CRAEFT

care, judgment, dexterity

Design Pilot: Integrating Digital Tools and Traditional Craft

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Executive summary

This deliverable reports the Craeft **Design Pilot**, an initiative that develops and tests practical synergies between **traditional craft practices** and **contemporary design** through a combination of digital innovation and structured design-led experimentation. It frames digital transformation not as an end in itself, but as a means to preserve, reinterpret, and extend craft knowledge while supporting new forms of design inquiry, prototyping, and dissemination across diverse craft domains.

Section 2 reviews the craft–design relationship in its historical and contemporary European context, identifying current drivers (e.g., digital tooling, sustainability, authenticity) and the conditions under which craft knowledge can remain relevant within modern design ecosystems. Section 3 then specifies the Design Pilot methodology as an iterative, co-creative cycle: it begins with an investigative phase to understand designers' needs and craft constraints, includes a cross-RCI mapping of "design" occurrences, and culminates in flexible workshop formats and a staged timeline from planning to final consolidation (M18–M36).

Section 4 describes the technical facilities employed in the Pilot. These include: (i) craft-specific simulators that support product design and appearance reasoning from 3D models; (ii) motion reconstruction from video (including egocentric/overview capture), semi-automatic action segmentation, and registration of recordings and linked assets in a knowledge base for web-based review; and (iii) interfaces to prototyping, notably 3D printing and interactive additive/subtractive solid editing workflows (RevolutionSolid Unity integration). Advanced porcelain appearance previews are treated as a pilot application of physically based rendering (PBR); the technical implementation is referenced to D3.2, Section 5.4.3 ("Porcelain Bodies"), while this deliverable focuses on how the capability is used in design practice.

Section 5 presents the Pilot's use cases as two complementary formats: exploratory and advanced, used to reframe craft traditions as contemporary media and to validate concrete design trajectories through prototypes, evaluation, and partner feedback. The Pilot is instantiated across five RCI domains, presented - according to investigation depth - in Sections 6 and 7 and regarding:

- **Aubusson tapestry** (Tapestry Design Studio),
- **Nancy glassblowing** (CERFAV),
- **Tinos marble-carving and Ioannina silversmithing** (PIOP),
- **Limoges porcelain** (Porcelain Design Studio; gestural exploration and digital toolkits),
- **Yecla woodcarving** (CETEM; design integration supported by prototyping).

The deliverable concludes with cross-cutting lessons and an outlook. A central challenge is the heterogeneity of design contexts and design meanings across RCIs, requiring careful calibration so that digital tools act as mediators rather than drivers of standardisation. At the same time, contextual diversity enables cross-learning and methodological transfer: practices can inform each other through analogy, strengthening the Pilot as a shared research space rather than isolated experiments. The outlook emphasises expanding exchanges among RCIs, extending to additional materials and audiences, and using exhibitions, educational programmes, and digital platforms to amplify impact.

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Abbreviations

AR	Augmented Reality
CH	Cultural Heritage
RCI	Representative Craft Instance
VR	Virtual Reality

Table of contents

1. Introduction

1.1 Purpose and Scope

This deliverable presents the *Design Pilot*, an initiative dedicated to synergies between design, digital technologies, and traditional craft practices. The pilot's overarching goal is to demonstrate how computational tools and design methods can bolster craft-making, broadening the creative and innovative horizons for artisans, designers, and researchers alike.

First, the deliverable offers a state-of-the-art literature review and ongoing debates on craft–design convergence. Drawing on historical precedents, it situates contemporary initiatives within a lineage of innovation that stretches from the Arts and Crafts Movement to current experiments with parametric software, extended reality, and additive manufacturing. It then outlines the methodological framework that underpins the *Design Pilot*, explaining how collaborators from craft, design, and technology work in tandem to ensure systematic integration of digital tools.

Following this methodological exposition, the deliverable addresses the technological innovations conceived or refined through the pilot, including specialised software workflows, sensor-based systems, and collaboration platforms. This section includes empirical data that gauges the impact of these tools on productivity, sustainability, and creative output. The final segment of this deliverable details the *use cases* developed within the diverse Representative Craft Instances (RCIs). These case studies illustrate how contextual factors, such as local materials, cultural heritage, resource availability, and technological choices, influence the pilot's application and outcomes.

