence between the recording, the rematerialisation and the original painting.

During the photography process, flashes are used to evenly illuminate the surface of the artwork. The camera normally remains fixed, while the position of the flashes is changed at least 3 times. The Cartoons were recorded in colour and infra-red at a resolution of 400–450 dpi at 1:1 scale.


Factum Foundation recording the colour of the Raphael Cartoons at the V&A
using panoramic composite photography © Gabriel Scarpa for Factum Foundation

Inscrita en el Registro de Fundaciones por OM 24/09/2009 con nº 878. VAT no. ESG85614899
info@factumfoundation.org
calle Albarracín, 28 - 28037 Madrid, Spain. Telf +34 91 5500978 / 44 Lexington Street - W1F 0LP London, United Kingdom

## CREATING THE MULTI-LAYERED BROWSERS

When high-quality data is acquired, it is possible for Factum to create a multi-layered browser of the painting: this online tool enables the visualisation of the 3D scanned surface, as well as the colour and infra-red data. Through this online platform, it is possible to move around the scanned surfaces and zoom in at macro-level photographic data with a resolution of 400 dpi on a scale of 1:1, from any computer or mobile screen. The tool developed by Factum after years of testing and improvement allows everyone, from museum conservators to the general public, to study in great detail the materiality of the recorded artworks.

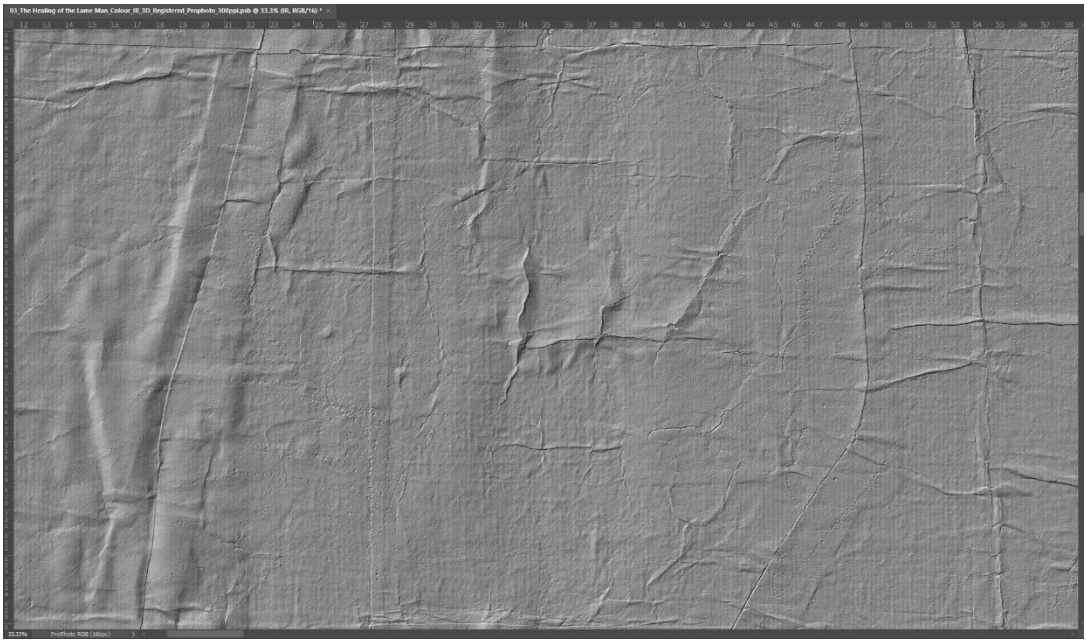
Once the recording was completed, the digital information captured on-site was processed in the Foundation's studio in Madrid. The raw files were carefully analysed, edited and stitched together to create the high-resolution composite images. Since the 3D data recorded by the Lucida is generated as a greyscale depth-map and shaded image renders, it is possible to employ image-based software like PTGui to align the tiles; a similar semi-automatic process is followed with the photography and infra-red images. As a result of these stitching operations, three panoramas (each around 40GB in size) are generated for each Cartoon: a 3D render (which is used as a base), a colour file and an infra-red file.

