THE PORTRAIT OF KING RAMA VI, VAJIRAVUDH, BY GALILEO CHINI (1914-1947)CONSERVATION AND RESTORATION OF THE PAINTING

By

Mr. Tam LAOVICHAYA

An Independent Study Submitted in Partial Fulfillment of the Requirements for Master of Arts Cultural Heritage Conservation and Management (International Program)

Silpakorn University

Academic Year 2025

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การค้นคว้าอิสระนี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรศิลปศาสตรมหาบัณฑิต
การอนุรักษ์และการจัดการมรดกทางวัฒนธรรม (หลักสูตรนานาชาติ) แผน ข
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By	Mr. Tam LAOVICHAYA
Field of Study	Cultural Heritage Conservation and Management (International Program)
Advisor	Professor Dr. Gabriela Krist

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Abstract

The Portrait of King Rama VI, Vajiravudh, by Galileo Chini (1914-1947)

Conservation and Restoration of the Painting

The Portrait of King Rama VI is one of the early modern Siamese paintings by Galileo Chini, an Italian artist, who created many artworks for the Thai monarch, during his time in Thailand.

The painting portrays great historical, aesthetic, emotional, and spiritual values.

Due to many factors related to material ageing, environmental conditions and previous semi-outdoor display, the portrait shows various damage patterns on the support and the painted surface.

Conservation and restoration include scientific examination, tests, experiments, and analyses to investigate the materials and techniques and to cautiously approach interventions.

The treatment should improve the overall condition of the painting with the aim of displaying it again.

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Tam LAOVICHAYA

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Introduction

The Portrait of King Rama VI (Vajiravudh), executed between 1914 and 1947 by the renowned Italian artist Galileo Chini, stands as important evidence for the era of Siamese modernisation. It is one of the few surviving royal portraits by Chini who is best known in Thailand for his frescoes in the Ananta Samakhom Throne Hall. This painting holds exceptional historical, aesthetic, and political significance. It is not only a depiction of the monarch but also a visual document of the strategic cultural exchange between the Kingdom of Siam and Italy during the early 20th century. This thesis presents a comprehensive study of the artwork, detailing its history, material composition, condition, and the conservation interventions undertaken to ensure its preservation.

The research is conducted in response to the painting's deteriorating condition, which had been exacerbated by its display in a semi-outdoor environment at Silpakorn University's Taling Chan Campus. Preliminary inspections revealed a complex array of damage phenomena, including a fragile and flaking paint layer, a yellowed and discoloured varnish and a structurally compromising auxiliary support system involving acidic materials.

This thesis is structured to provide a holistic view of the research and conservation process. The first chapter introduces the historical context, including Galileo Chini's role in the Siamese court and the political symbolism of Western-style portraiture during King Rama VI's reign.

The Technological and Condition Surveys chapters, present scientific investigation methods such as Polarized Light Microscopy (PLM) and Scanning Electron Microscopy with Energy-Dispersive X-ray Spectroscopy (SEM-EDS), to identify the stratigraphy of the paint layers, the nature of the ground, and the causes of deterioration.

The Aim and Conservation Concept chapter outlines the conservation steps and measures, emphasising the selection of reversible, conservation-grade materials compatible with the tropical climate of Thailand.

The report details the practical measures carried out, from the removal of the acidic backing board and the consolidation of flaking paint using sturgeon glue to the aesthetic reintegration of losses, through varnish reduction and retouching.

The final chapter proposes a preventive care and maintenance plan, including guidelines for regular environmental control and housekeeping, to safeguard the painting for its future installation.

Through these interventions, the practical conservation measures in the framework of the thesis aims not only to restore the visual integrity of the Portrait of King Rama VI but also to stabilise its material structure for future generations.

1.The Portrait of King Rama VI

1.1 Description

The Portrait of King Rama VI (Figure 1) is an oil painting on linen support executed by the Italian artist Galileo Chini between 1914 and 1947, depicting a monumental full-length portrait of King Vajiravudh, or King Rama VI, standing in a three-quarter pose, facing the viewer with a direct and authoritative gaze.

He is positioned centrally, dominating the canvas and set against a dramatic, theatrical background. The artist painted a dark curtain in which two naked figures, identifiable as Western mythological messengers or cupids in the Western artistic tradition, are shown presenting the emblem of the three-headed elephant, the royal insignia of Siam, suggesting a harmony between the King's modern Western education and his traditional Siamese heritage.

The rich contrast between the dark, layered curtain background rendered in shades of black, blue, and deep tones, and the attire creates the painting's most defining visual characteristic.

The white field marshal uniform, a striking juxtaposition of Western military precision and Siamese royal tradition, adorned with a golden robe draped across his body, together with sashes, chains and royal ornamental decorations, dramatically accentuates King Rama VI as the absolute focal point of the composition.

The visual prominence, combined with his distinct, contrapposto stance[1] with his weight resting on one leg, lending the figure a sense of naturalism and dynamic energy rather than rigid stance. This stance serves to emphasise the monarch's sovereign authority and kingship, visually asserting his elevated royal status and legitimacy of his reign.

[1] A standing human figure carrying its weight on one leg so that the opposite hip rises to produce a relaxed curve in the body (National Galleries of Scotland n.d.).

The lower area of the painting presents important historical details depict cultural diversity. In the lower left corner, a Western-style royal chair, possibly Louis-style furniture, appears, bearing the Royal Coat of Arms (the national emblem of Siam introduced during the reign of King Rama VI), alongside the *Thong Trairong,* or tricolour flag, the Thai national flag, which was officially introduced as the national flag of Siam by King Rama VI himself in 1917 (Parliamentary Museum of Thailand n.d.).

At the lower right corner of the painting, the signature of the artist is clearly visible and alongside the date of execution, 1914-1947, and location of execution, *Firenze*.[2]

This unusual date range may imply a retrospective completion or a specific commission timeline, marking the enduring connection between the Siamese court and the Italian artist.

Inventory	N/A
Artist	Galileo Chini
Title	The Portrait of King Rama VI
Technique	Oil painting on linen support
Dimension	218 x 138 cm 250 x 156 cm with ornate frame
Dating	1914-1947
Provenance	Her Royal Highness Princess Maha Chakri Sirindhorn
Owner	Silpakorn University

Figure 1: The Portrait of King Rama VI.

[2] Firenze is the Italian name of Florence, a major city in Italy.

1.2 History of the Painting

The painting was executed during Galileo Chini's stay in Thailand, when he was working under royal commission under King Rama VI (Lohapon 1998, 46). Following the completion of his contract, which will be discussed in chapter 1.3. *Galileo Chini*, Chini returned to Italy, where he continued working on the portrait. The painting was probably completed in Florence in 1947, as indicated by the inscription in the lower right corner.

The Portrait of King Rama VI was donated to the Royal Family of Thailand by the artist's heir, Signora Polidori Chini, on the occasion of the exhibition, Galileo Chini in the Kingdom of Siam (1911-1914), at the National Gallery, Bangkok, during March 30 to April 10, 1994, organised by the Department of Fine Arts, Ministry of Culture, Thailand (Italian Embassy in Thailand, and Department of Fine Arts 1994, 4).

Sometime between 1994 to 2000, the painting was royally bestowed to Silpakorn University by Her Royal Highness, Princess Maha Chakri Sirindhorn of the Royal Family of Thailand, as stated in the exhibition booklet (2001) listing the work as part of Silpakorn University's collection.

It was displayed again during a second exhibition, *In the Service of His Majesty: Galileo Chini in Siam*, at the National Gallery, Bangkok, Thailand, during January - February 2001 (Rittipairoj 2001, 57).

Later, the portrait was presented at Silpakorn University's Ta-Ling Chan Campus until its condition raised concerns requiring conservation intervention. The former Director of the Art Centre of Silpakorn University, in accordance with Silpakorn University's policy searched a conservation institution to undertake the treatment (Singhanat Sangsehanat, Interview by Tam Laovichaya, Zoom meeting, January 7, 2026). Proposals from various conservation institutes were sent to the management department, and as a result, the work should be carried out in the framework of a collaborative programme, the Joint Master's Programme Cultural Heritage and Conservation Management (CHCM) at

Silpakorn University International College (SUIC) and the Institute of Conservation, University of Applied Arts Vienna.

1.3 Galileo Chini

Within Thai art-historical discourse, Galileo Chini has received relatively limited recognition, despite his substantial artistic output and the significance of his commissions (Lohapon 1998, 47). In contrast, in early 20th-century Italy, he was regarded as a prominent and emerging figure, particularly within the 'Liberty', or Art Nouveau period/style. Chini is considered by Italians as a significant figure in the field of decorative art of the last century (Rittipairoj 2001, 56).

He was born in 1873 in Florence, on December 2, to Aristea Bastani and Elio Chini, members of a talented artisan family, (Italian Embassy in Thailand and Department of Fine Arts 1994, 10) and was a nephew of Dario Chini, a fresco restorer. After his parents' death, his uncle noticed his talent in art and decorative painting and decided to enrol him in Santa Croce Art School in Florence (Lohapon 1998, 48).

Figure 2: Autoritratto (Self-Portrait), Galileo Chini, 1901.

Chini first worked at the decorator's workshop of Amedeo Buontempo and later with Augusto Burchi, a Florentine painter of the time (Italian Embassy in Thailand and Department of Fine Arts 1994, 10). He started his own career in 1895, and at the same time he attended the *Scuola libera del nudo* (the Nude Art School) at the *Accademia di Belle Arti di Firenze* (Florence Fine Arts Academy), where he practiced portrait paintings. In 1901, his first year at the Venice Biennale, he won awards for his paintings *Autoritratto* (Self-Portrait) (Figure 2) and *The Calm*.

Chini participated at the Venice Biennale for many years, including 1909, the year when he decorated the dome of Venice Biennale's central pavilion with allegories of art and civilisation.

In 1909, King Rama V visited Venice and the Biennale, and the paintings of the dome inspired him to decorate the Royal Throne Hall in Bangkok for his forthcoming 40th anniversary of his reign as a monumental throne hall, named the Ananta Samakhom Throne Hall (Figure 3), (Peleggi 2002, 95) designed by Turin architects Annibale Rigotti and his assistant Mario Tamago (Peleggi 2002, 98) in the Neo-Renaissance style.

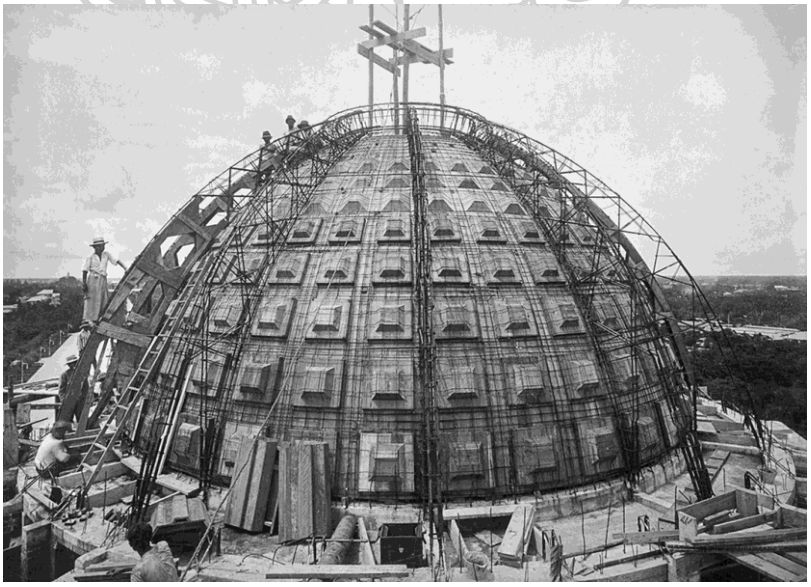

Figure 3: Reinforced-concrete dome of Ananta Samakhom Throne Hall under construction, late 1909.

Chini's invitation to Siam was not an isolated event. It was part of the Italian professional engagement in the Kingdom (Figure 4), which began in 1890 with the arrival of Carlo Allegri, an engineer from Varese, appointed to lead the Technical Section of the Ministry of Public Works (Peleggi 2002, 100). This appointment marked the beginning of sustained Italian cultural and technical migration to Siam, particularly in the fields of architecture, painting, decoration, and specialised engineering.

1.3.1 Galileo Chini in Thailand

Over the subsequent decades, Italian architects, artists such as Cesare Ferro, decorators, and technical specialists contributed extensively to major projects, leaving a lasting Italian imprint on Thailand's built and artistic heritage (Rittipairoj 2001, 55).

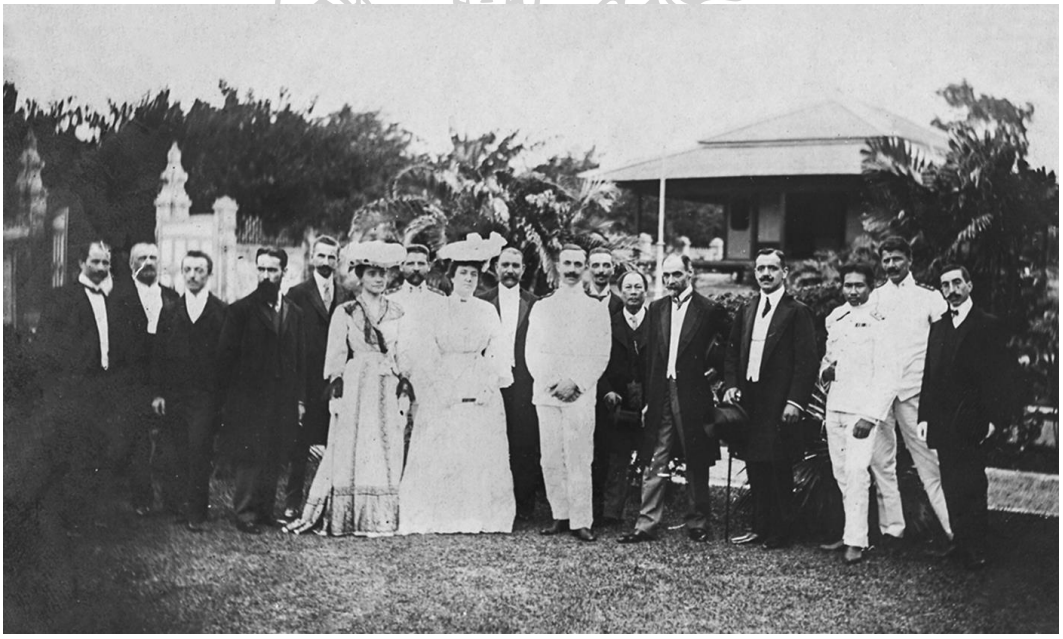

Figure 4: Italian architects and engineers with Ferdinando of Savoy, the Prince of Udine in Bangkok, 1906.

The prefabricated parts of Ananta Samakhon Throne Hall were initiated in late 1909. The interior painting was initially planned to be Cesare Ferro,[3] who had already decorated the interiors of the Amphon Sathan mansion (Peleggi 2002, 99) (Figure 5). Ferro ultimately declined the commission to paint the dome of Ananta Samakhom Throne Hall, having accepted an appointment as associate professor at the Albertina Academy of Fine Arts in Turin (Peleggi 2002, 100).

Galileo Chini was appointed as a replacement for Ferro. Although Chini had already gained recognition for major works and had painted the dome of the central pavilion of the Venice Biennale at the time of King Rama V's visit, his commission was not a direct result of that visit. Rather, it appears to have been facilitated through the intervention and recommendation of Carlo Allegri (Peleggi 2002, 100).

Figure 5: Interior painting by Cesare Ferro at Amphon Sathan mansion.

The contract between Galileo Chini and the Ministry of Public Works, the government body responsible for the construction of the Ananta Samakhom Throne Hall, specified a fixed working period of thirty months under clearly defined conditions. The agreement received

[3] Cesare Ferro Milone was a painter, born in Turin and lived in Bangkok in 1904, prior to Chini's stay. Ferro visited and worked in Bangkok for a second time in 1923-1924. His works focusing on portrait and mural paintings. He had portrayed Queen Savang Vadhana and Me Chani, ballerina della regina, a celebrated dancer of the Siamese court, exhibited at Venice Biennale 2024 (Belmonte 2024).

royal approval from King Rama V and was formally conveyed to Chao Phraya Yomarat[4] on July 28, 1910 (Lohapon 1998, 50).

In March 1911, Chini departed from Genoa on a German streamer bound for Singapore and later reached Bangkok at the end of June (Peleggi 2002, 100). He travelled to Bangkok after King Rama V's death. During his first three months of stay in Bangkok, he obtained entry permits to temples and the Royal Library's Manuscript Collection to study Siamese paintings (Peleggi 2002, 101) (Figure 6 and 7).

Figure 6: Sketch for a fresco depicting King Rama V by Galileo Chini.

Figure 7: Sketch of a Siamese figure and elements by Galileo Chini.

[4] Chao Phraya Yomarat (Pan Sukhum) was a Siamese statesman who served in several senior administrative positions and was closely involved in infrastructure, public works, and state modernisation during the reigns of King Rama V and VI.

Although grounded in Western architectural and decorative traditions, Chini's work incorporates elements of Thai iconography, including ornamental motifs and a highly detailed composition that fills the entire picture, evoking the style of traditional Thai murals (Peleggi 2002, 101). The compositions are enriched with mystical animal figures and stylised floral patterns, reflecting a synthesis of Western artistic training and local visual language.

The decorative plan of Ananta Samakhom Throne Hall comprises five frescoes arranged across two domes and ceiling, forming a sequence of large-scale scenes conceived in a chronological and conceptual progression. Beginning with the reign of King Rama I (Figure 8), followed by the major scene from King Rama V freeing the slaves (Figure 9), the main scene depicts the coronation of King Rama VI (Peleggi 2002,101) (Figure 10), thereby presenting a visual narrative of dynastic continuity and royal legitimacy.

In addition to Chini, his two assistants, Carlo Rigoli and Giovanni Sguanci, also played a significant role in bringing this major undertaking to completion (Moonmanas 2017).

Figure 8: King Rama I's triumphal return from Cambodia.

Figure 9: King Rama V freeing the slaves and rising Ananta Samakhom in the background.

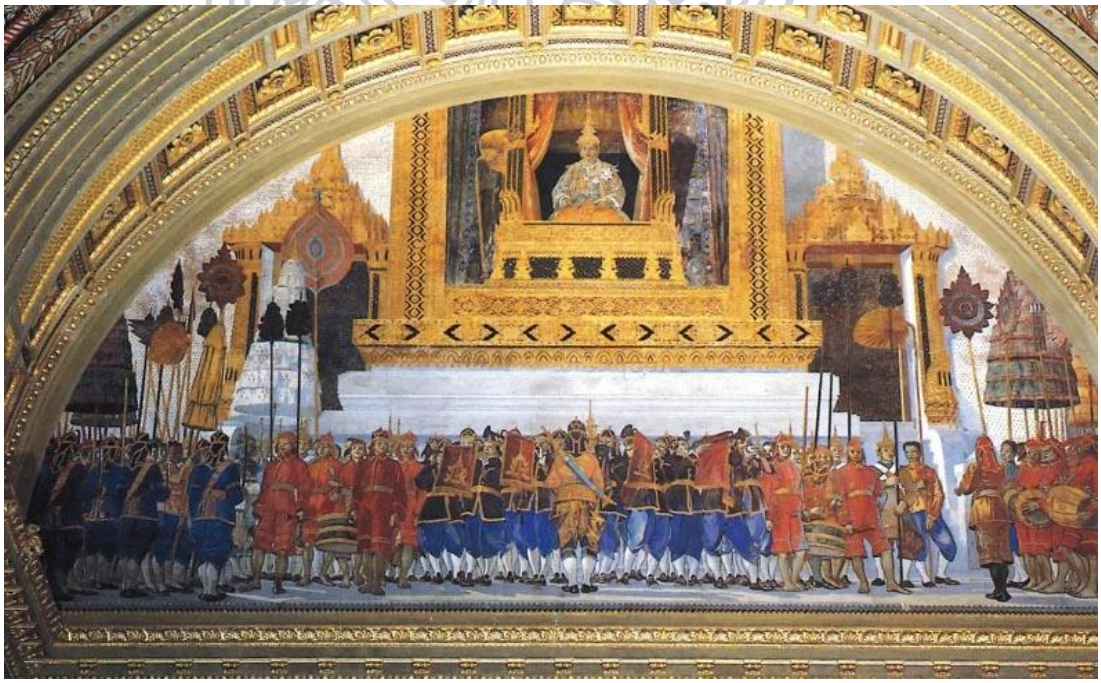

Figure 10: King Rama VI enthroned.