1.2 Rationale

The *Design Pilot* emerges from the growing recognition that craft and design, traditionally viewed in the modern world as separate spheres, are increasingly convergent. Artisanship is often linked to regionally rooted techniques and an intimate understanding of materials, operating within the localised and small-scale context of the workshop. In contrast, design functions at the scale of industry, relying on computational methods for rapid prototyping, mass production, and global market responsiveness. This opposition underscores the fundamental difference between the handcrafted precision of the artisan and the standardised, efficiency-driven industrial design processes [9]. Bridging these two domains presents significant potential for enhanced creativity, collaborative knowledge exchange, and methodological rigour. One central motivation for the pilot lies in its capacity to foster novel forms of creative experimentation. When craft practitioners and designers combine their expertise, they introduce one another to new techniques and conceptual frameworks. Artisans can move beyond localised processes to explore contemporary aesthetics or functional innovations, while designers benefit from the tactile intelligence and cultural depth embedded in craft traditions [7]. This dynamic fusion of perspectives frequently yields hybrid objects and design solutions that neither group might have developed independently.

A second justification for the pilot involves its role as a site for systematic testing. The *Design Pilot* is a quasi-experimental environment in which new technologies can be applied, assessed, and refined. These experiments offer valuable feedback on how digital workflows affect cost efficiency, material optimisation, and cultural fidelity. They also clarify how digital processes can be adapted to accommodate the constraints of different craft communities [16]. Such an evidence-based approach promotes iterative improvement and contributes to the broader discourse on the sustainability and scalability of craft–design collaborations [5].

Through structured collaboration, rigorous methodology, and targeted technological innovation, the *Design Pilot* underscores the complementary nature of craft and design. It demonstrates that the tension between heritage and innovation need not be antagonistic; instead, it can be harnessed to create new products, refine work processes, and enhance the vitality of craft communities. By bringing together craftspeople, designers, and researchers, this initiative aligns with academic research objectives and real-world needs, ultimately guiding the evolution of artisanal practices in a digitally driven era.

2. State of the Art: Craft–Design Synergy

Craft practices have historically underpinned modern design by uniting manual skill, material knowledge, and aesthetic intention. Before industrialisation, artisans were the designers, creating objects that balanced functionality with artisanship. As mass production gained momentum in the 19th century, this intimate link between making and designing was disrupted, leading to a clear division: craft was deemed manual labour, and design emerged as a specialised, conceptual discipline. This fragmentation raised concerns over the loss of the craft's cultural and artistic depth, prompting questions about handmade integrity in an era dominated by machines.

A collective response to the challenges posed by mass production emerged, centred on the conviction that craft and design should remain closely intertwined. Proponents of this viewpoint critiqued industrial manufacturing for reducing workers to mere operators and eroding the quality of everyday goods. They argued that those involved in making should also shape the object's form and function, preserving a direct link between creative intent and material execution. By emphasising the intrinsic character of materials and the artisan's active role in shaping them, this approach sought to restore dignity to everyday objects while promoting innovation. It challenged the notion that efficiency and uniformity had to come at the expense of aesthetic and cultural value. The guiding principle was that thorough craft offered a way to revitalise production without sacrificing the meaningful, hands-on qualities that enhance both maker and user.

Central to these debates was the tension between utility and aesthetics. Craft traditions, with their hands-on approach to material manipulation, offered a nuanced understanding of how objects could serve practical needs while embodying cultural and artistic values. Industrialisation threatened this delicate balance by prioritising speed and uniformity over expressive craft-making. Its critique underscored that aesthetic enrichment and social well-being were not secondary to production efficiency but integral to meaningful design. Although industrialisation would continue to separate design from making, the legacy of Craft and Design synergy laid the groundwork for ongoing conversations about harmonising artisanal skill with modern technologies and market demands.

2.1 Historical European Context of Craft and Design

2.1.1 Craft as the Foundation of Design

Designers have long served as critical intermediaries between preserving traditional craftsmanship and integrating technological innovation. Since the 19th century, during which industrialisation revolutionised decorative arts, designers have played a dual role: preserving artisanal practices while reimagining them in new contexts. The roots of this dialogue can be traced back to the context of the Arts and Crafts Movement, where William Morris and his contemporaries advocated for a return to craftsmanship as a reaction against the dehumanising effects of industrial mass production [15]. While this movement sought to resist industrialisation, it also recognised the potential of designers to mediate between artisanal traditions and evolving technologies, shaping products that balanced functionality and aesthetic value. Morris's workshops, for instance, employed mechanised looms alongside handweaving techniques, blending the old and new to create practical and beautiful textiles [18].