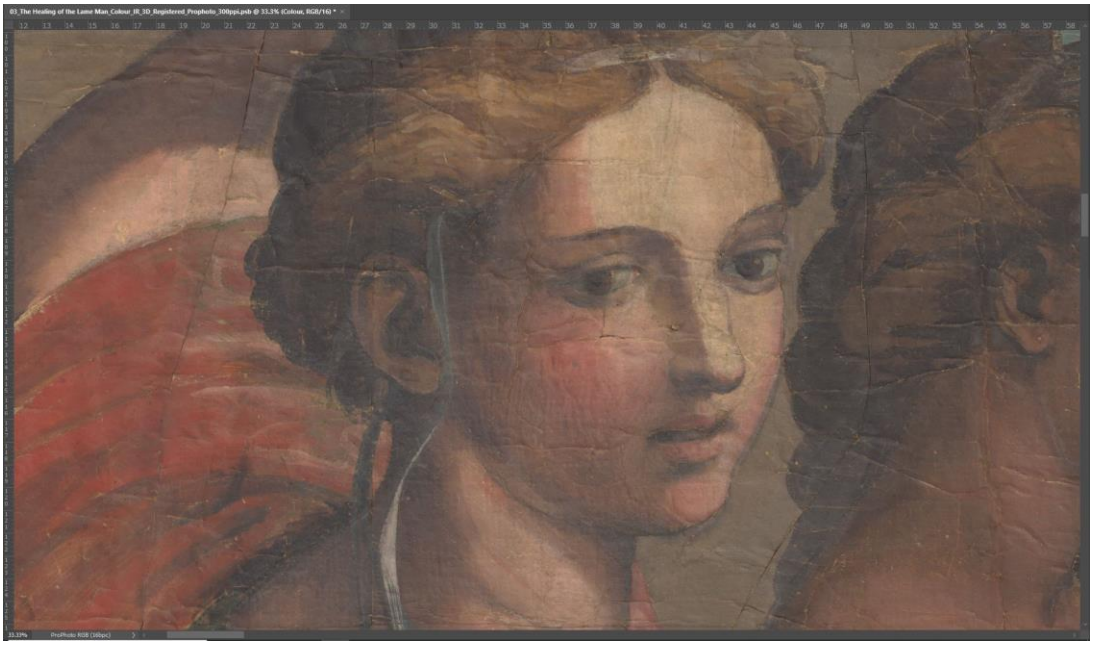
Factum software engineers are continually working to improve the automated processing of data: to speed up the process, improve alignment, and understand and exploit the potential of the cloud in which the data is stored and through which it is processed. Due to their scale, the recording, processing and output of data from the Raphael Cartoons has proved a stimulus to this development, opening the field for new reflections on the future role of AI and machine learning in the preservation of cultural heritage.

While the monitoring and safeguarding of these great works of art is the responsibility of the V&A and Royal Collection Trust, new technologies and high-resolution recording can contribute to this process by developing innovative, objective and detailed information allowing for new methods of display, both digitally to a global audience and physically through the production of exact facsimiles and other forms of materialisation.