1.3.2 Siam Modernisation and Westernisation

King Rama V did not only praise and admire Italian art and architecture, but also actively adopted Western models of governance, culture, and visual representation as part of a broader strategy of modernisation. Faced with increasing colonial pressure from European powers in the late 19th century, Siam pursued reform to safeguarding political sovereignty and to assert its status as a civilised and independent nation in Southeast Asia (Lohapon 2019, 470). Westernisation was therefore not only a new sense of its own aesthetic, but deeply political, encompassing administrative reform, infrastructure development, education, and the deliberate use of Western art and architecture to project an image of progress.

Within this context, cultural exchange with Western countries played a crucial role, and Italy emerged as a particularly significant partner. Italy had no colonial ambitions in Southeast Asia (Lohapon 2019, 470), allowing collaboration to develop a non-politically influenced diplomatic connection. Italian architects, engineers, and artists were consequently engaged in key public and royal projects, contributing to the visual transformation of Bangkok and the construction of monumental buildings that embodied modernity through European forms. This unique diplomatic environment created the ideal conditions for the arrival of Galileo Chini, whose work served as a distinct visual manifestation of the King's modernising ambitions.

The commissioning of Western-trained artists for Siamese traditional royal image and decoration, including portraits (Singhalampong 2019, 50), thus functioned as an intentional instrument of state representation, reinforcing the monarchy's alignment with international standards of civilisation while maintaining Siam's independence.

Within this context, the royal commissioning of the Portrait of King Rama VI itself reinforces the significance attributed to Western-derived concepts of civilisation and modernity, demonstrating how royal self-representation through portraiture functioned as a deliberate expression of Siam's engagement with Western cultural norms.

Royal portraiture played a crucial role in Siam's modernisation and Westernisation by functioning as a visual strategy through which the monarchy aligned itself with Western notions of civilisation, legitimacy, and statehood. As Eksuda (2019, 51) demonstrates, "portraiture was an imported Western medium that enabled the Siamese royal court to visualise the monarchy's modernity both domestically and internationally, particularly in response to Western critiques of Siamese social customs, gender ambiguity, and political order." The adoption of Western-style portraiture allowed Siamese rulers to present themselves according to European visual conventions associated with authority, rational governance, and modern nationhood, a process in which modernisation and Westernisation were effectively interchangeable, as Eksuda (2019, 51) discussed "how the aspiration for Western standards drove Siam's strategies to achieve modernity."

Royal portraits did more than just record what the King looked like; they were carefully designed to match Western standards (Singhalampong 2019, 55). This includes showing clear gender roles, disciplined body language, and a clear sense of hierarchy.

The conservation of the Portrait of King Rama VI is important. The work holds exceptional historical and aesthetic value, especially as it was created by Galileo Chini, one of the most influential Italian artists in Thai art history.

Beyond its material value as a large-scale painting, the portrait functions as a key visual document of Siam's modernisation and Westernisation during the early 20th century.

The Portrait of King Rama VI follows this pattern, using European methods of representation to create the King's image and to affirm Siam's modern identity, project royal authority, and demonstrate cultural compatibility with Europe during a period of intensified international engagement. Such portraits were therefore not decorative objects but integral instruments of modern statecraft, reinforcing the monarchy's role as the central agent of Siam's modernisation.

2. Technological Survey

The first inspection of the Portrait of King Rama VI occurred on December 7, 2023 (Kittiphong and Schubert, 2024). A comprehensive visual survey of the artwork was carried out during February 2024 at Silpakorn University Ta-Ling Chan campus to assess its physical condition.

The painting was displayed at the entrance of Silpakorn University, Ta-Ling Chan campus, using a French cleat[5] hanging system on a custom-made wooden display stand, designed with an imitation wood pattern with white cloth behind the painting (Figure 11). The stand was fitted to the specific size of the painting, with a space between the panel and the back of the painting, created by a hanging mechanism (Figure 12 and 13).

The painting was deinstalled and transported to SUIC in Bangkok during the same month with the help of an art handling company.

Figure 11: Display of the portrait at Silpakorn University Ta-Ling Chan campus, December 7, 2025

[5] A traditional hanging device for heavy paintings that supports the painting's weight across its entire width. A 45-degree angle is cut along the length of a plywood board, with one half of the cut section secured to the frame using long screws. The other half is aligned to match the corresponding section attached to the display wall (Arnold 1986).

Figure 12: French cleat hanging system.

Figure 13: Drawing of hanging system at Silpakorn University Ta-Ling Chan campus.

2.1 Auxiliary Support

Auxiliary support often used to refer to a stretcher or strainer, an auxiliary support is a frame over which a canvas is stretched (Hartin 2016).

The back of the painting is covered with a medium-density fibreboard (MDF)[6], sealed with water-activated paper tape applied in overlapping layers around the mount and the backside of the painting (Figure 14).

[6] Medium Density Fiberboard (MDF) is a composite wood product made by breaking down softwood into fibers, mixing them with wax and a synthetic resin binder (e.g. urea formaldehyde), and forming panels under high temperature and

Figure 14: MDF sealed with paper tape, the back of painting.

Figure 15: Staples attached to MDF on strainer (detail).

Figure 16: Staples attached to MDF on strainer (top).

The MDF wooden board is added to the strainer[7] using large double-leg metal staples (Figure 15 and 16). Under the MDF board, a long wooden plank is attached horizontally to the strainer with screws, serving as a stabiliser to prevent bending.

pressure. Modern MDF can also be made from materials like recycled paper, bamboo, carbon fibers, and sawmill off cuts (Kubba 2010, 221).

[7] Strainers is the type of auxiliary support used for stretched canvases. They are rigid frames and are not expandable, with fixed joints (Ammon n.d.).

The painting is placed on the rabbet of the ornate frame and stabilised using aluminium L-shaped metal plates (Figure 17). These plates block lateral movement and prevent looseness without being screwed directly into the strainer.

Figure 17: L-shaped metal plates.

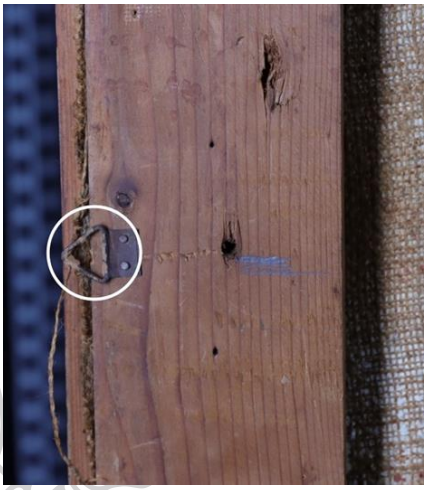

Figure 18: Small triangular metal hanging device.

A small triangular metal device is installed at the top centre of the strainer, presumably as a previous hanging support (Figure 18).

The painting has an inner wooden frame (Figure 19), that works in conjunction with the strainer to support the canvas. Both are specifically designed to align with the painting's size, they functioned as an aid in stretching the support (Figure 20, 21 and 22).

Figure 19: Painting front (left) and back (right), showing strainer and inner frame.

Figure 20: Drawing of inner frame in conjunction with strainer.

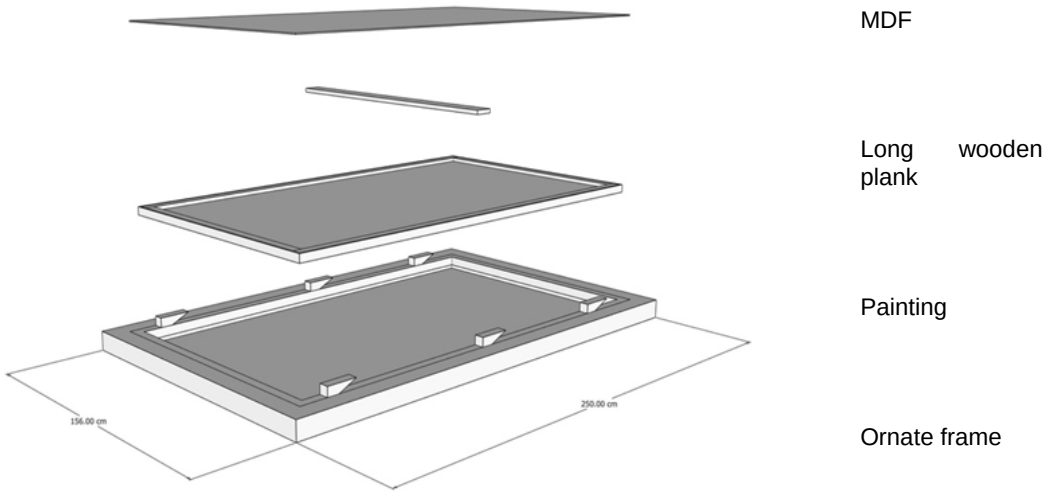

Figure 21: Drawing showing MDF, long wooden plank, painting and ornate frame (top to bottom).

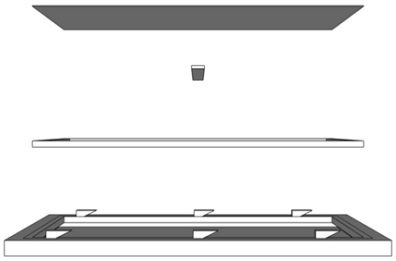

Figure 22: Drawing showing MDF, long wooden plank, painting and ornate frame in flat view (top to bottom).

2.2 Support

The support of the painting is canvas. A sample, consisting of a loose fibre from the back of the painting, was collected[8] using tweezers (Figure 23). Polarized Light Microscopy (PLM)[9] was conducted in June 2024.[10] The sample was prepared on a flat glass slide, dissected with a needle under wet conditions using a drop of deionized water, and divided into individual fibres.

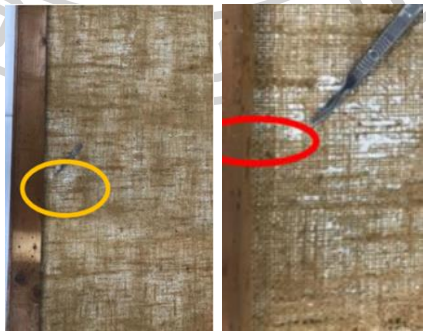

Figure 23: Sampling spot, overview (left) and detail (right) for canvas and ground.

[8] Sample was collected by Paul Schubet, SUIC, February 2024.

[9] PLM is a technique that uses transmitted plane-polarized light (PPL) and cross-polarized light (XPL) conditions to examine very small samples, usually pigments, particles, and fibres (Butler n.d.).

[10] PLM was conducted by Tatjana Bayerova, Institute of Conservation (IoC), University of Applied Arts Vienna.

After investigation and identification based on characteristic morphological features observed in longitudinal view (Figure 24 and 25), It was confirmed that the painting's support is linen.[11] The finding aligns with historical practices of Italian artists who preferred linen canvas for its superior durability, breathability and aesthetic qualities (Rohan 2023). Additionally, other works by Chini in Thailand are also executed on linen canvas (National Gallery Thailand n.d.).

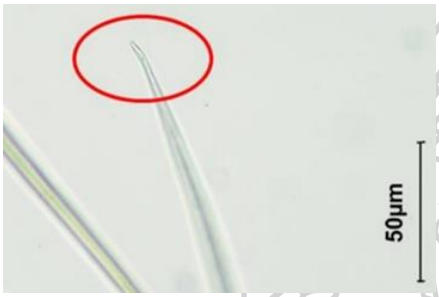

Figure 24: Fibre under transmitted polarised light, red circle marks the natural end of the fibre.

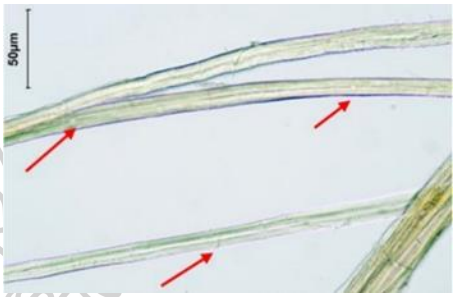

Figure 25: Fibre under transmitted polarised light, cross-marking nodes (see red arrows).

2.3 Ground

From the back of the painting, the white ground layer and ground materials are easily noticeable as they come through the gaps in the linen support (Figure 26). Samples were collected[12] from the back of the paintings and prepared for cross-sections[13] and photographed under ultraviolet (UV) and polarised light. Scanning Electron Microscope and Energy-Dispersive X-ray Spectroscopy (SEM-EDS) were used to analyse the white ground elements.

[11] See Appendix II Scientific investigation, sample no. 2961.

[12] The sample was collected by Paul Schubert, SUIC, February 2024.

[13] The cross-section was prepared by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024.

Figure 26: Ground layer visible through gaps in the linen support on the back of the painting.

The results of the scientific examination show that the white ground layer contains calcium carbonate (limestone). A powder dispersion method provided a more precise analysis, confirming that the ground material consists of finely crushed limestone particles, with a grain size not exceeding 5 micrometres (μm) (Figure 27).[14]

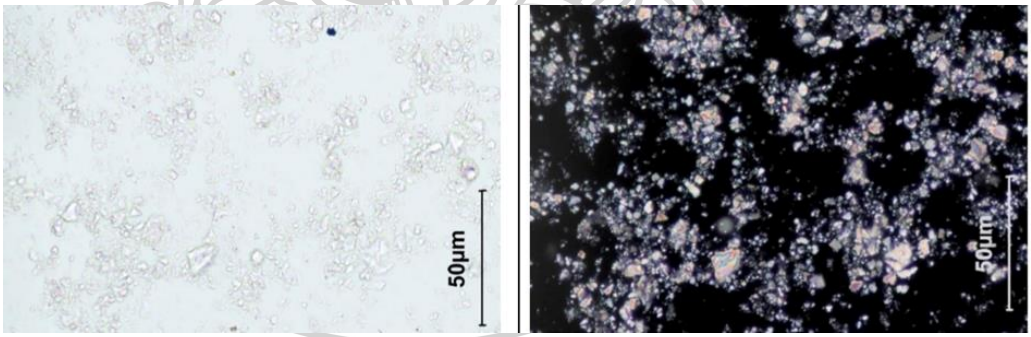

Figure 27: Photomicrograph under parallel polarised light (left) and crossed polarised light (right) of powder dispersion of ground sample, indicating crushed limestone.

The sample for the identification of the binding media was taken from the ground layer of the painting and analysed by spot tests (microchemical reactions).[15]

[14] The results are based on the analysis of sample no. 2958 and 2960 conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

[15] The microchemical spot Test for protein was conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

The results indicate that the binder is water-soluble. The spot tests for oils were negative, while the tests for proteins were positive. Therefore, the binder of the ground layer is a protein-based material, most likely animal glue.[16]

2.4 Paint Layers

The paint layers of the Portrait of King Rama VI were investigated and studied stratigraphically using a sample[17] from the red paint layer at the bottom left corner[18] (Figure 28). The sample was prepared for cross-section[19] analysis. and was easy to collect due to the flaking condition of the paint layer. Additional samples were not collected as sampling is an invasive technique.

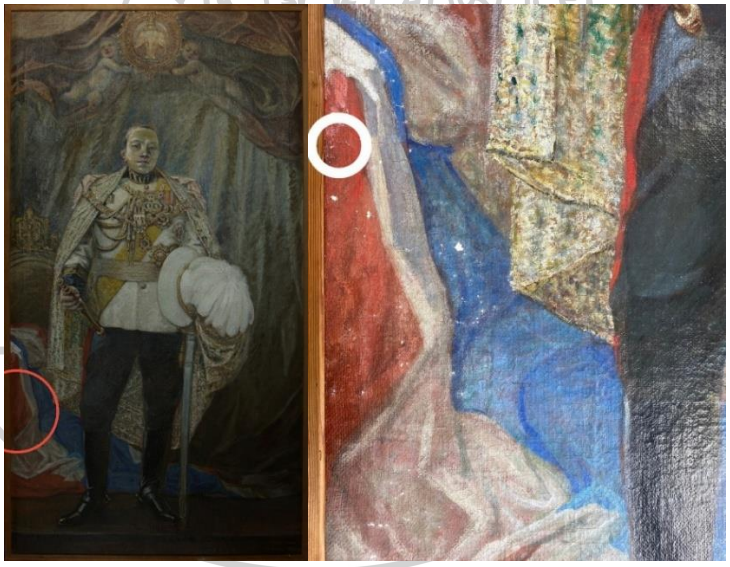

Figure 28 : Sampling spot, overview (left) and detail (right).

[16] The results are based on the analysis of sample no. 2960 conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

[17] Sample was collected at SUIC, February 2024 and analysed by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

[18] The results are based on the analysis of sample no. 2959 conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

[19] The cross-section was prepared by Tatjana Bayerova, IoC, University of Applied Arts, Vienna, June 2024.

Photomicrographs of the cross-section[20] were taken and analysed using optical microscopy at magnifications of 100x and 200x, revealing two distinct paint layers (Figure 29 and 30): a bright red layer (layer no. 2) and a thin dark red layer (layer no. 3) with a clear separation.

Figure 29: Cross-section of the red paint layer at 100x magnification.

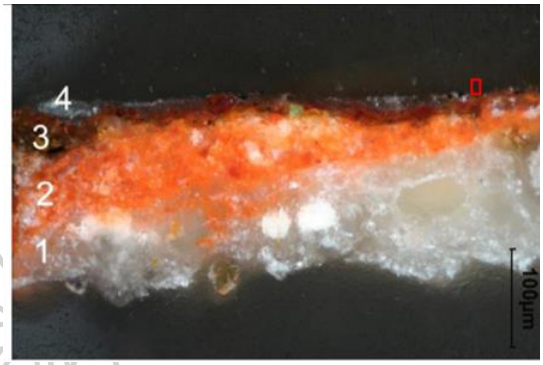

Figure 30: Cross-section of the red paint layer at 200x magnification.

SEM-EDS was used to examine the elemental composition of the pigments, showing slight variations in elemental content between the layers and as detailed in the semi-quantitative elemental analysis table.[21] The identified pigments include red ochre, zinc white, and bone black, with traces of manganese, suggesting the presence of sienna or umbra. Calcium carbonate was also found alongside other elements.

Microchemical spot tests to identify the binding media of the paint layers were conducted[22] on the same sample. The spot test for oils showed a strong positive reaction, indicating an oil-based binder in the paint layers.

[20] Cross-section analysis is a method for stratigraphy analysis by preparing samples in a polyester resin. After curing, the polyester block is cut to reveal the sample. The sample's stratigraphy exposed face is polished using various grades of abrasive paper (Ferreire et al 2025, 4; Sloggett et al. 2010, 78).

[21] See Appendix II Scientific investigation, sample no. 2960.

[22] The microchemical spot tests were conducted by Tatjana Bayerova, IoC, University of Applied Arts, Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

According to the technical examination report, the painting employs a highly skilled oil technique based on a drying oil medium. Different paint techniques were used with a variety of brushes applied to the background (Figure 31).

Figure 31: Variety of layers and brush strokes.

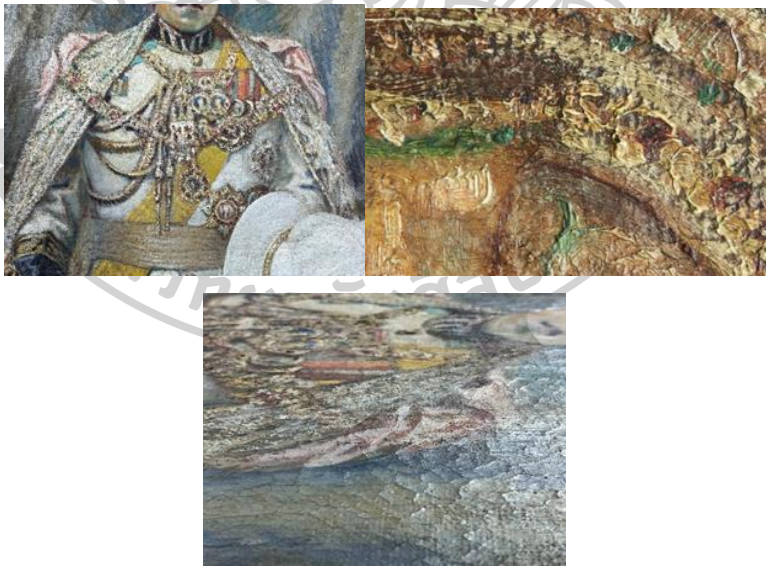

Figure 32: Various impasto areas in the ornamental attire.

The ornamented areas were carefully painted with impasto techniques (Figure 32). Due to the complexity of the attire's decoration, Chini executed various studies of King Rama VI's decorations and orders before creating the portrait (Figure 33).