The Union Centrale des Arts Décoratifs (UCAD) also highlights its pivotal role in bridging the gap between traditional craftsmanship and industrial production in 19th-century France [8]. Established in 1864, UCAD aimed to elevate the status of decorative arts by fostering collaboration among artists, designers, and artisans. UCAD's initiatives were instrumental in promoting synergy between art and industry, encouraging the creation of objects that combined aesthetic appeal with practical utility. Through organised exhibitions and the establishment of educational programs, this organisation sought to preserve traditional artisanal techniques while embracing modern design principles. This approach safeguarded cultural heritage and facilitated the adaptation of crafts to contemporary market demands. By acting as a conduit between the localised expertise of craftspeople and the expansive reach of industrial manufacturing, UCAD played a crucial role in ensuring that French decorative arts remained innovative and rooted in tradition during rapid industrialisation. UCAD's efforts led to objects that were not merely utilitarian but also carried significant artistic value, reflecting a harmonious blend of form and function. This integration of artistry into everyday objects exemplifies the organisation's success in merging design and crafts and continues to influence current debates on the relationship between art, craft, and industry. The efforts of the Union Centrale des Arts Décoratifs were part of a broader French strategy in the second half of the nineteenth century to reform the relationship between art, craft, and industry. Alongside UCAD, the École nationale supérieure des Arts Décoratifs played a crucial pedagogical role by professionalising design education and positioning drawing as the intellectual bridge between artistic conception and industrial production. Through structured training in ornament, materials, and applied design, the school prepared artists to collaborate effectively with manufacturers, ensuring that aesthetic quality remained central to mechanised production. Similarly, the Manufacture nationale de Sèvres exemplified how state-supported industry could integrate artistic direction with technical innovation. At Sèvres, industrial processes were combined with highly skilled hand-finishing and experimental research in glazes and forms, demonstrating that craftsmanship could be reorganised within a modern manufacturing framework. A further dimension of this synthesis emerged in the work of Émile Gallé and the École de Nancy, whose workshop-based production model blended artisanal virtuosity with industrial organisation. Gallé’s glass and furniture designs, produced through collaborative ateliers, embodied a regional interpretation of modernity in which naturalist aesthetics, technical experimentation, and serial production coexisted. Together, these initiatives reveal that nineteenth-century France did not frame industrialisation as a rupture with craft traditions; rather, it institutionalised and modernised them, constructing a national design culture grounded simultaneously in artistic heritage and industrial competitiveness.

From its origins, the history of Spanish design has been closely associated with architectural practice and discourse. In the construction of the history of design in Spain, the Catalan impulse stands out, which, since the mid-nineteenth century, was characterised by an active search for modernity rooted in local cultural identity. The city of Barcelona is intrinsically associated with this trajectory, particularly following its hosting of the Universal Exposition of 1888, whose pavilions were subsequently reused as the city’s first museums from 1891 onwards, signalling the institutionalisation of design and the applied arts within the urban fabric. Within this context, the emergence of Catalan Modernism (Modernisme) marked a decisive moment in which architecture, design, and craftsmanship were conceived as an integrated system. Led by architects such as Antoni Gaudí, the movement drew heavily on local artisanal knowledge to produce buildings whose forms and ornamentation combined structural experimentation with traditional craft techniques. These included ceramic tiling, wrought ironwork, stained glass, and stone carving. Gaudí’s projects, such as the Casa Batlló and the Sagrada Família, demonstrated how vernacular materials and skilled handiwork could serve visionary design principles, illustrating that industrial progress need not undermine regional craft legacies but could instead amplify them through new, imaginative expressions. Crucially, this craft-centred approach extended beyond architecture into furniture and interior design, reinforcing Modernisme as a comprehensive design culture. Designers such as Gaspar Homar and Joan Busquets translated Modernista aesthetics into the domestic sphere through highly crafted furnishings characterised by elaborate marquetry, sculptural carving, organic lines, and symbolic ornamentation. Produced within specialised workshops, these objects embodied a collaborative model in which designers and artisans worked closely to create unified interior environments. In this sense, Catalan Modernism articulated a vision of modern design in which architecture, furniture, and the decorative arts collectively negotiated the relationship between innovation, craftsmanship, and regional identity, positioning Barcelona as a central node in the history of Spanish design [19].