FACTVM
FOVNDATION
FOR DIGITAL TECHNOLOGY
IN CONSERVATION

**For immediate release – 24/09/2020**

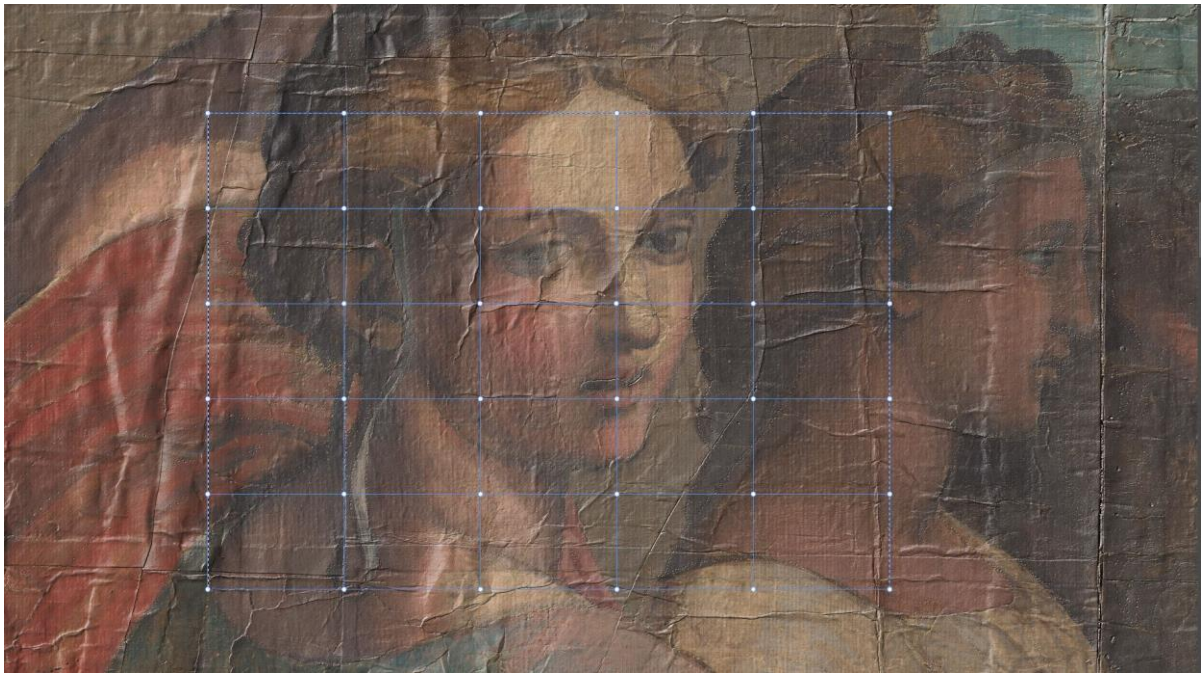




(Detail from *The Healing of the Lame* Man) The greyscale set of surface data acquired by the Lucida 3D scanner and the set of colour data captured with panoramic composite photography. © Factum Foundation for the V&A and Royal Collection Trust

FACTVM
FOVNDATION
FOR DIGITAL TECHNOLOGY
IN CONSERVATION

**For immediate release – 24/09/2020**



(Detail from *The Healing of the Lame* Man) Matching the surface and colour data using control points.


## Factum Foundation's projects on Raphael

**WORKS FOR THE EXHIBITION 'RAFFAELLO (1520-1483)'**
**2 JUNE – 30 AUGUST 2020**
**SCUDERIE DEL QUIRINALE, ROME**

"*Technology, provided again by Factum Arte, enables the juxtaposition of a facsimile of Raphael's Cartoon of 'The Sacrifice at Lystra' (around 1515-16) with the respective Vatican tapestry. The educational impact for the general public is indisputable: now scholars have to face the challenge of inserting these new tools into their research and exploiting their potential, before they are once more outwitted by commercial applications. The exhibition implicitly urges collaborations beyond the borders of museums and disciplines.*"

**Arnold Nesselrath**
Review in The Art Newspaper - July 2020

**Facsimile of 'The Sacrifice at Lystra'**

As a tribute to the 500th anniversary of Raphael's death, Scuderie del Quirinale in Rome opened 'Raffaello', curated by Marzia Faietti and Matteo Lafranconi, with contributions from Vincenzo Farinella and Francesco Paolo Di Teodoro and the supervision of Sylvia Ferino-Pagden as President of the scientific

committee. *Raffaello 1520-1483* looks in depth at the artist's life, his diverse works of art and his wide-ranging influence: more than 200 artworks, 100 of them by Raphael, were loaned from all over the world.

Raphael, *The Sacrifice at Lystra*. Photo: © Victoria and Albert Museum, London. Courtesy Royal Collection Trust / Her Majesty Queen Elizabeth II 2020

The Cartoon depicting *The Sacrifice at Lystra* was rematerialised as a facsimile for the exhibition and displayed alongside the finished tapestries.

The main reason that explains Factum's obsession for high-resolution surface and colour recording lies in the need to have a resolution that is meaningful for replication. When works of art can't travel easily or be exhibited in touring exhibitions in order to meet new audiences, as it is the case of the Raphael Cartoons due to their fragility, or when visitors can't travel themselves, exact facsimiles become a clear solution, benefitting both the institution caring for the work of art and the public.