Figure 33: Galileo Chini's study of King Rama VI showing the complexity of ornaments.

2.5 Varnish

Initial visual inspection under daylight revealed no evidence of varnish due to dirt and dust accumulation. However, a thorough condition survey using ultraviolet (UV) light (Figure 34) identified that the painting was originally varnished. Notably, the black painted areas retain a glossy appearance, while the white areas have developed a yellowish tint (Figure 35).

Figure 34: UV (Reskolux II) is used to examine the varnish.

Figure 35: White pigment area shows sign of yellowing.

A cross-section of the red paint layer examined under UV light reveals a thin, transparent layer (layer no. 4) on top of another layer (layer no. 3) (Figure 36). SEM-EDS elemental analysis detected only carbon and oxygen, indicating that layer no. 4 is organic in composition.[23]

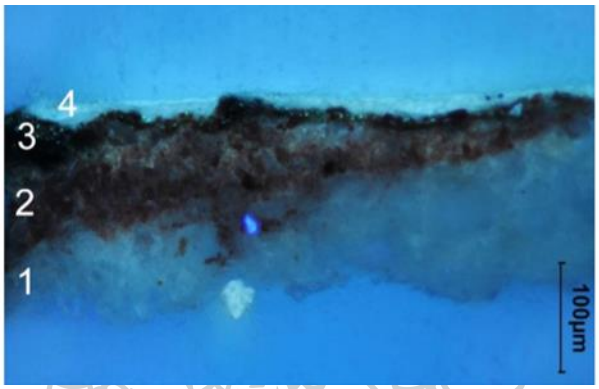

Figure 36: Cross-section of sample no. 2958 under UV shows a transparent layer at the top (layer 4).

The varnish was applied in a single layer and is well bound to the underlying paint layer, with no dirt trapped between them. This suggests that the varnish is original. Due to its bright greenish fluorescence under UV light, the varnish most likely contains a natural resin.[24] The varnish exhibited a greenish-yellow fluorescence under UV, indicating dammar or mastic resin, materials commonly used during the execution period.

2.6 Ornate Frame

The Portrait has an ornate wooden frame with ornaments and metallic, bronze or brass, paint (Figure 37). This frame imitates a Louis-style or French frame (Getty Museum n.d.). Louis Style frames can often be seen on Old Master paintings in Thailand; they show

[23] The results are based on the analysis of sample no. 2958 conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

[24] The results are based on the analysis of sample no. 2958 conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

exquisitely carved and gilded surfaces. The decorative ornaments of the frame are made of plaster or gypsum (Figure 38). This frame was not gilded, instead, it was painted with bronze or brass paint. It has wooden edge strips extending above the paint layer. Six French cleats hanging systems[25] are attached to the ornate frame by two long screws for each (Figure 39).

Figure 37: Ornate frame of the Portrait of King Rama VI.

Figure 38: Plaster ornament.

Figure 39: French cleat-like hanging system.

[25] A traditional hanging device for heavy paintings that supports the painting's weight across its entire width. A 45-degree angle is cut along the length of a plywood board, with one half of the cut section secured to the frame using long screws. The other half is aligned to match the corresponding section attached to the display wall (Arnold 1986).

3. Condition Survey

The condition survey of the Portrait of King Rama VI is conducted in two stages: a first visual inspection on site, followed by a detailed survey at the conservation laboratory.[26] The condition of the painting is primarily assessed through visual examination and photographic documentation under visible and ultraviolet light (UV). Non-invasive methods are prioritised to adhere to the principle of minimum intervention.

3.1 Auxiliary Support

The wooden strainer, with a horizontal wooden plank as an additional protective layer, is found to be in good condition. However, it is covered with an MDF backing board, which was adhered using water-activated paper tape. Both the MDF board and the tape shows signs of deterioration that could potentially cause chemical damage to the painting, such as off-gassing and fibre structural degradation. Underneath the paper tape, a white label with the name "Galileo Chini" was found (Figure 40). This suggests that the wooden strainer is likely original.

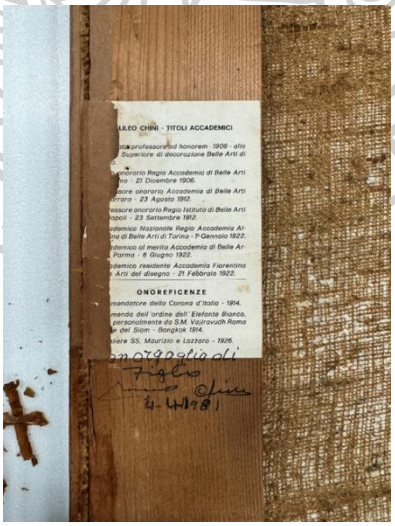

Figure 40: White label on strainer.

[26] Initial visual inspection was conducted by Paul Schubert and Kawinthip Kittiphong on December 7, 2023, Silpakorn University, Ta-Ling Chan campus, where the painting was displayed until conservation. Detailed condition survey was conducted at Silpakorn University International College, February 2024 headed by Gabriela Krist.

Wood Deterioration and Fungi

The MDF backing board showed dark spots on the exposed surface, which, upon dismantling, revealed mould growth on the inner side (Figure 41).[27]

Figure 41: Backing board of the painting (inner side).

The mould likely developed from trapped moisture in the gap between the painting and the backing board, exacerbated by high humidity (>60% RH). Additionally, moisture remaining in the white cloth from the original display stand may have further accelerated the decay of the material. The use of MDF poses additional risks to the painting due to its toxicity, particularly from formaldehyde and the emission of volatile organic compounds (VOCs), which are more pronounced in hot, humid conditions.

Acid Migration and VOC Emission

Acid migration from the MDF, a highly acidic material, occurs through direct contact and the off-gassing from VOCs. This process leads to the indirect contact degradation of the materials, which, in this case, is the water-activated paper tape. The acidic migration, combined with VOC exposure, caused the paper to darken (Figure 42) and weakened its structure, accelerating its deterioration. This reaction highlights the detrimental effects of

[27] Backing board was immediately removed from the lab after dismantling.

MDF on surrounding materials, particularly in terms of chemical interactions that promote faster decay.

Figure 42: Darkened water-activated paper tape.

Embrittlement

Water-activated paper tape, commonly used in mounting and framing, generally has a moderate lifespan. However, in hot and humid environments, and in direct contact with acidic materials, the tape's quality can significantly degrade. These conditions can cause the tape to lose its flexibility, making it susceptible to crackling, crumbling, or breaking (Conservation Centre for Art & Historic Artifacts 2022) (Figure 43).

Figure 43: Paper deterioration due to acidification.

Dirt and Dust Accumulations

Upon arrival at SUIC, dirt and dust were easily noticeable through optical inspection on the back of the painting, particularly on the multi-layered auxiliary support (Figure 44). Additionally, after dismantling the backing board, accumulated dirt and dust were found in the dust pockets between the strainer and the canvas support. Due to their hygroscopic properties, these particles can trap moisture more effectively, which may contribute to mould growth on the inner side of the backing board and even on the painting, if not properly cleaned and removed.

Figure 44: Dirt and dust accumulated on auxiliary support.

3.2 Support

The canvas support of the painting is made from linen fabric, based on characteristic morphological features observed in longitudinal view under transmitted polarised light (See Chapter 2.2. *Support*). Linen is made from flax plants, is naturally pest-resistant, a characteristic that contributes to its suitability for paintings, and therefore highly valued by professional artists. Linen also offers longevity for artworks, making it a preferred choice for the support of long-lasting paintings. However, compared to cotton canvas, linen is more difficult to stretch and less flexible, which makes it more prone to damage under stress or tension (Caves 2018).

The canvas support of the Portrait of King Rama V has deteriorated over time, exacerbated by the fluctuating climate conditions in its semi-outdoor installation area. Signs of support deterioration were observed during its display at Silpakorn University, Ta-Ling Chan Campus, and became even more noticeable during a thorough condition survey conducted at SUIC. The plain weave pattern (Figure 45) remains visible, despite most of the support being covered by the ground layer (Figure 46).

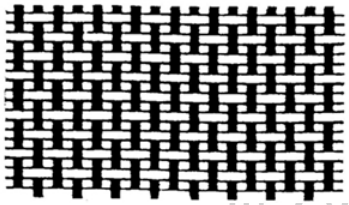

Figure 45: Plain weave pattern.

Figure 46: Weave pattern of the support.

Loose Tension

Due to the ageing of the linen support, loose tension can be observed when the painting is laid in a horizontal position or even during handling. The canvas is stretched over the strainer and held in place by the inner frame (See Chapter 3.1. *Auxiliary Support*), without any visible tacking margin marks. The inner frame appears to be a perfect fit for the canvas, relying solely on its dimensions to maintain tension (Figure 47).

However, fluctuations in relative humidity cause the wooden materials to expand and shrink, which reduced their ability to hold the canvas tightly. Linen canvas also moves with humidity fluctuations, which can further influence its mechanical behavior, potentially exacerbating deformation, stress distribution, and eventual degradation over time (Campo-Frances et al. 2025, 2).

Figure 47: Canvas stretched on strainer and inner frame.

Stretcher Marks Deformations

In a canvas painting, elongations and shrinkages can cause deformation, either recoverable or permanent (Campo-Frances et al. 2025, 1). In uncontrolled environments, depending on temperature and humidity ranges, the materials shrink due to the loss of moisture and swell due to an increase in moisture (Campo-Frances et al. 2025, 2). This type of deformation occurs due to the loose tension of the canvas, with the inner edges of the strainer bars imprinting on the painting's surface.

In this case, both the strainer bars and the wooden plank used as a stabiliser in the centre of the painting have left noticeable stretcher marks (Figure 48 and 49). This phenomenon is commonly seen in paintings on linen support, making them more susceptible to tension-related damage.

Figure 48: Mapping of the stretcher marks on the painting in white.

Figure 49: Close-up photograph of stretcher marks.

Puncture

A total of at least 15 small holes, each approximately 1 to 2 millimeters in size (Figure 50 and 51), were identified on the painting (Kittiphong and Schubert 2024), caused the loss of paint and ground layers falling through the loose canvas (Krist, email to the author, January 12, 2025).

Figure 50: Small holes visible on the paint surface.

Figure 51: Small holes visible over the whole painting.

3.3 Ground

Both visual and scientific examinations indicated that the ground layer is in a well- good state.

Degradation

For an old painting like the Portrait of King Rama VI, according to Hackney (2023, 9), “the chemical degradation of not only the ground, but also the canvas, size, and paint, needs to be considered. The slow reactions of oxidation and hydrolysis take place, during the natural aging of paintings, which may not be suddenly visible. Air pollution and light contribute to this deterioration, involving chemical interactions between the canvas and its environment” which can cause degradation of materials as well as the ground.

Losses

Losses, or lacunae, result in the loss of structure, which can be perceived when viewed in raking light (Van den Burg and Seymour 2024, 6) (Figure 52).

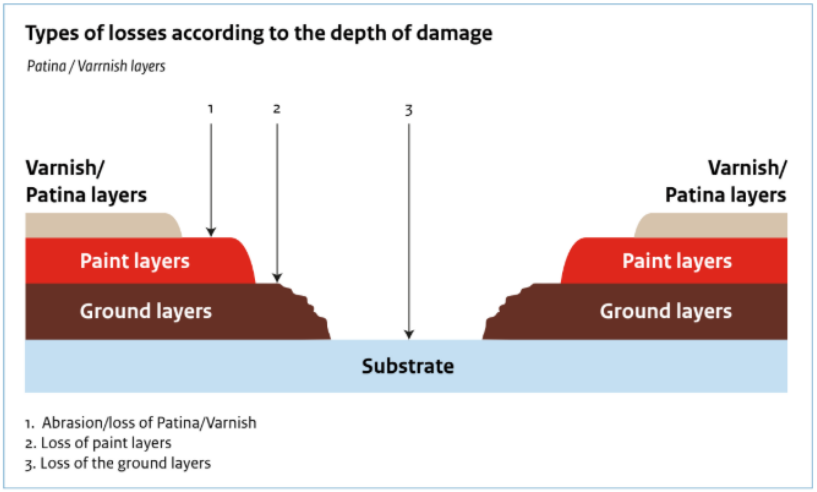

Figure 52: Different types of losses according to the depth of damage. Modified from The Conservation of Wall Paintings by Paul Phillipot.

Ground losses can dominate the viewer's experience, causing the viewer to register and remember the loss rather than the intact surface surrounding it (Van den Burg and Seymour 2024, 6) (Figure 53).

Figure 53: Paint and ground loss.

3.4 Paint Layers

Dirt and Dust Accumulations

A thick layer of dust covers the entire surface of the painting, due to its display in a semi-open condition facing the parking area at Ta-Ling Chan campus and missing maintenance. This location exposed the painting to airborne pollutants, facilitating the accumulation of dirt and dust on its surface. Areas with detailed impasto are particularly prone to dust accumulation, making these sections appear duller compared to others when viewed under visible light.

The hygroscopic nature of dust and dirt on oil paintings not only reduces their appearance but also acts like a sponge, holding humidity (Krist, email to the author, January 12, 2025), and leading to further degradation, if left uncleaned. The deposition of dirt on a surface

will impact an artwork in a number of ways. Aesthetically, dirt deposition results in an increase in light scattering on the surface, with desaturation of hues and a decrease in luminosity of both light and dark colours. As a result, dirt can alter the perception of optical depth and decrease the legibility of the image (Van den Burg and Seymour 2022, 13).

As Van den Burg and Seymour (2022, 13) state, “surface dirt encourages the degradation and deterioration of a work of art. Dirt is hygroscopic in nature and can encourage the growth of mould and other micro-organisms or provides a food source for insects. Components of dirt may also react with materials inherent to the artwork, forming by-products that can be difficult to remove without affecting the integrity of the artwork. Additionally, this layer of pollution can contribute to the degradation of the varnish” (See Chapter 3.5. *Varnish*).

Stain

A white stain is found on the surface, notably in the high-contrast area of the black trousers (Figure 54). The stain was most likely created by bird droppings. The building is frequently left open, providing an opportunity for birds or rodents to infiltrate. Bird droppings are acidic and can cause degradation of the paint layers and could also attract pests, potentially causing further damage. Acidic accretions, especially, are detrimental to works of art, they react with the surface, resulting in etching or corrosion of the paint (Van den Burg and Seymour 2022, 13).

Craquelure

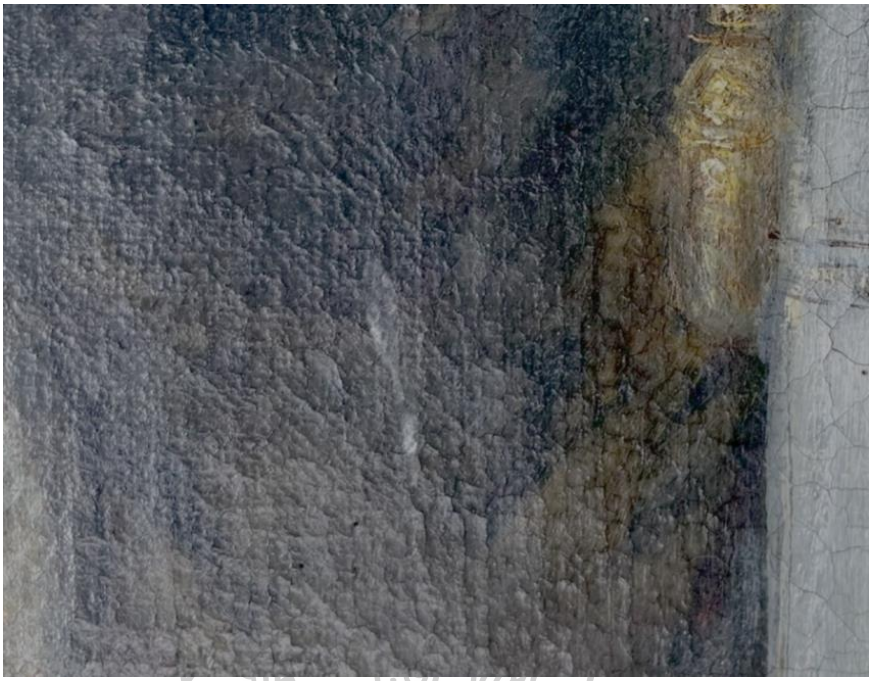

Figure 54: White stain.

Cracks[28] in paintings are formed due to constant swelling and shrinking of paints including grounds, instabilities in the painting's environment, excessive stretching of the canvas support, and/or mechanical impact during handling (Bury and Bratasz 2024, 6). The surface of the Portrait of King Rama VI shows a network of fine cracks in all areas, which is called 'craquelure'. Craquelure is caused by natural ageing of the painting and can be defined as a pre-condition of cupping.

Craquelure, commonly associated with the ageing of a painting, refers to the network of fine cracks that develop over time. However, it is important to note that even relatively young paintings can exhibit craquelure, which may result from drying cracks caused by violating the 'fat over lean' rule (Bucklow 2022, 287). The two types of craquelure, those from aging and those from improper drying of paint materials, can be distinguished by their distinct crack patterns. Ageing crack networks develop over time depending on the

[28] The term "cracks" usually refers to individual cracks in a surface, while "craquelure" is a network or pattern of cracks in paintings that develops across the surface or in sections (Slotsgaard 2020, 77).

display and storage condition (Bucklow 2022, 288) and show various patterns mainly depending on the type of support.

The textural ageing cracks found on this painting (Figure 55) show a similar pattern to that found in traditional 17th century Dutch canvas paintings (Figure 56). This pattern displays straight, jagged forms in the horizontal warp direction. This type of craquelure, while indicating the painting's age, can, if not properly managed, lead to deterioration, such as flaking, cupping, and loss of paint layers.

Figure 55: Ageing crack pattern found across the surface.

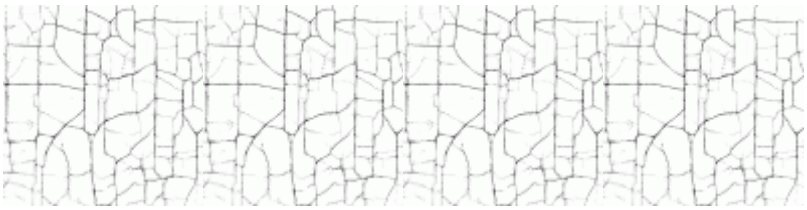

Figure 56: Typical 17th century Dutch canvas painting with a horizontal warp.

Flaking, Cupping and Loss of Adhesion

The painting was created during a period when animal glue was commonly used as a binding media of the paint material. This was further confirmed by scientific analysis,[29] which identified animal glue as the binding media. Such adhesives are particularly vulnerable to fluctuations in climate. Exposure to high temperatures and humidity can degrade the protein-based glue, resulting in a loss of adhesion and causing the paint layers to detach from the surface. Furthermore, when combined with other factors, such as a deformed and loose support (See Chapter 3.2. *Support*), cupping is noticeable, especially along the stretcher marks and across the painting's surface. When glue becomes brittle, it loses its flexibility. Further shrinkage of the support can cause the cupped ground and paint layers to delaminate and detach from the support. This phenomenon is often referred to as flaking (Van den Burg and Seymour. 2023, 29) (Figure 57).

Not only changes in humidity and temperature conditions,[30] but mechanical damages also resulting from handling and accidents (Goltz et al. 2022, 369) can result in flaking.

[29] Scientific analysis of sample no. 2960 was conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

[30] Term used to characterise painting that are created with unstable, poor quality, or improperly mixed on juxtaposed materials (Goltz et al. 2022, 369).

Figure 57: Cuppings on the painting.

Loss of Paint Layers

Several areas of the Portrait have lost paint layers along with the ground. Craquelure and flaking can lead to complete loss of paint layers if the painting is not properly handled e.g. during transportation. Impact damages may result in associated paint and ground losses, as well as damage to the underlying support.

Vibration during travel can also loosen layers (Goltz et al. 2022, 369). Adhesion failures (Figure 58) can lead to distortions or damage at the interface between layers of paint, ground, and support, and result in phenomena such as flaking, blistering, lifting, tenting and delamination of paint (Van den Burg and Seymour 2023, 29), or complete loss of paint layers (Figure 59).

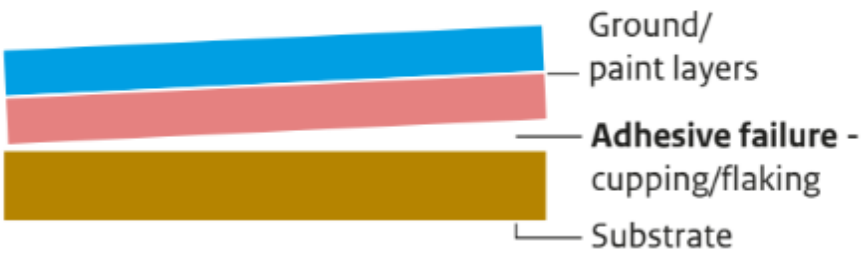

Figure 58: Drawing showing some types of adhesive failure within paint structure.