In Greece, there were parallel efforts to integrate local craft traditions with modern design ideals. Founded in 1837, the Athens School of Fine Arts[1] played a pivotal role in redefining the relationship between craft and design in 19th-century Greece. Created in the immediate aftermath of independence, the institution functioned not merely as an academy of fine arts but as a state instrument for shaping the material and visual identity of the emerging nation. Its curriculum integrated architecture, sculpture, painting, marble carving, woodwork, and decorative arts, positioning drawing as the intellectual foundation that unified conceptual design and manual execution. Through this pedagogical structure, traditional artisanal practices were systematised and aligned with academic principles of proportion, geometry, and classical order. Rather than relying solely on guild-based transmission of skills, craftsmanship was reframed within a modern institutional framework that elevated it from inherited workshop knowledge to culturally sanctioned production. This transformation was crucial in materialising the neoclassical architecture that came to define 19th-century Athens: while architectural language often derived from European academic models, its realisation depended on locally trained marble carvers, woodworkers, and metal artisans. The school thus mediated between imported design ideals and indigenous material expertise, producing a distinctly crafted neoclassicism. In this context, craft was not a nostalgic residue but an active component of nation-building, operating as both technical infrastructure and symbolic expression within the formation of modern Greek architectural identity.

Similar ideas and practices emerged across Europe in response to industrialisation's rapid expansion. In Belgium, for instance, figures such as Henry van de Velde spearheaded efforts to align craftsmanship with modern industry, believing in the social and aesthetic value of handmade objects. He advocated for the involvement of designers in improving everyday goods, arguing that industrial methods should not overshadow the creative integrity of artisanal work. He believed that thoughtful design, guided by artistic principles, could impart functionality and beauty to mass-produced products, bridging the gulf between maker and machine [25]. A parallel vision appeared in Austria through the Wiener Werkstätte, founded in 1903 by Josef Hoffmann and Koloman Moser. They maintained that traditional craftsmanship was critical for producing objects with genuine aesthetic and cultural worth. Hoffmann and Moser's workshop featured collaborations with cabinetmakers, silversmiths, and textile artisans, combining manual skill with refined design sensibilities in architecture, furniture, and decorative arts. They encouraged designers to remain conscious of cultural heritage and quality over mere productivity [27]. In Scotland, the Glasgow School developed a comparable approach that integrated local craft traditions with forward-looking design, emphasising natural materials, hand-drawn ornamentation, and simplicity in form. The chairs and interior decorations for the Glasgow School of Art, for example, illustrate how carefully orchestrated designs could enhance both function and aesthetic appeal without mechanical uniformity [13].

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[1] Originally established as the School of Arts (Scholeion ton Technon).

2.1.2 Expositions Universelles Bridged Traditional Craft and Modern Industry

The Expositions Universelles further demonstrated this intersection, showcasing innovations in design while promoting traditional craftsmanship from across the globe [12]. For instance, the 1855 and 1867 Expositions Universelles in Paris displayed handcrafted objects, textiles, ceramics, and furniture alongside cutting-edge machinery and manufacturing processes. This juxtaposition enabled a dynamic dialogue between tradition and modernity, inspiring designers to rethink how artisanal techniques could coexist with and benefit from emerging industrial methods. At these exhibitions, designers encountered a global spectrum of materials and techniques, encouraging cross-cultural exchanges that enriched design practices. For example, Japanese woodblock printing and ceramics, presented at the 1867 Paris Expo, heavily influenced European decorative arts and design movements such as Art Nouveau. Similarly, traditional weaving and dyeing techniques from regions such as India and North Africa inspired new design approaches incorporating handmade and industrial elements. These events served as incubators for innovation, encouraging designers to experiment with hybrid forms that married artisanal knowledge with the possibilities offered by new machinery.