FACTVM
FOVNDATION
FOR DIGITAL TECHNOLOGY
IN CONSERVATION

**For immediate release – 24/09/2020**

The facsimile of *The Sacrifice at Lystra* in the exhibition spaces.
Picture by Alberto Novelli © 2020 Scuderie del Quirinale – Ales

Accurate recordings are essential for the production of an exact facsimile, which should be identical to the original under the same viewing conditions. In the case of the Cartoons, that have to be shown behind glass and under low light levels, the facsimile has the advantage that it can be shown without protection under any lighting conditions. Increasingly recreations and facsimiles are being used as a new way to share, reunite and understand culture. The work carried out by Factum Arte on Veronese's *Wedding at Cana* is a good example of this: a facsimile of Veronese's great painting in the Louvre was installed into its original location in Palladio's refectory on the Island of San Giorgio Maggiore, Venice, now the home of the Fondazione Giorgio Cini.

To make the facsimile of *The Sacrifice at Lystra*, the surface relief of the painting was first printed in 3D using the elevated printing technology developed by Canon Production Printing, with whom Factum Foundation has collaborated over many years. Elevated Printing Technology is a revolutionary printing method that involves building up a relief surface in 5-micron layers to replicate the exact topography of a painting.

In Factum's workshops, liquid silicon is then poured over the relief print to create a mould of its surface. A cast is then made from this mould using a specially prepared acrylic gesso mix. This 'skin', which forms the base surface of the final facsimile, is then fixed to a backing canvas in a process that is similar to re-lining a painting. In the case of *The Sacrifice at Lystra*, a CNC-milled polyurethane panel generates the low frequency information (the undulations of the original surface) while the elevated print rematerialises the high frequency data (the surface character and brushmarks).

Factum's custom-made flatbed printer prints the color information in register with the 3d scanned texturized support.
© Adam Lowe for Factum Foundation

Factum's purpose-built flatbed printer has been designed in-house to print colour in multiple layers across large surfaces. Using a traditional method of registration, the colour and the relief are perfectly aligned, ensuring that the appearance of the facsimile is entirely faithful to the original. Multiple layers of over-printing ensure that the tone and hue or each colour is exact. The final stage is varnishing and hand finishing. In the exhibition in Rome the facsimile was on display at eye level and without glass and the experience of seeing the tapestry and the Cartoon side by side opens many new avenues for study.

FACTVM
FOVNDATION
FOR DIGITAL TECHNOLOGY
IN CONSERVATION

**For immediate release – 24/09/2020**

Once all printed panels are joined together, the seams are made invisible © Otto Lowe for Factum Foundation

The rematerialisation of the tomb inside the exhibition.
Picture by Alberto Novelli © 2020 Scuderie del Quirinale – Ales