Figure 59: Loss of paint layers along stretcher mark.

3.5 Varnish

The entire painting exhibits an uneven varnished surface. In areas where the varnish covers the painting, it shows noticeable signs of deterioration. The deterioration of the varnish layer is the result of the painting's long-term exposure to environmental factors, which have contributed to the unevenness and degradation of the natural resin.

As mentioned earlier (See Chapter 3.4. *Paint Layers, Dirt and Dust Accumulations*), surface dirt encourages the degradation and deterioration of a work of art. It is hygroscopic in nature, and when it deposits at the varnish interface, it can from salts, crusts, or mould spores. It can accelerate reaction between artwork's materials and humid atmosphere (Van den Burg and Seymour 2022, 13), causing degradation or alteration of the varnish.

Degradation, Yellowing and Discolouration

Varnish coatings often consist of a mixture of materials (Van den Burg and Seymour 2022, 11). In the case of the Portrait of King Rama VI, the historical varnish seems to be a natural resin,[31] probably dammar or mastic (See Chapter 2.5. *Varnish*). The Cultural Heritage Agency of the Netherlands (2022, 11) stated in Varnish Removal, that "these materials have in common a highly reactive chemical structure that is influenced by the ambient environment. Chemical changes are induced by exposure to light, moisture and heat, and especially to fluctuations in these conditions. Decolouration ensues and the vanish frequently becomes yellow, hazed, brittle and cloudy."

Extended exposure to air pollution, particularly in fluctuating climatic conditions, can significantly accelerate the degradation of the natural resin. Over time, the exposed varnish can undergo photo-oxidative degradation resulting in a yellowing or discolouration of an originally clear and transparent layer (Pieralli et al. 2023, 2). As the varnish deteriorates, it alters the overall appearance of the painting, impacting not only its aesthetic quality but also its protective function. This discolouration not only affects the visual clarity of the artwork but can also obscure details, compromising the artist's intended colour palette and the painting's overall aesthetic (Figure 60).

[31] The results are based on SEM-EDS elemental analysis of paint layer cross-section of sample no. 2958 conducted by Tatjana Bayerova, IoC, University of Applied Arts, Vienna, June 2024: The corresponding sample data sheet is provided in the appendix.

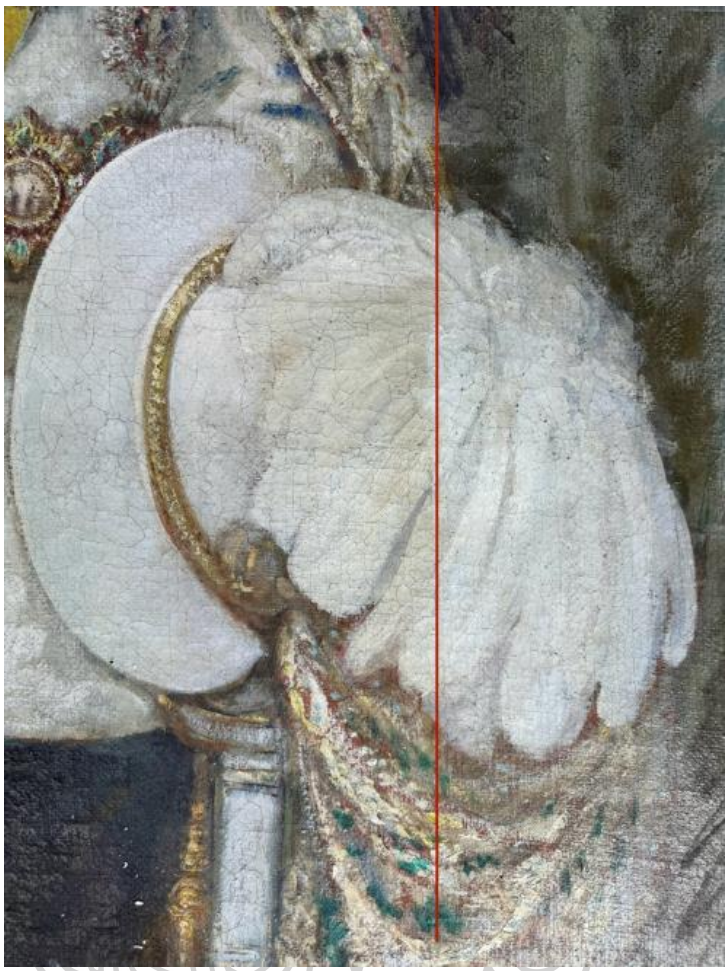

Figure 60: Deteriorated varnish (left) and after varnish reduction (right).

3.6 Ornate Frame

After visual inspection, it was concluded that the frame is a rather new addition to the painting. It is likely a replacement for the original frame, which remains undocumented. It is in good condition, showing little to no signs of deterioration.

Dirt and Dust Accumulations

The frame, like the rest of the painting, had accumulated a layer of dust from its exposure to the semi-outdoor environment of its original display area. Dust layers were found on all ornament of the frame (Figure 61).

Figure 61: Dirt and dust on a dry cotton swab.

Chipping and Dents

The ornamental decorations on the frame exhibit slight mechanical dents and areas where the surface had chipped away (Figure 62).

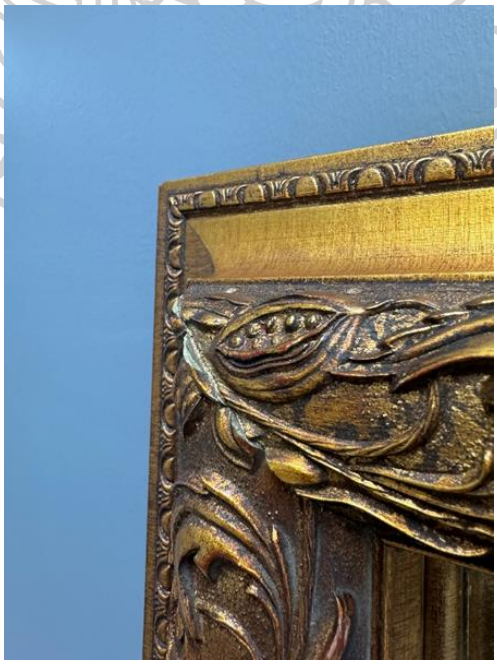

Figure 62: Chipped surface on ornate frame.

Summary - Overall Condition

The condition of the Portrait of King Rama VI demonstrates a series of interconnected damage factors that act as catalysts for further deterioration.

The looseness of the support, in conjunction with the strainer and wooden bar, caused mechanical damage, most notably seen in the visible stretcher marks on the paint layers. This damage has led to further cupping and flaking of the paint, which, combined with the natural craquelure, has accelerated the overall deterioration and contributed in some areas to the loss of paint. The entire painting was covered in accumulated dirt and dust.

Given these conditions, the painting is in need of conservation, with the extent of intervention ranging from minimal conservation to restoration, depending on the specific condition of each area.

4. Aim of Conservation and Restoration

The primary aim of the planned conservation treatment is to stabilise the fragile surface of the painting and the paint layers in order to prevent further deterioration and loss of original material. Special attention will be given to areas where flaking, lifting, or other structural instabilities are present, using appropriate consolidation methods to ensure the long-term preservation of the paint layer.

A secondary objective is to improve the painting's overall visual appearance. This includes the removal of surface dirt and a reduction of the discoloured varnish layer, as well as the filling of losses and retouching that respect the original aesthetic and historical values of the artwork. A new varnish will be applied after the varnish is reduced using stable and reversible materials to reintegrate visual harmony and to provide a protective layer. All aesthetic interventions will be executed using reversible materials to follow the principles and ethical standards of conservation practice.

Additionally, a revised mounting system will be implemented to replace the deteriorated auxiliary support and incompatible materials that contribute to mechanical stress or chemical degradation. The new display system will provide improved structural support while minimising potential risks. This will help to prevent mechanical stress and create a more stable environment for long-term preservation of the painting and future display.

5. Concept of Conservation and Restoration

The conservation and restoration of the painting follow established conservation principles, while also working within a limited timeframe. A clear conservation plan is created with a timeline, and proper handling methods are established to ensure that the painting stays safe during transport.

High-quality, conservation-grade materials are used. At the same time, sustainability is an important consideration. Local materials from Thailand should be used wherever possible, if they meet conservation standards.

All agents used for conservation must be compatible with the original materials of the painting or at least have a similar composition. They should be reversible and not cause any damage to the original, nor leading to chemical reactions or cause mechanical stress. This helps to prevent future damage.

Finally, the painting's original visual appearance must be recovered. Measures include reducing the old, yellowed varnish and applying a new varnish layer that matches the texture of the original, enhancing both protection and optical appearance.

Overall, the conservation plan aims to stabilise, preserve, and enhance the paintings optical appearance while ensuring sustainability and compatibility with the original materials.

The following steps have been envisaged and will be discussed below.

5.1 Relocation and Handling of the Damaged Painting

To mitigate the risk of further damage, every step of the conservation process must be planned. This includes assessing the potential risks involved in transporting the painting from Silpakorn University Ta-Ling Chan campus to SUIC.[32]

A critical aspect of this process is the evaluation of the painting's condition to ensure its safe movement. One effective method to protect it during transport is the application of a backing board. According to drop tests conducted on Van Gogh paintings,[33] a backing board can reduce vibration impact by up to 32% (Bisschoff, Leeuwestein, and Kracht 2023, 9). However, the primary risk considers paintings that have loose canvas supports or flaking paint layers, which are particularly vulnerable during movement.

If there is a high risk of paint loss, applying a temporary facing to the surface may be necessary to protect the painting during transport. This involves facing using very thin Tengucho, Japanese paper[34] (Figure 64) with reversible, weak, viscous, and non-penetrating adhesives (Goltz et al. 2022, 375). While this method is effective, it can be time-consuming, and it must be ensured that the paper facing will not remain for a long time on the surface. Given the relatively short distance between the two campuses, the benefits of such an intervention should be considered, based on risk assessment.

For the packing and transport, breathable wrapping material such as Tyvek® which consists of continuous, fine filaments of high-density polyethylene, should be used as an isolation layer before wrapping the painting with foam-backed bubble wrap[35] (Figure 65 and 66). While water vapor and gases can pass through it, Tyvek® prevents liquid water

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[32] Though the distance between the two campuses is only approximately 15-20 kilometres, depending on the route, the heavy traffic in Bangkok can pose significant challenges. The painting should be transported in a vehicle minimises vibration (National Gallery of Art 1997, 74).

[33] Conducted by the Kröller-Müller Museum, The Netherlands, 2021-2022.

[34] Tengucho is a thin but strong Japanese paper made from long cellulose fibres, commonly used in art conservation. The thinness can vary, typically ranging from 3.8 to 9 gsm (Awagami Factory® n.d.).

[35] A type of bubble wrap with an added foam layer to provide surface protection, helping to avoid bubble marks onto the surface.

from penetrating the surface (DuPont™ n.d.) (Figure 63). This property is essential to protect the painting, which is extremely vulnerable to shocks from high impacts, such as dropping or corner collisions.

Figure 63: Water resistant characteristic of Tyvek®.

Figure 64: Texture and thinness of Tengucho.

Figure 65: Texture of foam-backed bubble wrap.

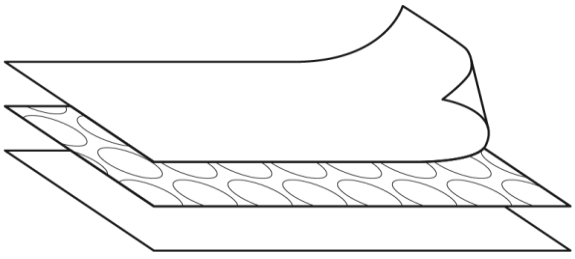

Figure 66: Drawing of foam-backed bubble wrap layers.

Objects with loose paint layers are particularly susceptible to shock damage (National Gallery of Art. 1997), making careful handling and appropriate protective measures

necessary. The type of vehicle is also an important factor. A closed-container truck with the container placed over the wheels and with reduced vibration, is the ideal vehicle for this task, as it helps to reduce temperature and humidity fluctuations during transportation in Bangkok's hot and humid environment.

To ensure the painting's safety, trained conservators or professional art handlers should be hired for the transport, along with a preventive handling plan, to manage the relocation in a way that minimises risks and maintains its condition and stability prior to any practical conservation.

5.2 Dismantling

Structural components supporting the painting, such as the ornate frame and backing board, provide physical support. The dismantling is often necessary to properly assess the condition of the painting, understand its structure and composition, and implement appropriate conservation measures. This step is taken with caution and careful consideration. Sometimes, these structural elements need to be removed and replaced if they are damaged or deteriorated, to prevent further damage to the painting.

Dismantling of the auxiliary supports allows the inspection of areas that are hidden in the painting's assembled state. These may include various important parts, such as the inner side of the backing board, the tacking margins of the canvas, and the back of the painting. This close examination can also help mitigate risks by providing insight into the original techniques, materials, and any previous treatments. Dismantling is crucial, not only for accurate documentation but also for developing proper treatment plans.

The dismantling of the ornate frame and backing board requires the use of various equipment, such as screwdrivers, to carry out the task effectively. Proper handling and adjustment of these tools are crucial to prevent physical damage.

5.3 Pre - Consolidation of Fragile Paint Layers

Prior to further cleaning of the surface of the painting, pre-consolidation of the fragile paint layers is necessary. This means that a diluted solution of a consolidant is applied initially to improve the penetration of a higher-percentage solution applied in a second step (Soppa 2022, 1576). Large areas of loose paint may require a stronger consolidant than weakly bound powdery paint (Goltz et al. 2022, 372). Based on consolidation tests on matte paint mock-ups, 3% sturgeon glue is the most promising medium since does not add much gloss to the surface, and its adhesion is proven sufficient (Caira 2021, 23) for pre-consolidation. Higher concentrations of sturgeon glue can be applied with a thin brush on loose pieces of paint without causing visual changes (See Chapter 5.6. *Consolidation)*.

5.4 Cleaning

Cleaning is a fundamental step in the conservation and restoration process, serving both preventive and aesthetic purposes. Theoretically, the decision to clean the artwork is based on the aim of conservation, which may vary depending on the condition, historical value, and intended function of the object. In practice, any cleaning intervention must be carefully considered to ensure that it aligns with the methods and principles of conservation, along with the proper selection of materials.

Barros Garcia states in *Re-evaluating the roles of the cleaning process in the conservation of paintings* that cleaning is an extremely complex process and may serve different aims, and even the audience or client can be considered as an active element who may influence the decision-making process (Barros García 2015, 21).

Regarding the traditional role of cleaning as a conservation procedure, Bradley Jr. (1950) mentions that “the most important purpose of cleaning is to prevent such damage, not to improve the appearance of the picture.”

In the case of the Portrait of the King Rama VI, the aim of conservation and restoration is to improve the overall visual appearance of the painting for public display, while also ensuring its long-term stabilisation and preservation. The cleaning process addresses both an aesthetic enhancement and a conservation measure, especially with the intention to carefully retain the painting's patina, which reflects the natural passage of time and its historical authenticity.

5.4.1 Auxiliary Support

The removal of mould-infected backing boards is essential for health and safety reasons of the conservator(s). This process should be carried out promptly upon the painting's arrival at SUIC to prevent the spread of contamination. A backing board affected by mould must be removed and isolated from both the artwork and the conservation environment to avoid further damage to the object and the handling person. According to the Canadian Conservation Institute (CCI), handling mould-contaminated objects requires the use of personal protective equipment (PPE) and high-efficiency particulate air (HEPA) filtration to ensure safe and proper procedures.

This procedure also helps to maintain a clean conservation area, optimises workspace, and supports accessibility for next treatment steps.

The wet cleaning of the frame, displayed in semi-outdoor environments where dust tends to accumulate in hard-to-reach areas, such as the top edge of the ornate frame is necessary, to ensure that the accumulated dust is removed. This process requires the use of purified water, with deionised water being the most used.

Two different types of purified water are being considered for wet cleaning. Deionised water and Distilled water. Deionised water differs significantly in composition from distilled water. Distilled water is produced through distillation, a process that removes most mineral content and other impurities, resulting in highly purified water and it is too aggressive in conservation with the mineral ions present and may not be pH neutral (Van den Burg and Seymour 2022, 34). In contrast, deionised water is created by passing water

through an electrically charged resin, which removes mineral ions but may leave behind some organic contaminants (Tang and Jones 1979, 61).

However, for large-scale conservation projects, such as this treatment, which requires significant quantities of water and chemical supplies, deionised water is recommended since it costs less and easier to source locally (Maleen Schalk, personal communication, SUIC, May 16, 2025). Nevertheless, regardless of the type of purified water used, measuring the pH prior to each use is recommended (Meincke 2007) to ensure the consistency and suitability for the painting.

The choice of materials for the cleaning process is also important in both dry and wet cleaning methods. Polyurethane (PU) sponges, particularly latex-free ones, are commonly used for cleaning delicate or sensitive surfaces. With a microporous structure, these sponges are highly effective at capturing dust and dirt during the first dry cleaning. When used wet, they can lift even more dust and dirt particles from the surface.

In addition, PU sponges are also valued for their efficacy and sustainability. They can be washed and reused up to five times, making them a cost-effective option in conservation treatments (Klinkert 2024, 126). PU sponges are the most suitable for the cleaning the auxiliary support of this painting.

A museum vacuum cleaner with suction control and a filtration system specially designed for conservation (Figure 67 and 68) is needed for removing coarse dust and dirt particles from the ornate frame, along with a soft synthetic brush, to prevent the spread of unknown contaminants from the removed degraded backing board. This precaution helps to maintain a safe environment during the cleaning process.

Figure 67: Museum vacuum, Muntz Blowvac 555-MU-E HEPA GS.

Figure 68: HEPA-Micromotor filter and melt blown filter bag set.

5.4.2 Removal of Tape

The accumulation of surface dirt and dust affects not only the painted surface but also the ornate frame and wooden strainer. Removing dust and dirt is important since they attract humidity from the air, which can cause problems. Regular removal of these components is important to prevent excessive accumulation, which can lead to microbial growth on the auxiliary support that traps dirt and dust due to hygroscopicity (Van den Burg and Seymour 2022, 13).

The process of removing water-activated paper tape adhesives from gilded or painted frames must be carried out carefully. This step needs to be performed to get access to the painting and poses a significant risk to the painting and ornate frame. Dry mechanical removal of the tape can cause harmful abrasive damage to the ornate frame, while a wet method is needed to soften the deteriorated tape. However, excessive moisture can cause the lifting of original paint layers, swelling of the wooden substrates, or staining of the surface finish.

Dry mechanical removal of tape is the first step of this painting's treatment. The mechanical removal of the water-activated paper tape from localised areas on the reverse side of the auxiliary supports. This process needs precision and must focus on specific zones where the adhesive has been applied. A scalpel is used for controlled execution, with a no.15 blade likely being the most suitable due to its small size. It is important to remove all deteriorated and contaminated materials to prevent any chemical reaction or biological attack.

Wet cleaning after dry mechanical removal is an effective method to ensure the careful removal of the water-activated tape from ornate frames, it is important to use cleaning sponges with specific moisture retention properties. High-quality, conservation-grade sponges that release minimal and controlled amounts of moisture are essential to prevent damage to the frame. In Thailand, such sponges are not available. Polyurethane (PU) sponges and the suction block "Blitz-Fix"[36] are recommended for this task. However, due to the large size of the object, PU sponges, typically small in size, may not be practical. Blitz-Fix sponges, with their hydrophilic polyvinyl alcohol-based structural network, are better suited, as they can hold significant amounts of aqueous liquid while limiting penetration. This ensures that cleaning occurs only at the surface interface without affecting surrounding areas (Manfredda et al. 2021, 11).

5.4.3 Reverse Side of the Painting

Cleaning the reverse side of the portrait is a critical conservation measure because dust and grime accumulated on the back can attract moisture and pests, eventually degrading the canvas. In the 19th century, the curator of the South Kensington Museum (SKM), Richard Redgrave (1804-1888), had a protocol for dealing with newly acquired paintings (Costaras 2013). Redgrave's acquisition procedure involved cleaning the reverse of the

[36] Blitz-Fix is a synthetic polyvinyl-alcohol (PVA95) sponge with very fine pores (micropores) and strong capillary suction. It is used for wet or damp cleaning and for soaking up excess adhesives (Klinkert 2024, 126).

painting as well as the front (Costaras 2023, 272). Neglecting the verso's condition can cause unintended and unpredictable damage in the future.