Subsequent fairs, such as the 1900 Exposition Universelle in Paris, reinforced this synergy. While popular for its lavish Art Nouveau pavilions and sumptuous displays of furniture, glassware, and jewellery, the 1900 exhibition also underscored how mechanised processes could facilitate the large-scale production of objects formerly dependent on handicraft. The French Pavilion, for instance, presented cutting-edge machine looms that replicated intricate tapestry patterns traditionally woven by artisans in Aubusson and Gobelins. Designers observing these demonstrations realised that carefully calibrated machines might preserve and extend the aesthetic vocabulary of handweaving by incorporating finer threads or larger colour palettes more quickly than human weavers could manage [22].

Beyond Paris, the 1904 Louisiana Purchase Exposition (St. Louis World's Fair) in the United States similarly underscored the global reach of these exchanges. Although not strictly termed an Exposition Universelle in the European sense, it hosted significant international pavilions that showcased craft traditions from East Asia, Africa, and Latin America. As with earlier Paris events, the St. Louis Fair juxtaposed handmade textiles, ceramics, and artisanal tools against modern assembly lines and mass-market consumer products. European observers, including designers and manufacturers, noted similarities between certain indigenous techniques (like African indigo dyeing or Japanese *katazome* textile printing) and their historical traditions, paving the way for cross-pollination in pattern design and colour application [21].

Similarly, at the 1906 International Exposition in Milan, often regarded as part of the broader lineage of world's fairs, organisers highlighted Lombardy's textile industries and artisanal silk-making processes. Traditional sericulture was displayed alongside automated reeling machines that vastly accelerated the extraction of silk threads from cocoons. Italian designers, often linked to the ongoing Stile Liberty (Italian Art Nouveau) movement, integrated these mechanised processes with hand-finishing to produce fabrics that retained regional motifs yet satisfied expanding demands from domestic and foreign markets [11].

Across these exhibitions, the guiding principle was consistent: handcrafted artefacts were on display with new technologies and manufacturing systems. This encounter often motivated designers and artisans to assess how local craft traditions could be adapted or preserved in an era increasingly defined by industrial capability and global trade networks. Patterns, techniques, and materials once isolated to specific regions now circulated widely, encouraging designers to experiment with forms that married artisanal knowledge with the efficiency or precision offered by modern machinery. Such international showcases functioned as *incubators of innovation*, fostering artistic crossovers that not only impacted the immediate era but also laid the groundwork for the ongoing debate on how technology and craft might best coexist in the design of the future.

2.1.3 Modernism and the Role of Design

The 1920s marked a pivotal era in this history, as movements like the Bauhaus and avant-garde approaches redefined the relationship between craftsmanship, technology, and mass production. Designers of this period extended the dialogue between tradition and innovation, exploring new materials, production techniques, and aesthetic ideologies while maintaining a connection to artisanal practices.

Established by Walter Gropius in 1919 in Weimar, Germany, the Bauhaus was born from the desire to bridge fine art, craft, and industrial production. Gropius envisioned a school where students and masters would collaborate in workshops to generate new design, architecture, and applied art approaches. The early curriculum drew on craft-based teaching methods, encouraging students to experience materials firsthand before applying these lessons to more industrial processes [27]. When the Bauhaus relocated from Weimar to Dessau in 1925, Gropius and colleagues placed a stronger emphasis on reconciling artisanal craftsmanship with machine-age efficiency. Marcel Breuer's iconic *Wassily Chair (1925–1926)* illustrates this integration, combining tubular steel (associated with industrial manufacturing) with minimalist forms rooted in Bauhaus aesthetic principles. Similarly, Marianne Brandt's metalwork workshop produced household items (lamps, teapots) that showcased precise geometric forms and high production standards, demonstrating that design informed by craft knowledge could thrive in an industrial context. Even after its forced closure in 1933, the Bauhaus continued to influence global design. Emigrating Bauhaus masters, namely Ludwig Mies van der Rohe and László Moholy-Nagy, carried their principles to cities like Chicago, where they fostered new institutions (e.g., the Illinois Institute of Technology and the New Bauhaus). Many Bauhaus ideas, specifically simplicity, functionalism, honest use of materials, and integration of art and industry, would underpin mid-century modern design worldwide. The school's legacy demonstrated that modern design need not abandon artisanal integrity, showing that handcraft methodologies (like those taught in the Bauhaus workshops) could inform mass-produced objects.