**Rematerialisation of Raphael's tomb**

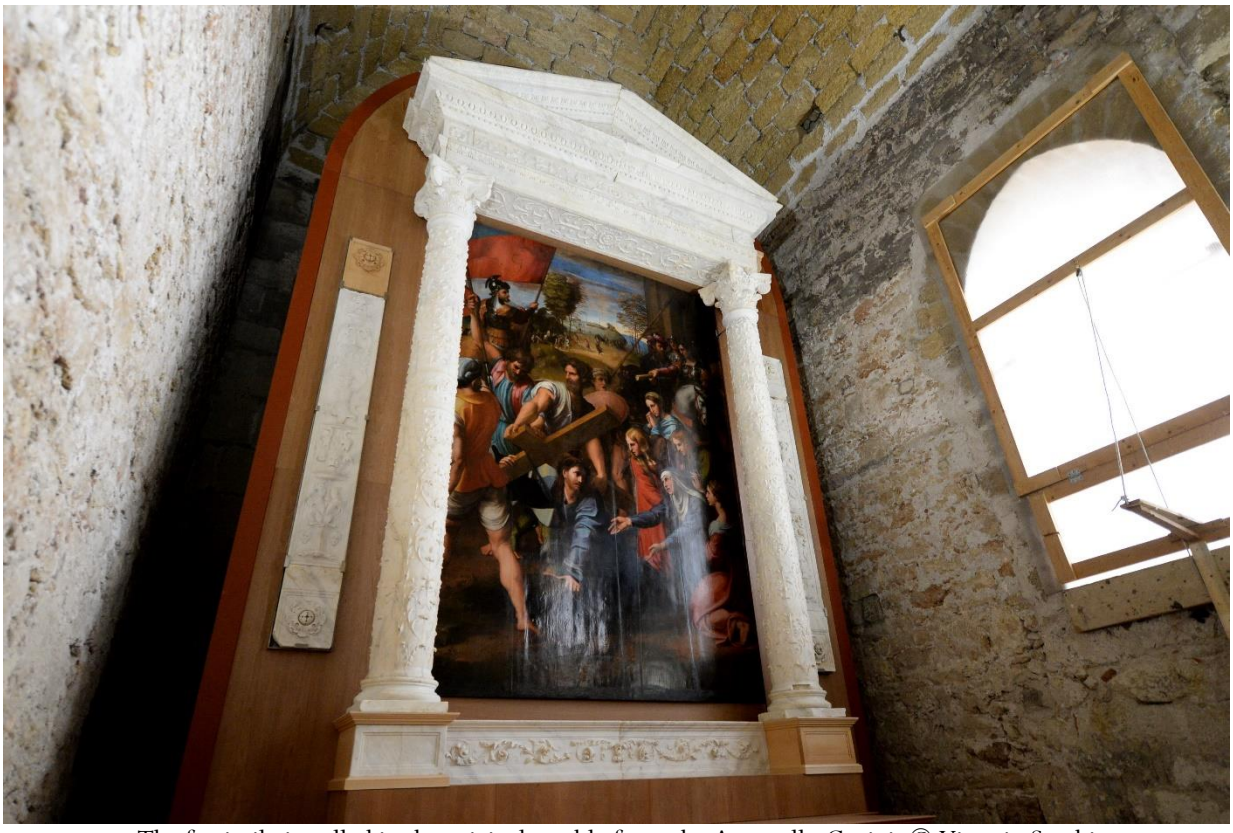
Factum Arte also created the starting point of the exhibition: a rematerialisation of the painter's tomb from the Pantheon, with its 19th-century additions removed upon request of the curators. After a Factum Foundation team carried out the recording of the original tomb in the Pantheon in December 2019, almost all of Factum's departments were involved in the rematerialisation process from the acquired digital data, with engineers, architects, sculptors, artists, welders and digital experts working side by side on the various elements making up the tomb.

FACTVM
FOVNDATION
FOR DIGITAL TECHNOLOGY
IN CONSERVATION

**For immediate release – 24/09/2020**

## A RECREATION OF *LO SPASIMO DI SICILIA* RETURNS TO PALERMO

On 9th July 2020, Factum Foundation's recreation of Raphael's *Christ Falls on the Route to Cavalry,* nicknamed *Lo Spasimo di Sicilia*, was installed in the monastery of Santa Maria dello Spasimo in Palermo, where the painting hung until the middle of the 16th century. The original painting by Raphael, now in the Museo del Prado in Madrid, was transferred from a wooden panel onto a canvas after being taken to Paris by Napoleon, during the Spanish War of Independence. Factum Foundation addressed this fact with the recreation of the painting on a rigid panel, in order to install it into its original frame in its original location in Palermo.



The facsimile installed in the original marble frame by Antonello Gagini. © Vittorio Sgarbi

FACTVM
FOVNDATION
FOR DIGITAL TECHNOLOGY
IN CONSERVATION

**For immediate release – 24/09/2020**

# About Factum Foundation

Factum Foundation for Digital Technology in Conservation is a not-for profit organisation founded in 2009 in Madrid by Adam Lowe. It works alongside its sister company, Factum Arte, a multidisciplinary workshop in Madrid dedicated to digital mediation and physical transformation in contemporary art and the production of facsimiles. The Foundation was established to demonstrate the importance of documenting, monitoring, studying, recreating and disseminating the world's cultural heritage through the rigorous development of high-resolution recording and rematerialisation techniques. The Foundation's activities include: building digital archives for preservation and further study, creating and organising touring exhibitions, setting up training centres for locals to learn the different technologies developed by the Foundation to record their own cultural heritage, and producing exact facsimiles as part of a new approach to conservation and restoration.

## Communication and press – Factum Foundation and Factum Arte

Nicolas Béliard - nicolas.beliard@factum-arte.com
Giulia Fornaciari – giulia.fornaciari@factum-arte.com

Please do not hesitate to contact us for images.

Factum Foundation Calle de Albarracín, 28
28037 Madrid

factumfoundation.org