The most common contaminants are dust and dirt, microbial growth, and residues of insect activity. Most paintings which are exhibited or stored, gradually accumulate dirt and discoloration on their surface, and dust on the back side of the canvases (Committee of Council on Education 1858, 64). Mould can establish colonies in damp dust on the back of a canvas.

To prevent further damage to the surface of the painting, the painting should be laid face down on a flat table with a smooth support. A commonly used method for dry cleaning of the reverse side of the painting is the use of a vacuum cleaner with a HEPA filter and soft brushes, followed by overall cleaning with latex sponges (Books, Long, and Pocobene. 2023, 398). Prior to the treatment, unstable or loose materials must be secured, and the vacuum cleaner should be equipped with a fine net cover to prevent accidentally removing the original material from the painting.5.4.4 Surface Cleaning

Dust, due to its fine particulate nature, can penetrate between the paint layers, ground, and support. Once it thickens, these particles are difficult to remove and can contribute to long- term deterioration. The major concern is dust's hygroscopic property, its tendency to absorb and retain moisture from the surrounding environment. This retained moisture creates microclimates at the interface between the paint and support, promoting biological activity such as mould growth and accelerating chemical processes like hydrolysis and metal soap formation (Kuta 2023), depending on the materials present.

Dry cleaning of the painting is necessary using a museum-grade vacuum cleaner and soft brushes.

A HEPA filter vacuum cleaner is necessary if mould is expected to be present. The filter must be replaced before use and used only once. The vacuum cleaner should operate at its lowest suction setting to remove only dust particles, thereby avoiding the accidental

removal of any original, loose materials. A net protection is recommended to avoid accidentally sucking up the original loose particles.

Surface cleaning of the painting must be carried out with extreme care and precaution. A PU sponge is recommended for this delicate task due to its suitable properties. Because the painting has many fragile and unstable paint layers that are prone to loss, only areas in a stable condition should be cleaned.

To remove dirt, dust, and stains from the original paint surface, wet cleaning can be employed in a second step to improve the painting's appearance, bringing it closer to the visual effect intended at the time of its creation. However, the complete removal of surface dirt may also affect the patina (Wolbers and Stavroudis 2022, 500). The selection of solvents and aqueous materials must be carried out with care, and preliminary testing is required before any aqueous or solvent cleaning is executed.

Wet cleaning usually begins with the use of deionised water. However, in cases where water alone does not achieve satisfactory results, the addition of a mild detergent may assist in removing dust, dirt, and other impurities from the surface. Detergents must be carefully chosen, as inappropriate formulations may affect original materials.

Two test series are conducted to find the most compatible and suitable material.

The first method, as a cautious way, is compress by gel-like agent. The increased viscosity of water by adding hydrophilic polymers, the so-called gelling agents, is a strategy commonly used to limit the amount of water released (Cremonesi 2013, 179) especially for the treatment of water sensitive materials.

Agar-agar is selected as a medium since its polysaccharide complex, composed of galactose, when dissolved in hot water and cooled down, its molecules will tightly form into a mesh, capable of retaining large amounts of water. When applied to a porous surface, agar gel can gradually release this water (Cremonesi 2013, 180) and content.

The gels are prepared in four different solutions: 5 g agar-agar in 100 ml water, 0.6% Marlipal, 0.7% Tri-Ammonium Citrate (TAC), and less than 1% Marseille soap (Figure 69).

Figure 69: Four different solutions are prepared with 5 g agar-agar for surface cleaning tests.

Gels are placed directly on a mock-up painting from 1-5 minutes and after that rinsed with deionized water (Figure 70). The test results proved to be not very effective, and the preparation of the gels required a lot of time. Therefore, this method is not selected.

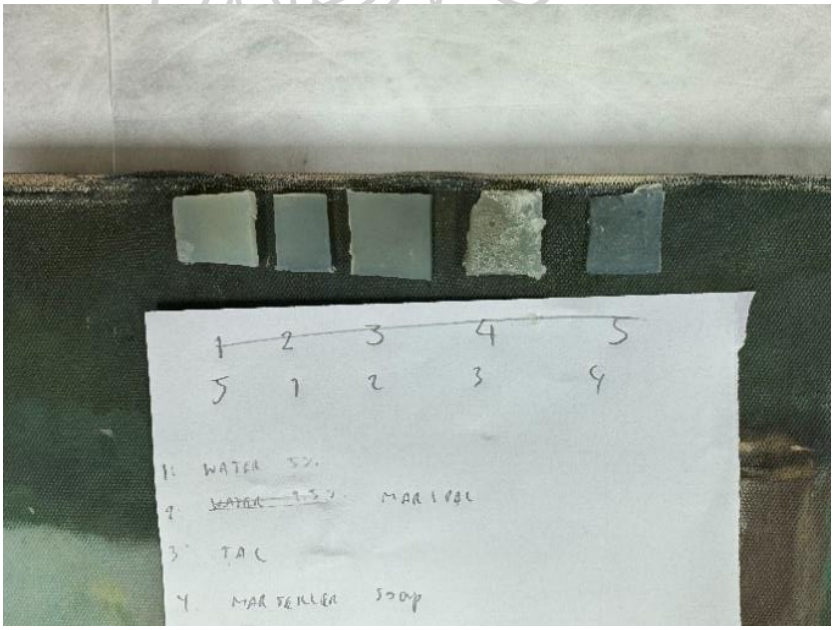

Figure 70: Agar-agar gel tests on the mock-ups.

The second test series with various detergents was conducted[37] using three different solutions: deionised water; 0.6% Marlipal in deionised water; and 0.5% TAC in deionised water. The latter two were followed by a rinse with deionised water. All solutions were applied with cotton swabs (Van den Burg and Seymour 2022) (Figures 71).

Figure 71: Test series of wet cleaning.

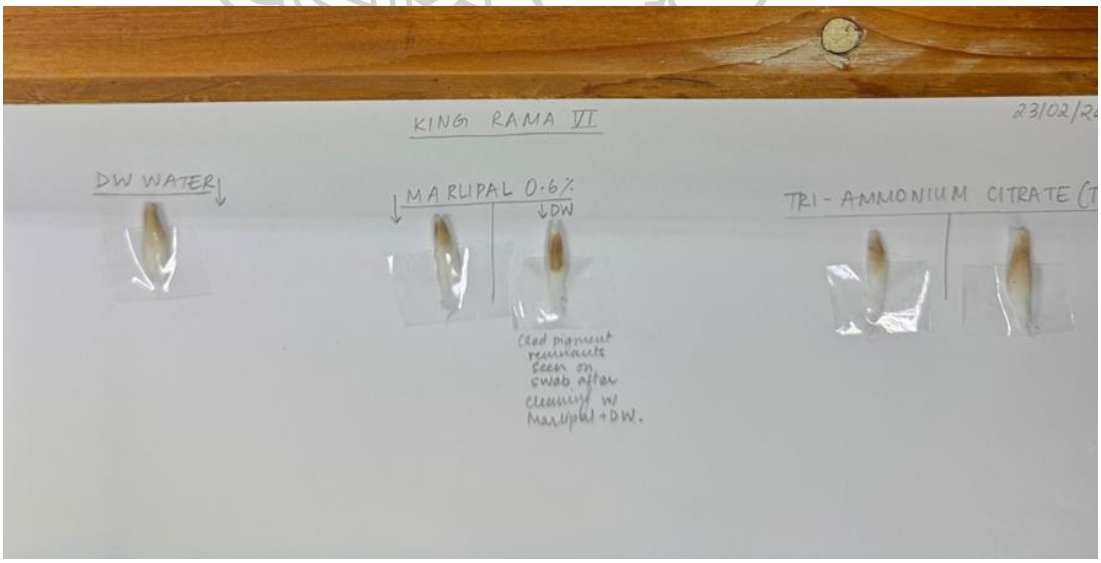

Figure 72: Comparison of the saved swabs.

[37] Conducted by Tanushree Gupta, at SUIC, February 23, 2024.

0.6% Marlipal was the most effective detergent in removing dust and dirt compared to the other two solutions (Figure 72); however, it caused some loss of original pigment and was too aggressive for this painting. 0.5% TAC showed the best results and proved to be the most effective cleaning agent without harming the paint layer (Table 1).

Table 1: Tests of wet cleaning

Test series		
Detergents	**Solubility of pigments**	**Result**
De-ionised water (DW)	Not soluble	Less effective
0.5% Marlipal in DW	Soluble	Aggressive
0.5% TAC in DW	Not soluble	Effective

5.5 Consolidation

Due to the high amount of craquelure, cupping, and flaking of the paint layers, consolidation is an important step in the conservation and restoration of this painting. In conservation practice, reversibility is a fundamental principle that should be considered at every stage and in every material selection. However, the consolidation process presents a particular challenge to this principle, as once flaking paint has been consolidated, it is difficult to reverse the treatment. Therefore, both the method and materials used in this step must be carefully chosen and thoroughly researched, utilising high-quality, conservation-grade substances or scientifically proven materials.

Since the 1970s, conservators have aimed to use materials that are compatible with the original components and allow for future re-treatment, rather than prioritising strict reversibility (Goltz et al. 2022, 370).

Scientific analysis has shown that paintings created before the end of the 19th century employed natural binder-based grounds, containing plant oils or animal glues. The Portrait of King Rama VI is one example; scientific examination has revealed that its ground layer contains protein, most likely animal glue.[38] When selecting the most compatible consolidation adhesive, animal glue may be more appropriate than plant-based, synthetic, or semi-synthetic alternatives.

Animal-based glues are commonly made from the skins of animals such as rabbits or cows, or from the bladders of fish such as sturgeon. Sturgeon glue is made from the swim bladder of the sturgeon, which is pure collagen (Horie 2010, 231). Fish collagens have fewer hydroxyproline amino acid units, resulting in a shrinkage temperature between 6 and 32°C. This leads to a lower preparation temperature. When soaked and heated in water, this glue is totally dissolved. After filtering, the glue is ready to be used (Horie 2010, 231). As a flexible adhesive with great strength in low concentration, low shrinking, and a nearly colourless appearance (Goltz et al. 2022, 372), sturgeon glue exhibits low viscosity but achieves similar cohesion values (max. 60-100N/mm^2) (Soppa 2022, 1572). It also requires a lower activation temperature, which is particularly beneficial when working with fragile paint surfaces where heat could cause damage (Petukhova and Bonadies 1993). Sturgeon glue also has a longer curing time, which makes it easier for handling and application, and is recommended for consolidation.

The preparation and application of sturgeon glue must be carried out with precision. A variety of concentrations, ranging from 3% to 10%, might be required depending on the condition of different areas. During application, the glue should be gently heated in a water bath on a hot plate to a temperature of no more than 30–40°C to preserve its properties and maintain its effectiveness. A fine brush is used to apply the adhesive

[38] Binding medium analysis carried out by Tanja Bayerova, IoC, University of Applied Arts Vienna, found that the binder is water-soluble, the spot test for oils was negative, and both spot tests for proteins were positive; The corresponding sample data sheet is provided in the appendix.

directly into the gaps. Heat is then applied using a low-temperature electric spatula, with a silicone foil interleave to protect the paint surface.

Higher concentrations of sturgeon glue tend to leave more residue, which must be carefully removed using deionised water applied with a cotton swab. To ensure optimal adhesion, a weight of approximately 50 grams should be placed over the treated area until the consolidated area is dry. A mount board should be used as an intermediary layer to assist in flattening the consolidated area to create an even result.

5.6 Varnish Reduction

Painting conservators have discussed the considerations surrounding the effects of time and ageing (Bomford 2022, 481), such as darkened or discoloured varnish. Paul Philippot states that the effect of time is the concept of “patina,” and that patina itself is the normal effect that time has on materials (Bomford 2022, 482).

However, the yellowing of a layer of varnish may be seen as damage in one context but not in another. Ruhemann noted that a religious painting covered in darkened varnish may be more valuable if it is not cleaned (Ruhemann 1982, 46).

The most heated debates arise concerning decision-making, whether certain non-original layers should or should not be removed, for example, varnish layers (if the varnish is original, making decisions can be even more difficult), as stated by García (Barros García 2015, 15). Three possible choices were introduced by Gerry Hedley in his lecture *On humanism, aesthetics and the cleaning of paintings* which are the total, partial, and selective removal. Total removal of varnish is rarely carried out (Hedley 1985), and selective cleaning may be executed if necessary. Most commonly, varnish reduction is carried out, as it leaves a thin layer of yellowed varnish on the painting and causes less change to the original paint.

The complete removal of varnish materials that have degraded (oxidised, discoloured) with age is problematic. Painting conservators are constrained to employ cleaning

methods and materials that are deemed consistent with professional guidelines and standards of practice, and processes and materials should be ‘reversible’. Removing old surface coatings is not ‘reversible’, as they cannot be replaced (Wolbers and Stavroudis 2022, 500).

Paolo Cremonesi, an Italian restorer, chemist, and biochemist, reports in many of his publications on innovative methods to remove aged, oxidized varnishes from easel paintings without leaching out components (Cremonesi 2018) or aggressively removing and dissolve the original varnish. His methods such as controlled delivery of solvent and surgical micro-aspiration systems, could effectively reduce the extent of leaching (Héritier et al. 2021, 8) and overcleaning.

The proposed conservation step focuses on reducing the deteriorated varnish, rather than completely removing it. To minimise risks to the original surface, selected solvents and methods have been tested to identify a cautious approach.

Available solvents were used in a series of tests on a mock-up painting. Two test series are conducted for varnish reduction to find the most compatible method to deliver the solvent mixtures. All test solvent mixtures were applied with cotton swabs on wooden sticks in rotating movements under ultraviolet light (Table 2).

Table 2: Test series for varnish reduction (applied with cotton swabs)[39]

Solvent mixtures and Application	Post-cleaning	Solubility of pigment	Dissolving Effect
Pure Ethyl Alcohol	Total clean	No	Effective
White Spirit ST®	Total clean	No	Effective
White Spirit Patty®	Not dissolved	No	Not effective
Isopropyl Alcohol/Water 1:1	Partial clean	No	Effective
Pure Isopropyl Alcohol	Total clean	No	Effective
Ethyl Alcohol/Isopropyl Alcohol/Water 3:2:5	Partial clean	No	Not effective

The results of the varnish reduction tests using selected solvents applied with cotton swabs showed effective cleaning for most of the solvent mixtures, except for White Spirit Patty® (Figure 73 and 74). A mixture of isopropyl alcohol and deionised water (1:1 ratio), as well as a combination of ethyl alcohol, isopropyl alcohol, and deionised water (3:2:5 ratio), demonstrated promising cleaning results. These outcomes align with the principle of gradual varnish reduction.

[39] The tests series for varnish reduction were conducted by Paul Schubert, SUIC, 2024.

Figure 73: Comparison of the test of selected solvent mixtures applied with cotton swabs.

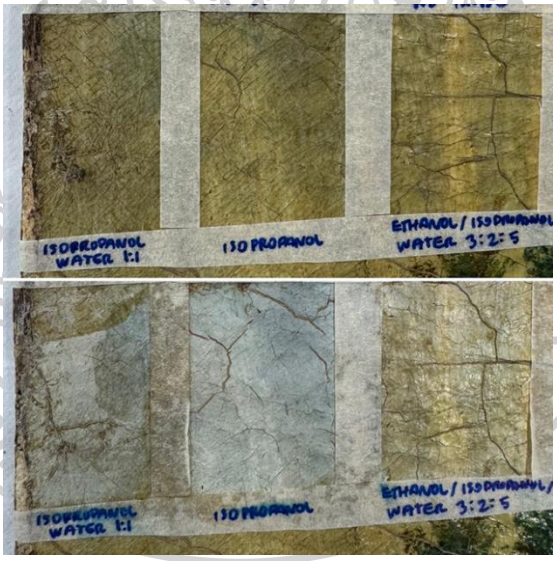

Figure 74: Comparison of the test of selected solvent mixtures applied with cotton swabs.

Table 3: Test series for varnish reduction (applied with sponge compress and rinsed with cotton swab)[40]

Solvent mixtures and Time	1 minute		3 minutes		5 minutes	
	Post-cleaning	Dissolving Effect	Post-cleaning	Dissolving Effect	Post-cleaning	Dissolving Effect
Pure Ethanol	Total clean	Effective	Total clean	Effective	Total clean	Effective
Isopropanol/Water 1:1	Partial clean	Effective	Partial clean	Effective	Total clean	Effective
Pure Isopropanol	Total clean	Effective	Total clean	Effective	Total clean	Effective
Ethyl Alcohol/Isopropyl Alcohol/Water 3:2:5	Partial clean	Effective	Partial clean	Effective	Total clean	Effective

Figure 75: Comparison of selected solvent mixtures applied with Blitz-Fix sponge placed on the painting.

[40] The test series for varnish reduction were conducted by Paul Schubert, SUIC, 2024.

The results of the varnish reduction test using the Blitz-Fix sponge with selected solvents showed varied outcomes, particularly after being placed on the painting for a 3-minute application (Figure 75). Isopropanol mixed with deionised water (1:1) produced impressive results in a short time. However, different coloured areas may require different methods to achieve the most effective results.

Although the 1:1 mixture of isopropanol and deionised water showed promise during the three-minute spot tests, the results lacked consistency across different coloured sections.

To address this, pure isopropanol is selected. This approach was determined to be the most reliable method for achieving an even and effective varnish reduction across every area of the work.

5.7 Filling

To enhance the visual appearance of the painting and to ensure its stable condition and capability for display, the closure of the loss areas is essential.

Filling these areas is not only important for aesthetic reasons but also for maintaining the structural integrity of the surface, especially when both the paint and ground layers are missing. Although this painting has only a few areas of loss, filling remains necessary for an improved overall appearance.

Closing losses by filling serves as the foundation for successful retouching. Therefore, this step must be performed with care, even if it needs to be repeated multiple times (Caroline Ocks, personal communication, IoC, University of Applied Arts Vienna, September 2024).

Adjusting the surface level involves a three-stage process: applying and levelling the fill material, texturing it to match the original surface, and colour integration (Fuster-López 2022, 586). Ocks stated that the good filling helps to enhance the appearance in the retouching step by achieve the correct hue, starting with the selection of a filling material (Caroline Ocks, personal communication, IoC, University of Applied Arts Vienna, September 2024).

In accordance with the core principles in conservation, the filling process, like most treatment measures, must be reversible. Improper selection of materials can result in irreversible damage. The filler must be compatible with the original materials of the artwork and appropriate for the support, in this case, a linen canvas.

Mixtures (putties) used to close losses in paint layers consist of fillers, e.g. chalk, or gypsum, and natural or synthetic binders, e.g. natural oils, synthetic glues, resins, and wax. However, some are not suitable for tropical environments with high humidity and temperatures, as they can degrade quickly and cause further damage. Traditionally, inert materials such as chalk mixed with animal glue were found in the painting's ground layers. Technical examination of this painting confirmed the presence of calcium carbonate and gypsum as fillers in the ground layer.[41]

Before applying the putty, exposed areas of the support must be prepared and consolidated with a compatible adhesive, such as sturgeon glue. A 1:1 mixture of Champagne and Bolognese chalk is used with rabbit skin glue and a drop of linseed oil for the putty. The ratio of the binder to the inert material influences the structural behaviour of filler formulations (Fuster-López 2022, 605).

The filler should be prepared and applied in a stable environment to prevent drying cracks, bubbles, and other mechanical issues. Smoothing should be done using a small cork block wrapped in cotton cloth.

When levelling the closed areas, the paint layer texture should be imitated. In this case, the filler should be levelled and evened. Each step must allow sufficient drying time before proceeding to the next.

[41] The results are based on optical and morphological properties of sample np. 2960, it can be concluded that the ground material is crushed limestone by Tatjana Bayerova, IoC, University of Applied Arts, Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

5.8 Retouching

Retouching the filled areas is a common practice. Retouching methods can range from invasive to minimalist approaches. The goal is to achieve a visually blended image at a viewing distance, using techniques such as fine lines or dots (Nadolny 2022, 574-576), like the Viennese retouching method, without striving for perfect imitation, which is often rejected in modern conservation ethics (Nadolny 2022, 580). In some cases, a single neutral colour is used to subtly unify the damaged areas with the surrounding original paint. Lighter tones are often preferred, as they allow the new paint to age over time and eventually blend with the original hue.