While the Bauhaus exerted a notable influence throughout Europe, Scandinavian design emerged with its distinct perspective, merging functionalist ideals with a deep respect for natural materials and artisanal traditions. The emphasis on "human-centred" design, seen in Denmark, Finland, Sweden, and Norway, took shape partly through architects and furniture makers who sought to create minimalist, yet warm and inviting objects. Designers like Arne Jacobsen, Børge Mogensen, and Hans J. Wegner in Denmark championed local woods and time-honoured woodworking techniques. Their works, such as Wegner's *Wishbone Chair (1949)*, were simultaneously modern and respectful of centuries-old joinery. In Finland, Alvar Aalto exemplified this synergy by fusing technology (e.g., bentwood processes) with his country's woodworking legacy. His *Paimio Chair (1931–1932)* remains an emblematic piece, combining laminated birch[2] and gentle curves that served both functional and ergonomic considerations. While distinctly modern in appearance, the chair retained a handmade sensibility through the use of local timbers and

[2] A Nordic staple.

attention to craft details. Aalto's approach underscored the conviction that true innovation flourishes when designers collaborate with skilled artisans, adapting traditional methods rather than discarding them.

Scandinavian designers also looked outward, collaborating with manufacturers across Europe and the United States. Firms like *Fritz Hansen* in Denmark or *Artek* in Finland bridged artisanal finishing with industrial production. The result was furniture that could be efficiently manufactured in larger volumes without sacrificing the subtlety of craft. This model set a precedent for other European regions, where designers increasingly recognised that the direct knowledge of materials, wood, wool, or metal, was key to producing modern yet timeless objects.

In Italy, postwar designers such as Gio Ponti and Carlo Scarpa embraced artisanal techniques, including ceramics, glassblowing, and woodworking, to enrich their modern creations. Scarpa's collaborations with Venetian glassmakers at *Venini* showcased how centuries-old glass-blowing skills could be adapted to produce striking contemporary forms. This approach mirrored Scandinavian functionalism and Bauhaus rationalism in spirit while accentuating the expressive qualities of local craft. Following Art Deco's popularity in France, a renewed interest in craft-based modern interiors emerged among figures like Jean Prouvé and Charlotte Perriand. Though known for metalworking and industrial aesthetics, Prouvé's workshop often drew on artisanal input for finishing details, demonstrating how handcrafted qualities could enhance mass-produced components. This interplay highlighted a Pan-European pattern: even as standardisation rose, designers frequently integrated artisanal finishing or region-specific techniques, ensuring cultural resonance and a sense of craft. The result was a flourishing diversity of styles and methodologies, united by the conviction that balancing heritage and innovation yields modern and culturally enduring designs.

Contemporary designers continue to revisit these legacies, sometimes integrating digital fabrication, biomaterials, or generative software. The fundamental principle endures: craft, whether rooted in woodworking, glassmaking, or textiles, can inform contemporary production in ways that celebrate culture, respect materials, and expand creative possibility. By looking at these historical references and pedagogical initiatives, contemporary design remains anchored in the understanding that the heart of modern design is often a wellspring of artisanal skill.

2.2 Contemporary Craft–Design Dynamics

Recent decades have witnessed a renewed interest in craft from designers as a deliberate contrast to mass production. While industrial manufacturing often favours uniformity and scale, many contemporary designers seek artisanal methods to infuse their work with uniqueness and narrative depth. This shift stems partly from consumer fatigue with standardised products and a growing appreciation for objects that exhibit individual character. At the same time, the global spread of digital technologies and platforms has led to heightened homogeneity in product offerings. In response, practitioners who value handmade elements utilise craft traditions to differentiate their designs and reconnect with localised modes of making. The wider "*maker movement"* amplifies this trend by championing self-production, open-source innovation, and small-scale, workshop-based manufacturing, positioning crafts-related practices as an alternative or complement to industrial models.

An increasing number of practitioners operate at the fluid intersection of craft and design, merging artisanal expertise with contemporary aesthetics, materials, and technologies. Rather than seeing craft purely as a manual pursuit, they embrace its core values, i.e. intimate material knowledge, meticulous attention to detail, and storytelling, within a design framework that accommodates rapid prototyping and digitally-based workflows. These hybrid practices underscore that the boundaries between designer and maker are not fixed: a single individual might shift between conceptual planning, hands-on crafting, and advanced technological manipulations, ultimately revealing how craft principles and design thinking can coexist to yield innovative outcomes.