In contemporary art, where the artist is still alive and able to provide guidance retouching decisions tend to be more flexible. However, for traditional oil painting, such as the Portrait of King Rama VI, where most of the method was documented and studied in art school, art history, and art conservation, careful research and collaboration with fellow conservators, curators, owners, and the artist's studio (Digney-Peer et al. 2022, 608), in this case, studying the work of Galileo Chini and his foundation, are essential to preserve the artist's original intention. As responsible retouching is not a creative process (Digney-Peer et al. 2022, 608). In this conservation, retouching is to improve an overall appearance.

Selection of retouching paints in interventions, should allow removable from the remaining original paint layer without harming it, and the materials should be inert towards the remaining original, but still stable and compatible with the appearance of the original paint (Digney-Peer et al. 2022, 613). An aqueous based colour system is selected for tests on mock-ups.

Watercolour as a first layer and followed by gouache as a second layer is conducted (Figure 76). Test results show that watercolour works very well as a base colour before adding gouache to help enhance colour shades and provide opacity to match original oil paint.

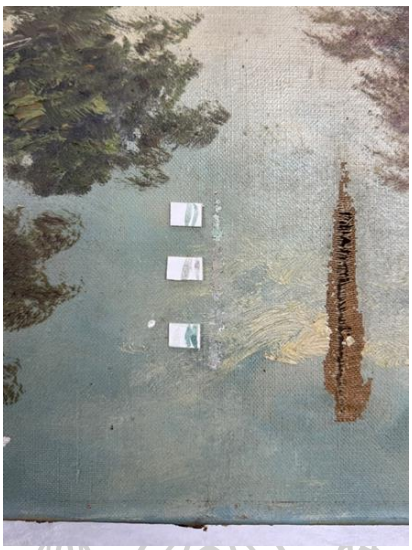

Figure 76: Colour matching on a mock-up oil painting with watercolour and gouache.

The natural craquelure resulting from ageing should be left untouched.

5.9 Varnish Application

Varnish is an outermost layer that has a protective role, and its function is mainly aesthetic. Applying varnish improves the optical characteristics of the painting surface, making it glossier and smoother, and increasing saturation of the colours. Most traditional Western paintings have a transparent varnish coating as a surface finish. An ideal varnish should remain colourless, transparent, removable over time, and should have the correct mechanical properties of strength and flexibility to follow any movement of the underlying substrate without cracking (Pieralli et al 2023, 1).

Varnish is the layer most exposed to degradation by external agents. Materials originally used as painting varnishes (typically natural resins) can alter at the molecular level mainly due to photo-oxidation, resulting in loss of transparency, yellowing, and changes of solubility (Pieralli et al 2023, 2). The selection of the type of varnish is necessary for the optical appearance of the Portrait of King Rama VI and to prevent degradation. Cross-section analysis using SEM-EDS[42] identified a natural resin as the original varnish. However, natural resins are not available in Bangkok. Therefore, a range of ready-made

[42] The cross-section was prepared by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024.

commercial products, both imported and local, are tested[43] to achieve a suitable finish (Table 4).

The test is conducted on mock-ups, two varnish products are selected and applied by brush.

Table 4: Test series for varnish application (applied by brush)

Test Series	
Products	**Glossy Property**
Schmincke™ Dammar varnish	Compatible
Winsor & Newton™ Artist' Satin varnish	Closer to the original varnish (Paul Schubert, personal communication, November 2025)

The tests show that Winsor & Newton™ Artist' Satin varnish has the better result (Paul Schubert, personal communication, November 2025). It is selected as the varnish for the Portrait of King Rama VI.[44]

5.10 New Backing and Assembling

The Portrait of King Rama VI painting's auxiliary support and ornate frame remain in good condition, meaning structural repair is not required. The treatment will focus solely on renewing the backing board. This is essential to protect the painting's support from mechanical and atmospheric damage, as detailed in Chapter 2.1.

A completely closed backing board of hygroscopic material but breathable is essential to this portrait, which is a fabric-supported oil painting. The new backing should act to buffer the painting from moisture and also serve as a protection layer during transit (Mecklenburg 1982, 127).

[43] The test series of the selected varnishes were conducted by Paul Schubert, SUIC, 2024.

[44] The test results of the varnish application and selection were carried out by Paul Schubert, SUIC 2024.

Buffered, acid-free, pH between 7.5-9.0 custom-cut, 4 ply thickness Antique White Crescent™ Museum Mat boards are selected as locally available. This RagMat Museum Solids board is a 100% cotton and lignin-free with safe surface sizing for artwork (Crescent Brands 2023). A 4 ply thickness is enough as a backing board and is only available in Thailand, compared to 6 and 8 ply. This new backing board is an alternative conservation-grade material compared to the previously removed one (Figure 77).

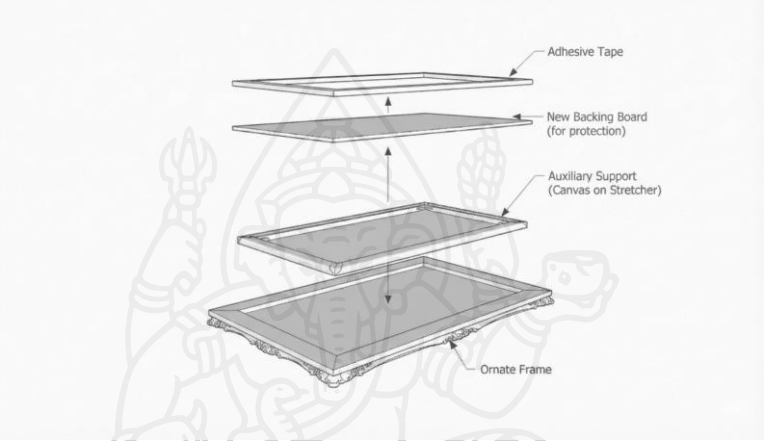

Figure 77: Drawing of adding a new backing board to the ornate frame.

An assembling step will follow the original finish with brown paper tape (See Chapter 2.1. *Auxiliary Support*). Brown kraft paper wet adhesive tape (Figure 78) which is usually selected for picture frames to bond the passepartout to the back side of the ornated frame. This type of adhesive strip is made with gummed paper, and is manually moistened with a sponge or brush (Modulor n.d). Ideally, an acid-free tape is necessary for this method.

Figure 78: Kraft paper wet adhesive tape.

6. Measures Carried Out

6.1 Relocation and Handling of the Damaged Painting

The Portrait of King Rama VI was transported from Silpakorn University's Ta-Ling Chan campus to SUIC by the local art handling company Art Tank. The company's vehicle followed the recommendations described in Chapter 5.1.[45] (Figure 79 and 80).

Figure 79: Vehicle with hydraulic lift and container over wheels.

Figure 80: Air-condition was installed inside the closed container truck.

The painting was soft packed with Tyvek® placed beneath foam-lined bubble wrap, enclosed in a custom-made corrugated board, which acted as an outer shell for additional protection. All procedures were carried out by professional art handlers under the supervision of conservators.[46]

[45] A closed truck with the container placed over the wheels with reduced vibration can help to reduce shock and vibration damage.

[46] The relocation and handling procedures were done by conservators, Paul Schubert and Kawinthip Kittipong, SUIC, 2024.

6.2 Dismantling

Water-activated paper tapes were mechanically cut using a scalpel and the tools were removed using screwdriver (Figure 81).

Figure 81: Tool covered with paper tape, holding frame and auxiliary support together.

The contaminated backing board was mechanically removed using a pry bar. It was loosely attached to the strainer (Figure 82) with double-legged staples (Figure 83). and water-activated adhesive paper tape, as previously described in Chapter 3.1.[47]

The wooden plank positioned in the middle was dismantled using a screwdriver, applying minimal pressure to avoid vibrations that could harm the painting. L-shaped metal plates were removed using an electric screwdriver. In the areas that were difficult to access due to the limited reach of the electric tool, a hand screwdriver was used. These L-shaped plates were added to secure the strainer's position within the rabbet of the ornate frame (Figure 84).

[47] The MDF wooden board is attached to the strainer using large double-legged metal staples. Under the MDF wooden board, a long wooden plank is attached horizontally to the strainer with screws, likely serving as a stabiliser to prevent bending.

Figure 82: Backing board was loosely mounted to the strainer.

Figure 83: Doubled-legged metal staplers were tacked to the strainer.

Figure 84: An L-shaped metal plate was removed from the original position.

The strainer, once freely movable, was carefully removed from the ornate frame by at least six trained individuals with proper art handling experience. The frame was then relocated to SUIC storage.

All mechanical dismantling procedures were performed by a conservator[48] and carried out in accordance with health and safety guidelines. During the dismantling process, cleaning of the auxiliary support elements was conducted simultaneously, as described in Chapter 6.3.[49]

6.3 Pre - Consolidation of Fragile Paint Layers

A 3% solution of sturgeon glue was used to pre-consolidate the most fragile areas of the painting, particularly where the paint exhibited significant cupping or was at risk of cracking prior to surface cleaning. The adhesive was applied using fine brushes (size 0) to ensure precise application (Figure 85). A heat spatula was then employed to carefully

[48] The dismantling was carried out by the conservator, Paul Schubert, SUIC, 2024.

[49] The cleaning was carried out together with dismantling.

lay down the tented paint flakes. To prevent direct contact between the spatula and the paint surface. A sheet of silicone foil was inserted between the two(Figure 86).

Figure 85: Sturgeon glue was applied with a fine brush.

Figure 86: Demonstration of pre-consolidation procedures.

Sturgeon glue residue remaining on the surface was gently removed using a cotton swab dampened with deionised water. To flatten the pre-consolidated paint layers, light pressure (less than 1 kg) was placed over the treated area, with a protective layer of silicone foil and mat board interleaved (Figure 87).

Figure 87: Flattening of the consolidated paint.

The weight was left in position for a maximum of 24 hours, allowing drying and gradual flattening. The pre-consolidation process contributed to a more stable surface, allowing subsequent cleaning to be carried out more efficiently and safely.

6.4 Cleaning

6.4.1 Auxiliary Support

The initial step involved dry cleaning using a museum-grade vacuum cleaner (Muntz Blowvac 555-MU-E-HEPA GS) equipped with a HEPA filter, in conjunction with a soft synthetic brush. This process was carried out first to minimise the risk of spreading potential microbial infestations that may have been present in accumulated dust. PPE was worn by the operators during the whole time of this process.

The auxiliary support was wet cleaned[50] using a polyurethane (PU) sponge dampened with deionised water, applied in a light dabbing motion. This method helped to prevent sponge residues penetrating in the wooden surface, limiting sponge use also reduced the frequency of residue removal and helped to avoid over-wetting.

The wet cleaning process proved effective in fully removing remaining dust, dirt, and residues of water-activated paper tape that could not be eliminated by dry cleaning alone.

6.4.2 Removal of Tape

This was followed by the mechanical removal of the paper tape. A wide spatula and scalpels with various blade sizes and handle types were used to carefully lift and remove the brittle tape without damaging the underlying surface.

Dry cleaning was essential not only for the removal of larger, brittle adhesive residues but also for eliminating dust and dirt.

[50] The wet cleaning was carried out by CHCM student, SUIC, 2024.

Residues of deteriorated paper tape that could not be removed through dry cleaning (Figure 88) were further treated. A felt-pad with a weight and a Blitz-Fix sponge, pre-soaked in deionised water, was gently compressed onto the affected areas for approximately one minute (Figure 89). This brief application allowed the adhesive to swell, making it easier to be removed mechanically with a spatula (Figure 90). The compression time was deliberately limited to minimise the risk of water affecting the wooden elements of the auxiliary support.

Figure 88: Residues of paper tape after mechanical removal.

Figure 89: Pre-soaked felt pad with weight moistening the paper.

Figure 90: Swollen paper was easier to remove with a spatula.

The process of cleaning the ornate frame began with dry cleaning using a soft brush and vacuum cleaner (Figure 91) followed by wet cleaning using a PU sponge, pre-wetted with 0.6% Marlipal in deionised water (Figure 92). The method proved effective in removing dust and dirt from the ornate frame (Figure 93 and 94).

Figure 91: Dry cleaning of the ornate frame using a soft brush.

Figure 92: Wet cleaning using a PU sponge with 0.6% Marlipal.

Figure 93: PU sponge cleaning residues from the ornate frame.

Figure 94: Before (left) and after (right) cleaning.

6.4.3 Reverse Side of the Painting

Dry cleaning commenced on the reverse side of the painting support using the same museum-grade vacuum cleaner employed for the auxiliary support, alongside a soft brush. A single HEPA filter was necessary, as the amount of particulate matter on the reverse was comparatively lower. Nevertheless, its use was deemed essential due to the potential presence of mould. A protective mesh was placed over the nozzle of the vacuum cleaner to prevent the unintentional removal of any loose material from the artwork.

Figure 95: Scythe-shape paper tool to removing dust from the pocket.

A soft natural-bristle brush was used to dislodge dust towards the vacuum nozzle. A custom-made, scythe-shaped cardstock paper tool was employed to gently extract embedded dust and loose particles from the pockets (Figure 95).

The back of the painting was further cleaned with a polyurethane (PU) sponge, applied in a single sweeping motion with minimal pressure, to avoid any risk of mechanical stress. Wet cleaning was intentionally avoided.

Following dry cleaning, the painting was carefully turned face-up for further treatment. Ethafoam[51] supports covered in Tyvek® were positioned beneath the painting to stabilise the slackened support and prevent additional strain or distortion during remedial interventions on the painted surface.

6.4.4 Surface Cleaning

Dry cleaning of the painting's surface was carried out using a PU sponge applied in a gentle swiping motion, with minimal pressure (Figure 96), in areas that did not exhibit

[51] Ethafoam is a recyclable polyethylene foam, medium-density with shock-absorption and vibration-dampening characteristics.

tenting or cupping. This careful approach aimed to avoid dislodging any fragile or cracked paint layers, even though those areas had already been pre-consolidated.

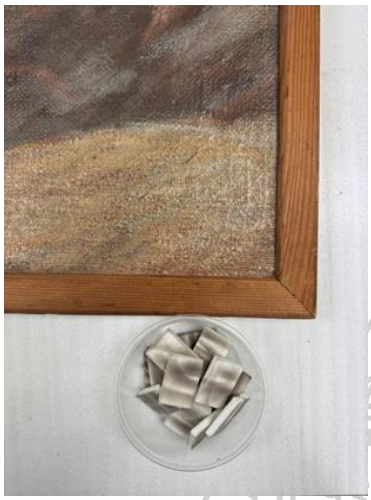

Figure 96: Dirty PU sponges after dry cleaning.

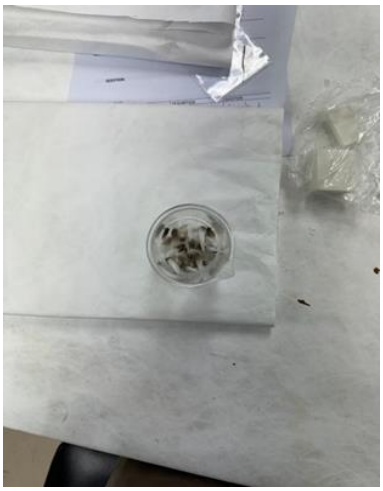

Figure 97: Cotton swabs after wet cleaning.

Figure 98: Impasto areas after cleaning.

Following dry cleaning, wet cleaning procedures were partially applied for the removal of ingrained surface dust. These selected areas were cleaned using a 0.5% solution of Tri ammonium citrate (TAC) in deionised water, applied by PU sponges and cotton swabs. After treatment, any remaining TAC residue was removed using a cotton swab dampened with deionised water (Figure 97). Special attention was given to impasto areas, which had

accumulated a thick layer of dust and dirt (Figure 98). These areas were cleaned using a more cautious and slower approach compared to the rest of the surface.

The visual effect of the wet cleaning was subtle, only greasy or stained areas showed noticeable improvement.

6.5 Consolidation

The consolidation was carried out using a 4% sturgeon glue solution in areas with minimal tenting and a 7% solution in fragile or highly tented areas. The adhesive was prepared and soaked overnight then gently heated on a hot plate to a maximum of 30-40°C the next day to preserve its properties and ensure effectiveness. Sturgeon glue is expensive and has a short life after once prepared, so the plan and schedule had to be carefully coordinated to avoid material waste (Figure 99).

Figure 99: Sturgeon glue before soaking it overnight.

Sturgeon glue was applied directly using a fine brush (Figure 100). Heat was then applied with a low-temperature electric spatula, using a silicone foil barrier to prevent direct contact with the paint surface (Figure 101). Any remaining adhesive was carefully removed with deionised water using a cotton swab.

Figure 100: Sturgeon glue was applied with a fine brush.

Figure 101: To activate the glue a heated spatula was applied.

To optimise adhesion, a weight of approximately 50 grams was placed over the treated area, allowing gravity to assist in securing the flaking paint (Figure 102). A photo board was used as an intermediary layer to evenly distribute pressure. Special care was taken in impasto areas, where a felt pad was inserted beneath the photo board to accommodate the uneven, more sensitive surface (Figure 103).

Figure 102: Weight over the consolidated flaking paint.

Figure 103: Felt pad and photo board were added in the impasto area.

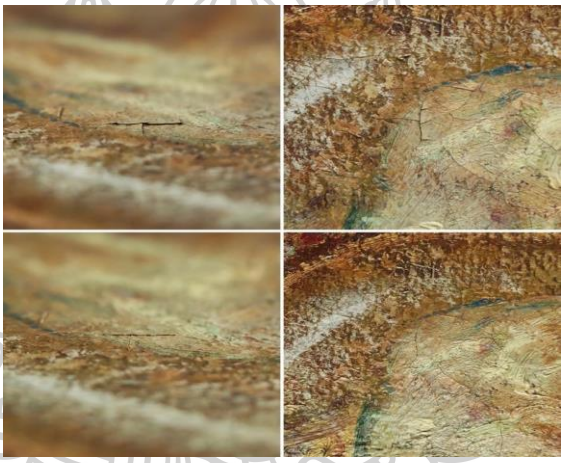

Figure 104: Flaking paint layer before (top) and after consolidation (bottom).

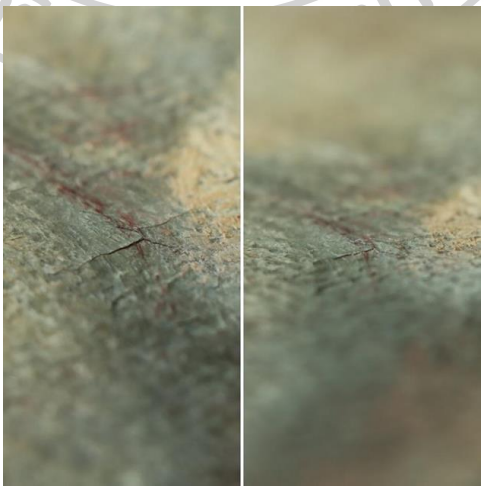

Figure 105: Flaking paint layer before (left) and after consolidation (right).

This process followed a similar approach as the pre-consolidation but employed higher glue concentrations to ensure the long-term stability of the flaking paint layers (Figure 104 and 105).

6.6 Varnish Reduction

Pure isopropyl alcohol proved to be the most effective solvent for varnish reduction. A Blitz-Fix sponge was used as a compress over larger varnished areas, while a PU sponge was chosen for more precise and controlled application in smaller or delicate areas (Figure 106). The duration of compression was adjusted according to the specific characteristics of each area (Figure 107). Varnish was reduced to a thin layer in brighter sections, such as the white-painted areas, where the yellowing of the varnish was most visible, as described in Chapter 5.7. *Varnish Reduction*.

Figure 106: Varnish residue on the PU sponge.

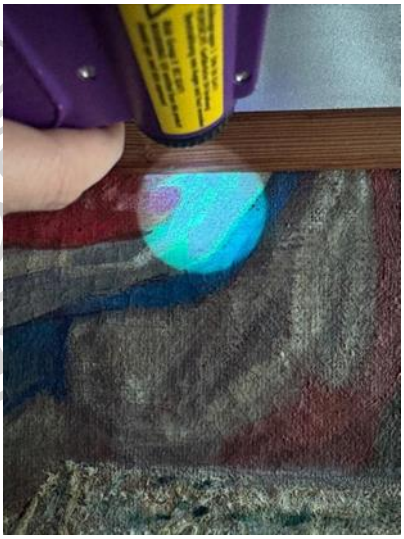

Figure 107: Uneven varnish can be seen under the UV light.

Overall, the varnish reduction was successfully carried out on selected areas. The treatment produced significant outcomes (Figure 108), still preserving the original hues and historic appearance of the artwork.

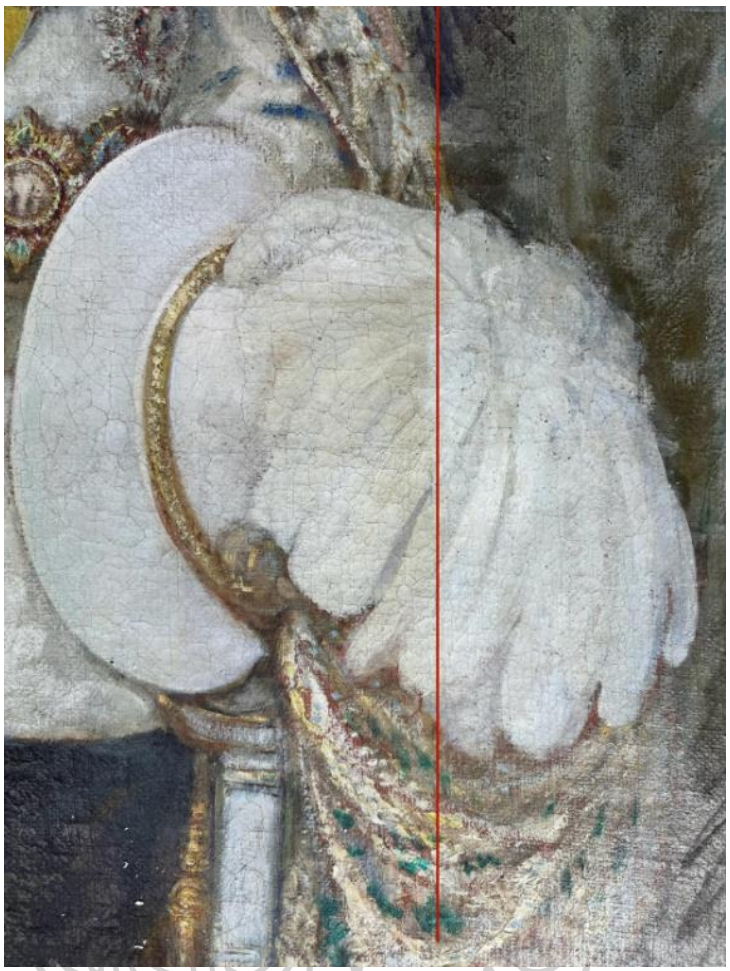

Figure 108: Area with aged varnish (left)
and area after varnish reduction.

6.7 Filling

For the filling material, a traditional chalk-based recipe was used. A 5% solution of rabbit skin glue was saturated with a 1:1 mixture of *Champagne* and *Bolognese* chalk, a drop of linseed oil was added (Figure 109).

Figure 109: Preparation of the filling material.

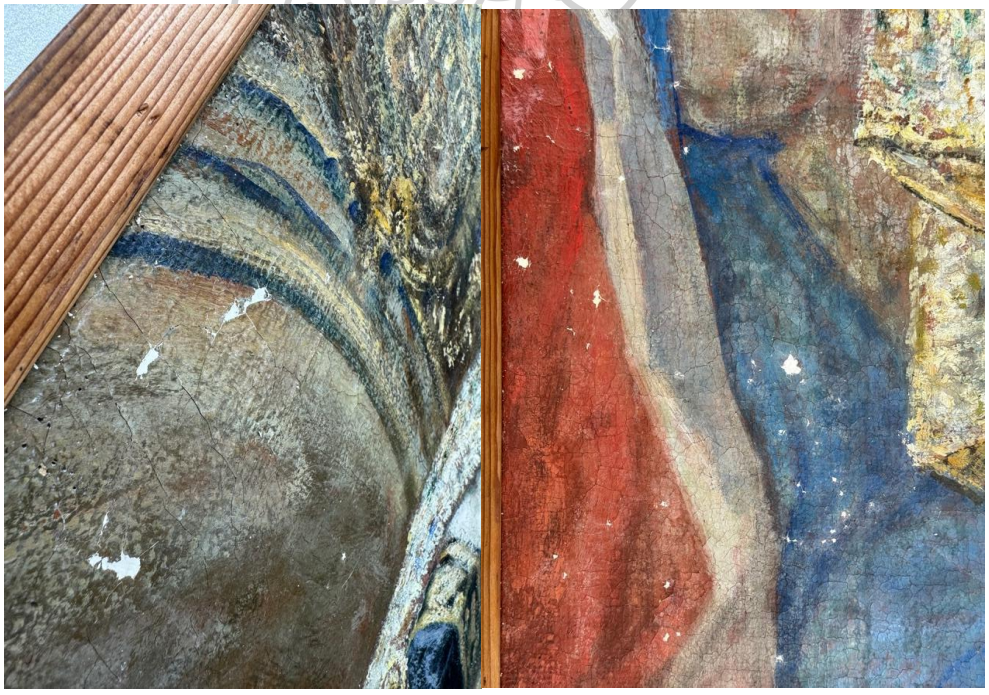

Figure 110: Loss areas were filled.

Figure 111: Putty was levelled using a cork wrapped in cloth.

The filling material was generously applied to the areas of loss using a thin spatula (Figure 110), leaving excess material on the surface and allowing it to dry for half an hour before being sanded down to the desired level using a piece of cork wrapped in cloth (Figure 111).[52]

6.8 Retouching

The retouching process was done[53] using techniques such as fine lines and dots, known as the 'Viennese technique' (Figure 112). This approach involved applying a first layer of watercolour (Figure 113), followed by a second layer of gouache (Figure 114). The gouache was applied using tiny dots to imitate the original paint surface and to visually match with the surrounding, using fine brushes in various sizes ranging from 0 to 2.

[52] The filling was executed by Paul Schubert, SUIC, 2024.

[53] The retouching was executed by Paul Schubert, SUIC, 2024.

Figure 112: A fine brush used for retouching.

Figure 113: Water colour was used as a first layer for retouching.

Figure 114: Gouache was applied in a second step.

This process aimed to integrate the filled areas with their surroundings, with the intention of making the retouching distinguishable from a certain distance (Figure 115, 116, 117 and 118).

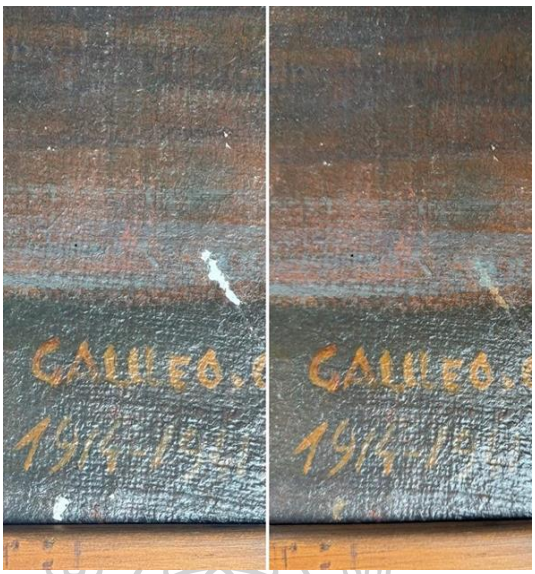

Figure 115: Water colour as a first layer of retouching,
before (left) and after (right).

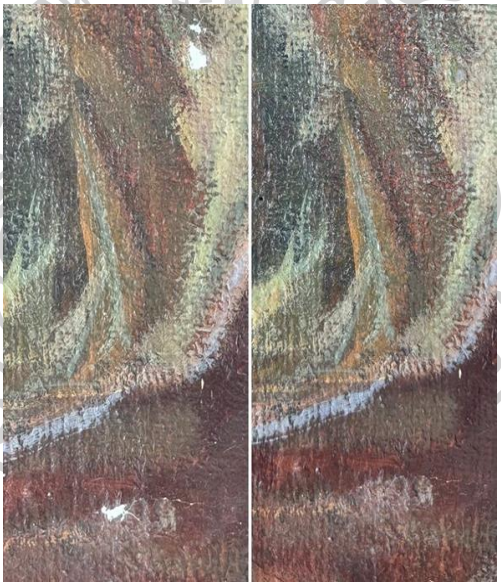

Figure 116: Retouching with gouache colour,
before (left) and after (right).

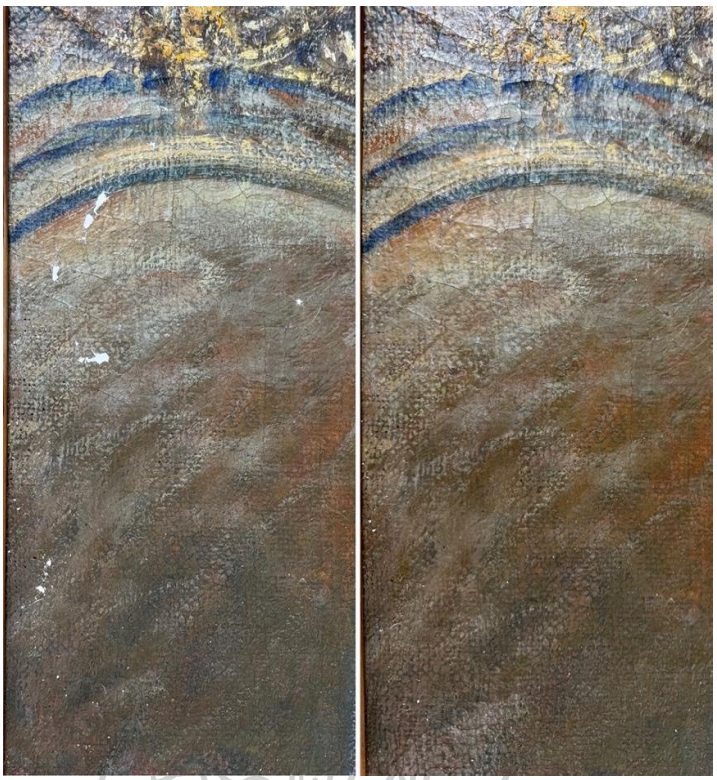

Figure 117: Retouching with gouache colours,
before (left) and after (right).

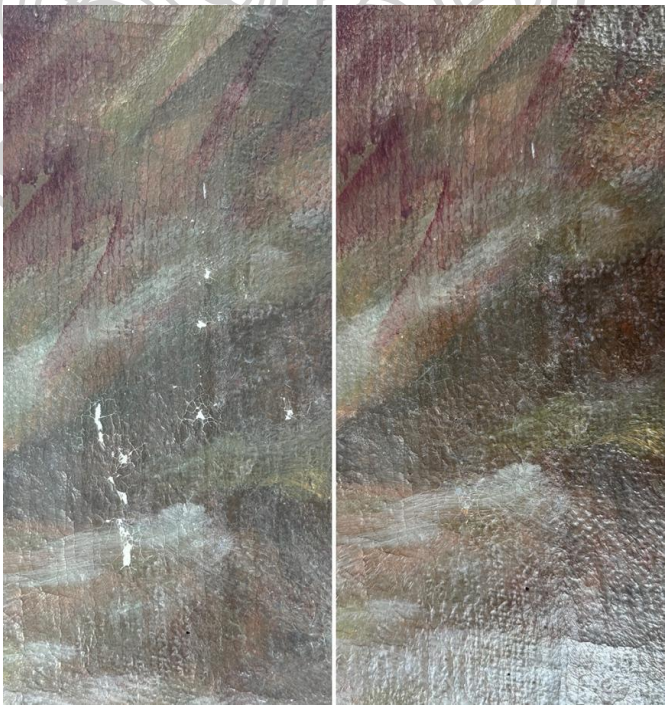

Figure 118: Retouching with gouache colours,
before (left) and after (right).

6.9 Varnish Application

For the final varnish, ready-made synthetic varnish, Windsor & Newtons Artist' Satin Varnish™, was used. The application was carried out with a thin, even layer applied over the entire surface (Figure 119 and 120).

The application of the new varnish, especially in areas where the old, yellowed varnish had previously been removed, such as the bright, white-painted sections, was carefully executed[54] (Figure 121).

Figure 119: Varnish was applied using a brush.

Figure 120: Varnish with a glossy finish.

Figure 121: Application of the new varnish.

[54] The varnish application was executed by Paul Schubert, SUIC, 2024.

The application of the new varnish helped visually integrate the retouched areas (Figure 122). In addition, the varnish provides a protective layer against dust, dirt and even UV light (Kittiphong and Schubert, 2024).

Figure 122: The Portrait of King Rama VI after the retouching and application of new varnish.

6.10 New Backing and Assembling

To support the weakened tension of the linen canvas, buffered, acid-free, custom-cut Crescent™ foam core mat boards with a thickness of 5mm were placed at the back. Although the material is museum grade, an additional protective layer of Tyvek® was used

to cover the boards, to prevent direct contact from the backing and painting's support (Figure 123).

Figure 123: Tyvek® covers the foam board.

As the painting needs structurally supported from loose tension of canvas, a new backing board with greater strength and resistance to humidity and pests was prepared.

Figure 124: Various sized Ethafoam blocks fill the void between the painting and the backing board.

The void between the inserted foam board and the backing board was filled accordingly (Figure 124). Ethafoam was cut to the right dimensions and inserted to keep the foam core board and backing board in position.

The backing board was reattached using the original method, with staplers and water-activated paper tape.

The cleaned, ornate frame was reassembled with the strainer, and all deteriorated structural elements were replaced. Additionally, water-activated paper tape was used to finish the framing (Figure 125).

Figure 125: The water-activated paper tape was added to finish the framing.

7. Preventive Care and Maintenance

Paintings are complex objects composed of multiple sensitive materials, and each may respond differently to environmental conditions. When one component begins to deteriorate, it can trigger or accelerate the degradation of others. Unfortunately, only with time, damage becomes visible, it may already be too late to fully mitigate the effects. This is particularly true for historical paintings, whose aged and fragile materials make them especially vulnerable to the so-called *agents of deterioration*. Even after conservation or restoration treatment, a painting remains at risk if it is not properly cared for. Preventive conservation, alongside responsible collection management and routine maintenance, plays a crucial role in mitigating future damage and supporting the long-term preservation of artworks.

The Portrait of King Rama VI is a significant painting and a valued legacy of Silpakorn University. It is not yet decided, where the painting will be presented in the future, either at the University's new City Campus at Muang Thong Thani (Figures 126) or at the newly planned, the Archives at Silpakorn University, Sanamchandra. The final decision from Silpakorn University Council at the end of 2025 is in consideration regarding the display location (Singhanat Sangsehanat, Interview by Tam Laovichaya, Zoom meeting, January 7, 2026).

As both designated exhibition spaces are not yet ready for installation, City Campus is recently operated and Archives is still in construction plan, an on-site care and maintenance plan cannot currently be implemented. However, a general preventive strategy should be established in advance to ensure the painting's safety and preparedness for future display.

Figure 126: Silpakorn University City Campus, rendering.

Handling 7.1 Art and Installation

The handling and installation of artworks, particularly historical easel paintings with complex frames and fragile surfaces, require detailed planning to minimise risks. The Portrait of King Rama VI, framed in an ornate structure and measuring approximately 250 x 156 cm, presents particular challenges due to its large size, its fragile paint surface with a noted risk of flaking and losses, and its significance as a cultural asset.

Professional art handling is essential in mitigating the risks associated with movement, including mechanical damage, shock, and rapid environmental changes. In this case, the painting will be transported and installed by a specialised art handling company, ensuring trained personnel and appropriate equipment are in place. An A-frame dolly[55] is recommended for transport (Figure 127) to avoid excessive handling and to reduce vibration or sudden movement during relocation (Stoner 2012, 663).

[55] A-frame dolly or cart is commonly used to transport paintings, framed works and other flat objects (DAP 2021).

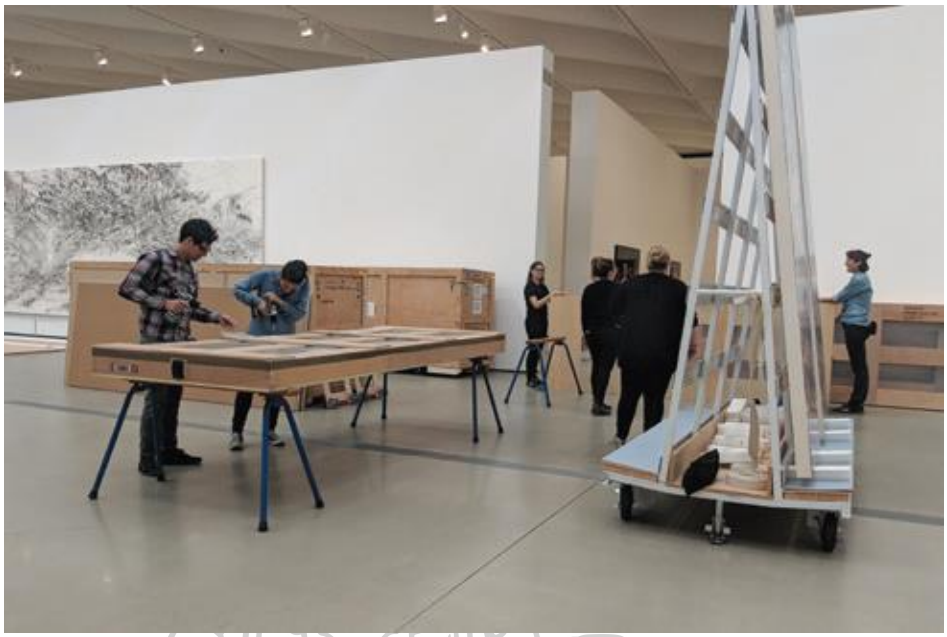

Figure 127: A-Frame dolly used for Julie Mehretu's artwork, Cairo, 2013.

Before the painting is moved, it must be thoroughly assessed by a conservator. This examination should include a review of existing condition reports and documentation to evaluate any identified areas at heightened risk during transport. Insurance coverage should also be arranged in accordance with institutional policy and the artwork's value, even if the transportation distance is minimal (Ramsay 2022, 661).

Framing and backing boards act as protective layers, reducing the risk of direct contact with packing materials and serving as a buffer against environmental fluctuations. In this case, the existing ornate frame provides limited protection, and a custom-designed travel frame or handling frame might be necessary. These frames offer additional support, isolating the painting from direct pressure and absorbing vibrations or shocks during movement. If packing is required, a soft-packing method might be appropriate to ensure that climate conditions remain stable. This typically involves layers of bubble wrap with an interleaving barrier layer such as Tyvek® (Stoner 2012, 663).

Upon arrival at the display site, the painting should remain in its packaging for a minimum of 24 hours (Ramsay 2022, 670) to allow for gradual acclimatisation to the new environment. This reduces the risk of damage caused by rapid fluctuations in temperature

and relative humidity, which can cause stress to both the support and paint layers. The installation itself must be conducted by trained art installers or conservators, following detailed instructions developed in advance. Ramsay (2022, 67) emphasises that “these should specify handling procedures, orientation, fixings, and any environmental considerations relevant to the painting’s condition.”

A final condition report must be completed after installation, forming part of the documentation for ongoing preventive care. This record will serve as a benchmark for future monitoring and maintenance, helping to identify any new signs of deterioration over time.

7.2 Climate and Environment Control

Environmental control plays a crucial role in preventive conservation, particularly for collections displayed in hot and humid climates. For the Portrait of King Rama VI, maintaining a stable environment is vital to minimise deterioration risks such as flaking paint, mould growth, and frame deformation. While full museum-standard controls may not always be achievable in display settings, a combination of operation, facility management and collection care can effectively reduce environmental stress.

7.2.1 Temperature

In tropical climates, maintaining strict temperature levels is often challenging due to high ambient heat and fluctuating conditions. For painted surfaces, rapid temperature shifts can cause expansion and contraction of both the support and paint layers, causing flaking and delamination.

While the usual range for temperature in collection spaces is between 20–24 °C, in tropical climates, the priority should be placed on reducing fluctuations rather than meeting a rigid setpoint (Maekawa, Beltran, and Henry, 41). Daily and seasonal stability is more important than strict control. Where active climate systems (e.g. air conditioning)

are used, care must be taken to avoid direct air flow onto objects and to prevent overly rapid cooling or heating.

Passive strategies, such as using well-insulated display walls and allowing sufficient air circulation behind framed works, can support thermal buffering in environments where HVAC[56] systems are unreliable or intermittent.

The most important point regarding temperature is fluctuation. An increase of even one degree can causes physical, chemical, and biological reactions (Bickersteth 2016, 13).

7.2.2 Relative Humidity

Relative humidity (RH) is one of the most critical environmental factors for painted surfaces, particularly in hot and humid regions. Uncontrolled RH can lead to swelling and shrinking of the canvas or panel support, paint flaking, and biological growth. The recommended RH for paintings is between 45–55%, however, in tropical settings, this may be difficult to maintain consistently. As The Australian Institute of the Conservation of Cultural Material (AICCM) suggests the goal should be to avoid extreme fluctuations and sustain conditions within a manageable range of 40–60% (Bickersteth 2016, 16). Suggestion of the HVAC set point, based on the American Institute for Conservation (AIC) interim guidelines, at 50% with an allowable fluctuation ±10% RH with a maximum cumulative fluctuation of 10% in any 24-hour period (ICOM-CC and IIC 2014) is ideal and suit with Thai's environment. Excess humidity can be controlled by installing dehumidifiers, limit ventilation in the display room, or using silica gel and other desiccants in enclosed cases.

It is also essential to avoid positioning paintings on external walls or near moisture-generating sources such as windows, plumbing, or HVAC outlets, all of which may cause microclimates and encourage localised condensation.

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[56] HVAC stands for heating, ventilation, and air-conditioning and describes systems used to regulate temperature, improve indoor air quality, and control humidity (Fonda n.d.).

7.2.3 Light

Light is a major agent of deterioration for painted surfaces, causing fading, yellowing, embrittlement, and photo-oxidation. Exposure to ultraviolet (UV) and high-intensity visible light can be especially harmful to aged and sensitive media.

Visible light levels should be maintained at 150–200 lux for paintings, with UV radiation kept under 75 μW/lumen (Maekawa, Beltran, and Henry 2015, 33), ideally using UV filters on light sources or glazing. Indirect lighting, filtered daylight, or LED fixtures with stable output and low UV/IR emissions are preferred. The most important with light is exposure time, minimise illumination, natural and artificial light is necessary.

Because the Portrait of King Rama VI includes areas with risk of flaking paint and potentially light-sensitive pigments, it should be displayed away from direct sunlight, and lighting should be switched off overnight. Periodic rotation of displays or regular review of exposure levels can also be implemented as part of the maintenance routine.

7.2.4 Pollutants

Airborne pollutants, both particulate (e.g. dust) and gaseous (e.g. ozone, sulphur dioxide, volatile organic compounds) (Maekawa, Beltran, and Henry 2015, 33), pose significant threats to artworks. In a tropical urban setting such as Bangkok, pollution from traffic, construction, and building materials can cause discolouration, corrosion, and chemical degradation of paintings and frames.

Where possible, the display environment should be supported by appropriate filtration systems, such as HEPA[57] filters or activated carbon filters in HVAC units. Regular housekeeping and dry cleaning, including the use of microfibre cloths on non-art objects and vacuuming with HEPA-filtered equipment, are essential preventive measures.

[57] A High-Efficiency Particulate Air (HEPA) filter is an air filter efficiency standard that captures 99.97 percent of particles down to 0.3 microns. This filter can capture dust ranging from large particulates that can be seen by the naked eye to very small particles that can only be detected through a microscope (Lawson n.d.).

7.2.5 Integrated Pest Management (IPM)[58]

Pests, including insects and mould, are a significant concern in tropical climates. Organic materials such as canvas, wood, adhesives, and paint media are all susceptible to pest damage. Hot and humid environments support rapid insect reproduction and fungal growth due to prolonged periods of high humidity (Maekawa, Beltran, and Henry 2015, 47) which can go unnoticed until significant damage has occurred

An IPM plan should be established for the display area, including regular monitoring, avoiding the introduction of unquarantined materials or infested furniture, maintaining clean and dry conditions, ensuring proper air circulation, sealing entry points and installing air curtains.

Isolation and detailed check of objects prior to exhibition is highly recommended. IPM is most effective when implemented as a routine, it is a non-chemical strategy, with active intervention only when necessary.

Monitoring with traps is a widely used method for collecting data on pest presence and activity of pests. There are various types of traps such as sticky traps, pheromone traps, and occasionally UV-light traps, which are distributed throughout the building to collect insects (Querner and Biebl 2024, 2). Regular checking and replacement of traps every one to two months is necessary to maintain an effective preventive strategy. As new pest species can be introduced at any time (Querner and Biebl 2024, 5), continuous monitoring allows for necessary proactive planning.

[58] The concept of IPM was developed in the 1950s and has been applied in museums, libraries and archives since the 1980s. It is a holistic concept to reduce the application of biocides, such as methyl bromide, DDT or lindane which affect not only objects but also people's health and focused on prevention, monitoring (checking of traps) and using non-chemical treatment methods (e.g. Nitrogen, Carbon dioxide, freezing and humidity regulated heat treatment) (Querner 2022).

7.3 Emergency Preparedness

Emergency preparedness is a critical aspect of preventive conservation and risk management in cultural institutions. While the long-term preservation of artworks depends heavily on environmental control and proper handling, events such as fire, flood, vandalism, or political unrest can cause irreversible damage if not properly anticipated. Therefore, institutions must be equipped not only with climate control and maintenance protocols but also with robust emergency response procedures that protect both people and collections.

In the case of the Portrait of King Rama VI, which is intended for long-term display at Silpakorn University's City Campus or newly built, Archives at Sanamchandra Campus, it is essential that an Emergency Preparedness Plan is developed and integrated into the museum's standard operating procedures. This should take into account the specific risks of the site, including fire hazards, tropical climate conditions, and potential challenges associated with evacuating large, framed works with fragile paint layers.

A fundamental first step is to carry out a thorough risk assessment to identify the types of emergencies most likely to affect the artwork. This process should be tailored to local conditions and updated regularly through the collaboration of multiple stakeholders, including registrars, art handlers, conservators, and building maintenance teams.

The emergency plan must be site-specific (Dorge and Jones. 1999, 29), developed through collaborative input, and tested through training and simulation. Effective plans are those that evolve from the institution and incorporate lessons learned from drills and real events.

Evacuation decisions should be made only when specific conditions are met, including, when the threat to the institution is real, the damage cannot be prevented, safe storage is available, and handling is possible. Moreover, evacuation should be carried out only when it is safe for people to access the incident area (ICCROM 2016, 7). Because these conditions depend on the physical environment, on-site risk assessments and test drills

are necessary immediately after the painting is installed. These drills are required to verify that evacuation is physically possible and to validate the practical evacuation plan.

When an emergency occurs, a four-stage emergency evacuation workflow can be used as a guideline: which are Assess, Prepare, Document, pack and move, and the last stage is Relocate and store (ICCROM 2016, 9-47). Special attention must be given to large or heavy artworks, as the Portrait of King Rama VI. Stabilisation and securing in situ plans could be implemented too, if immediate evacuation is not possible.

Given the regional context, fire remains a primary risk for collections displayed in Thailand. Fire prevention efforts should include regular inspection of electrical systems, ensuring unobstructed escape routes, use of flame-retardant materials.[59] Proper maintenance of fire detection and suppression systems is necessary. University staff must be trained not only in evacuation procedures but also in the use of appropriate fire extinguishers.

There is no universal extinguishing agent for all fires. Fires have been divided into four classes. The physical composition of the Portrait of King Rama VI, specifically the linen canvas, wooden strainer, and gilded wooden frame, classifies any potential fire as Class A (solid organic substances).[60] Therefore, the selected extinguishing agent must be effective on Class A fires while not causing irreversible damage to the painting. Fire-extinguishers for paintings can be wet (water), foam and dry chemical powder extinguishers (Anghelone 2022, 23). However, water mist fire extinguishers are the least damaging for paintings (Icon and ICOMOS 2022). Foams and dry powder extinguishers can damage the painting due to its acidic and corrosive chemical properties (Icon and ICOMOS 2022).

Sprinkler systems in open display areas should be introduced to the staff for further understanding of the system function, due to it can potentially damages to fragile surfaces

[59] Flame-retardant materials are built specifically to help resist catching fire, slow ignition and slow burn.

[60] Class A: Fires of solid substances that burn under ember formation, e.g. wood, textiles, paper, coal, and rubber (Anghelone 2022, 22).

and ornate frames. Pre-action systems[61] are generally preferred to avoid accidental damage to artworks.

7.4 Training of Local Staff and Internal Communication

Emergency preparedness cannot rely solely on documents. It must be informed through regular training, simulation drills, and clear communication. University staff or curators at Sanamchandra (Singhanat Sangsehanat, Interview by Tam Laovichaya, Zoom meeting, January 7, 2026), including new hires, should be familiar with evacuation procedures and contact protocols. A Comprehensive standard operating procedure (SOP) manual or emergency handbook, including university maps, contact lists, artwork handling or conservator guidelines, and checklists should be made easily accessible to everyone.

7.5 Monitoring and Scheduling for Regular Collection Care

For the long-term preservation of the painting, a structured monitoring plan should be established and followed from the day of installation. Responsibility should be shared across related staff according to their roles, from housekeeping and facility staff to conservators or other trained staff. After transport and installation, the team should complete full photographic documentation (overall and detailed views), record the hanging system and fixings, check environmental and light conditions (temperature/relative humidity, lux and UV), and implement initial integrated pest management by placing and labelling sticky traps.

As university staff or curators cannot supervise the painting continuously, clear housekeeping and handling rules are essential. Sprays and aerosol cleaners should not be used near the work, as residues can settle on the surface and accelerate deterioration. Only dry cleaning of the area and floor, not to clean on the artwork. Any surface cleaning on the painting, consolidation, or other collection care and treatment must be carried out only by a trained conservator.

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[61] The systems which only release water when smoke or heat is detected.

To keep the programme practical and consistent, the monitoring tasks and routine collection care should be organised as a simple checklist and timetable for staff to follow (Table 5).

The table structures routine care by aligning the frequency of each activity with a clear task description, the responsible person, the methods, and the records.

Adopting this checklist approach strengthens consistency and data integrity, reduces the risk of omissions, and establishes a reliable audit trail. It facilitates early detection of change, enables faster and more coordinated incident response, and clarifies accountability across teams. It also supports training and handovers, improves continuity of care for the painting, and contributes to demonstrable standards and procedures with preventive conservation principles.

In conclusion, a preventive conservation framework for the Portrait of King Rama VI should be applied before and after installation, emphasising early planning and risk assessment, followed by post installation condition reporting, environmental control, and emergency preparedness. Monitoring programmes, including photo documentation and records, together with ongoing collection care, proper housekeeping near the display area, and minimal intervention by a conservator, will help ensure the artwork's safety and long-term preservation by reducing risk.

Table 5: Preliminary schedule for collection care[62]

Frequency	Task	Responsible person	Description	Record
Daily	Security and environment check	Security Guard / Housekeeper	Visual check for obvious theft, water leaks, or insects. Confirm lights are off at closing	Duty logbook
Weekly	Room housekeeping	Supervised housekeeping staff	Dry cleaning of floors only. **Do not touch the artwork.** Check for dust accumulation on the frame (**do not clean**).	Housekeeping checklist
Monthly	IPM and data logger check	Trained staff	Collect pest traps and replace. Download temperature/RH data.	IPM and environment report
Quarterly	Visual condition check	Trained staff	Compare object with the latest photo documentation.	Condition update log
Biannual	Surface cleaning and inspection	Conservator	Inspection with raking light. Dry cleaning of frame and structural supports using soft brush/HEPA vacuum cleaner.	Conservation report
Annual	Full condition report	Conservator	Thorough examination of paint layers. Update risk assessment. Annually photo documentation.	Annual care report
*Emergency response to specific conditions (such as leaks, construction vibration, and pests) must be reported to the conservator and curator immediately.				

[62] Based on Conservation Centre for Art & Historic Artifacts, Collection Housekeeping Guide, 2022.

Summary

The conservation and restoration of the Portrait of King Rama VI by Galileo Chini have achieved its objectives, the stabilisation of the artwork's physical structure and recovering of its aesthetic integrity. This thesis documented Chini's artistic techniques and applied materials, based in research and sampling carried out at Silpakorn University International College and analysed at the laboratory of the Institute of Conservation, University of Applied Arts Vienna. The investigation confirmed that the painting is executed on a high-quality linen support with a ground layer composed of fine-grained calcium carbonate (limestone) bound with animal glue. Stratigraphic analysis revealed a complex application of oil-based paint layers, including the use of red ochre, zinc white, and bone black, finished with a natural resin varnish. These findings highlighted the vulnerabilities of the work within a tropical environment.

The practical treatment followed conservation concepts and plans. The removal of the damaging Medium-Density Fibreboard (MDF) backing and the acidic paper tape from the framing, and the consolidation of the flaking and tenting paint layers, using of sturgeon glue, selected for its high penetration and flexibility, proved effective in re-adhering the fragile paint to the ground without altering the surface texture. The reduction of the aged, yellowed varnish using Isopropanol revealed the vibrancy of the original colours, particularly the white areas of the Field Marshal's uniform. Losses were filled using a reversible mixture with Champagne and Bolognese chalk, followed by retouching applying the 'Viennese technique', utilising a watercolour base and gouache.

The Portrait of King Rama VI has been conserved from a fragile condition to a stable condition suitable for exhibition. However, the long-term preservation of this painting relies heavily on the post-treatment care outlined in this thesis last chapter. Furthermore, the implementation of the proposed preventive conservation plan including climate monitoring, light control, and the adherence to the collection housekeeping schedule, is essential. As the painting is prepared for its future display, an emergency preparedness plan should be implemented immediately after the designated location has been decided to ensure the painting's safety

REFERENCES

Backing board was immediately removed from the lab after dismantling.

Based on Conservation Centre for Art & Historic Artifacts, Collection Housekeeping Guide, 2022.

Binding medium analysis carried out by Tanja Bayerova, IoC, University of Applied Arts Vienna, found that the binder is water-soluble, the spot test for oils was negative, and both spot tests for proteins were positive; The corresponding sample data sheet is provided in the appendix.

Blitz-Fix is a synthetic polyvinyl-alcohol (PVA95) sponge with very fine pores (micropores) and strong capillary suction. It is used for wet or damp cleaning and for soaking up excess adhesives (Klinkert 2024, 126).

Cesare Ferro Milone was a painter, born in Turin and lived in Bangkok in 1904, prior to Chini's stay. Ferro visited and worked in Bangkok for a second time in 1923-1924. His works focusing on portrait and mural paintings. He had portrayed Queen Savang Vadhana and Me Chani, ballerina della regina, a celebrated dancer of the Siamese court, exhibited at Venice Biennale 2024 (Belmonte 2024).

Chao Phraya Yomarat (Pan Sukhum) was a Siamese statesman who served in several senior administrative positions and was closely involved in infrastructure, public works, and state modernisation during the reigns of King Rama V and VI.

Class A: Fires of solid substances that burn under ember formation, e.g. wood, textiles, paper, coal, and rubber (Anghelone 2022, 22).

The cleaning was carried out together with dismantling.

A closed truck with the container placed over the wheels with reduced vibration can help to reduce shock and vibration damage.

The concept of IPM was developed in the 1950s and has been applied in museums, libraries and archives since the 1980s. It is a holistic concept to reduce the application of biocides, such as methyl bromide, DDT or lindane which affect not only objects but also people's health and focused on prevention, monitoring

(checking of traps) and using non-chemical treatment methods (e.g. Nitrogen, Carbon dioxide, freezing and humidity regulated heat treatment) (Querner 2022).

Conducted by Tanushree Gupta, at SUIC, February 23, 2024.

Cross-section analysis is a method for stratigraphy analysis by preparing samples in a polyester resin. After curing, the polyester block is cut to reveal the sample. The sample's stratigraphy exposed face is polished using various grades of abrasive paper (Ferreire et al 2025, 4; Sloggett et al. 2010, 78).

The cross-section was prepared by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024.

The cross-section was prepared by Tatjana Bayerova, IoC, University of Applied Arts, Vienna, June 2024.

The dismantling was carried out by the conservator, Paul Schubert, SUIC, 2024.

Ethafoam is a recyclable polyethylene foam, medium-density with shock-absorption and vibration-dampening characteristics.

The filling was executed by Paul Schubert, SUIC, 2024.

Firenze is the Italian name of Florence, a major city in Italy. .

Flame-retardant materials are built specifically to help resist catching fire, slow ignition and slow burn.

A-frame dolly or cart is commonly used to transport paintings, framed works and other flat objects (DAP 2021).

A High-Efficiency Particulate Air (HEPA) filter is an air filter efficiency standard that captures 99.97 percent of particles down to 0.3 microns. This filter can capture dust ranging from large particulates that can be seen by the naked eye to very small particles that can only be detected through a microscope (Lawson n.d.).

HVAC stands for heating, ventilation, and air-conditioning and describes systems used to regulate temperature, improve indoor air quality, and control humidity (Fonda n.d.).

Initial visual inspection was conducted by Paul Schubert and Kawinthip Kittiphong on December 7, 2023, Silpakorn University, Ta-Ling Chan campus, where the painting

was displayed until conservation. Detailed condition survey was conducted at Silpakorn University International College, February 2024 headed by Gabriela Krist.

The MDF wooden board is attached to the strainer using large double-legged metal staples. Under the MDF wooden board, a long wooden plank is attached horizontally to the strainer with screws, likely serving as a stabiliser to prevent bending.

Medium Density Fiberboard (MDF) is a composite wood product made by breaking down softwood into fibers, mixing them with wax and a synthetic resin binder (e.g. urea formaldehyde), and forming panels under high temperature and pressure. Modern MDF can also be made from materials like recycled paper, bamboo, carbon fibers, and sawmill off cuts (Kubba 2010, 221).

The microchemical spot Test for protein was conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

The microchemical spot tests were conducted by Tatjana Bayerova, IoC, University of Applied Arts, Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

PLM is a technique that uses transmitted plane-polarized light (PPL) and cross-polarized light (XPL) conditions to examine very small samples, usually pigments, particles, and fibres (Butler n.d.).

PLM was conducted by Tatjana Bayerova, Institute of Conservation (IoC), University of Applied Arts Vienna.

The relocation and handling procedures were done by conservators, Paul Schubert and Kawinthip Kittipong, SUIC, 2024.

The results are based on optical and morphological properties of sample np. 2960, it can be concluded that the ground material is crushed limestone by Tatjana Bayerova, IoC, University of Applied Arts, Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

The results are based on SEM-EDS elemental analysis of paint layer cross-section of sample no. 2958 conducted by Tatjana Bayerova, IoC, University of Applied Arts, Vienna, June 2024: The corresponding sample data sheet is provided in the appendix.

The results are based on the analysis of sample no. 2958 and 2960 conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

The results are based on the analysis of sample no. 2958 conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

The results are based on the analysis of sample no. 2959 conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

The results are based on the analysis of sample no. 2960 conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

The retouching was executed by Paul Schubert, SUIC, 2024.

Sample was collected at SUIC, February 2024 and analysed by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

The sample was collected by Paul Schubert, SUIC, February 2024.

Sample was collected by Paul Schubet, SUIC, February 2024.

Scientific analysis of sample no. 2960 was conducted by Tatjana Bayerova, IoC, University of Applied Arts Vienna, June 2024; The corresponding sample data sheet is provided in the appendix.

See Appendix II Scientific investigation, sample no. 2960.

See Appendix II Scientific investigation, sample no. 2961.

A standing human figure carrying its weight on one leg so that the opposite hip rises to produce a relaxed curve in the body (National Galleries of Scotland n.d.).

Strainers is the type of auxiliary support used for stretched canvases. They are rigid frames and are not expandable, with fixed joints (Ammon n.d.).

The systems which only release water when smoke or heat is detected.

Tengucho is a thin but strong Japanese paper made from long cellulose fibres, commonly used in art conservation. The thinness can vary, typically ranging from 3.8 to 9 gsm (Awagami Factory® n.d.).

The term “cracks” usually refers to individual cracks in a surface, while “craquelure” is a network or pattern of cracks in paintings that develops across the surface or in sections (Slotsgaard 2020, 77).

Term used to characterise painting that are created with unstable, poor quality, or improperly mixed on juxtaposed materials (Goltz et al. 2022, 369).

The test results of the varnish application and selection were carried out by Paul Schubert, SUIC 2024.

The test series for varnish reduction were conducted by Paul Schubert, SUIC, 2024.

The test series of the selected varnishes were conducted by Paul Schubert, SUIC, 2024.

The tests series for varnish reduction were conducted by Paul Schubert, SUIC, 2024.

A traditional hanging device for heavy paintings that supports the painting’s weight across its entire width. A 45-degree angle is cut along the length of a plywood board, with one half of the cut section secured to the frame using long screws. The other half is aligned to match the corresponding section attached to the display wall (Arnold 1986).

A type of bubble wrap with an added foam layer to provide surface protection, helping to avoid bubble marks onto the surface.

The varnish application was executed by Paul Schubert, SUIC, 2024.

The wet cleaning was carried out by CHCM student, SUIC, 2024.

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