2.2.1 Digital Technology and the Craft–Design Relationship

In the digital age, designers continue their historical role as intermediaries between tradition and innovation by leveraging advanced tools such as computational design, 3D printing, and augmented reality to reinterpret traditional crafts. Digital tools offer unprecedented opportunities to reinterpret, preserve, and innovate age-old techniques. They enable a deeper understanding of the materiality, process, and cultural significance of traditional crafts while opening new pathways for creative expression and design experimentation. The evolving relationship between manual artistry and digital precision reflects a dynamic synergy where the strengths of each approach mutually reinforce the other. Rather than allowing one to overshadow the other, this relationship celebrates the unique contributions, fostering a new era of craftsmanship that bridges heritage and modernity.

Manual artistry offers a tactile, intuitive connection to materials that digital precision cannot replicate. The hand of the artisan imbues each object with individuality, imperfection, and a sense of humanity. Conversely, digital tools provide unparalleled precision, scalability, and the ability to execute complex forms that would be unattainable by hand alone. When integrated thoughtfully, these approaches amplify one another, preserving the soul of traditional craft while pushing the boundaries of design. One notable example of this synergy is found in the work of Studio Formafantasma, an Italian design duo renowned for integrating artisanal practices with technological processes. In their "Craftica" project, they collaborated with artisans to create objects that blend traditional materials like leather and horn with contemporary digital techniques, resulting in pieces rooted in craft traditions and distinctly modern in their execution [2].

The fusion of manual artistry and digital precision is particularly evident in European design practices, where the rich history of craft serves as a foundation for technological innovation. In the Netherlands, Joris Laarman Lab exemplifies the interplay between handcraft and robotics. Laarman's furniture designs often begin as hand-sculpted models, which are then translated into digital forms and refined using parametric software. These designs are fabricated using robotic arms, which mimic the fluid movements of a human artisan to create complex, organic structures. The resulting works, such as his "Bone Chair," are a testament to how manual artistry and digital precision can harmonise to achieve groundbreaking innovation.

The synergistic relationship between manual and digital methods has also transformed design education and collaborative practices. In schools such as the ENSAD Limoges, students are encouraged to explore handicraft and digital fabrication, fostering a holistic approach to design. Programs often incorporate workshops where students learn traditional techniques such as ceramics, alongside training in 3D modelling. This dual focus prepares designers to navigate the complexities of integrating tradition with innovation. Providing access to digital tools and training allows artisans to experiment with new techniques while maintaining their connection to traditional craft practices.

2.2.2 Adaptive Sustainability

Craft traditions also play a crucial role in addressing contemporary sustainability challenges. By nature, many craft processes rely on local resources and low-impact methods, reflecting an ethos of material mindfulness that contrasts with large-scale industrial production. Artisans often engage intimately with their materials, adjusting techniques to reduce waste or reusing offcuts for secondary products. This hands-on approach resonates with the global push toward circular economies and eco-conscious design, as it values durability, repairability, and minimised environmental footprints. In contemporary practice, integrating such “craft thinking” means responsible sourcing, close collaboration with local suppliers, and designs favouring longevity over short-lived novelty. As designers grapple with pressing ecological concerns, the inherently holistic mindset of craft, one that ties together material provenance, cultural identity, and the dignity of making, offers potent insights for forging more ethical and sustainable design paradigms.

Adaptive sustainability also involves aligning traditional crafts with circular design principles. Circular ceramics, for example, develop a system where broken or discarded pottery is digitally scanned, ground into powder, and reused in new creations. This approach ensures that traditional ceramics remain part of a sustainable lifecycle while reducing waste. It reimagines artisanal practices by blending heritage techniques with strategies for resource efficiency, waste reduction, and regenerative systems, positioning traditional crafts as exemplars of sustainable innovation in a contemporary context.

Traditional crafts naturally align with sustainability due to their use of local materials, low-impact processes, and cultural depth. Adaptive sustainability builds on these inherent qualities by introducing modern concepts such as reuse, regeneration, and closed-loop systems. By embedding these ideas into traditional practices, adaptive sustainability ensures that crafts remain viable and meaningful while addressing the pressing environmental concerns of the modern era. Applying circular design principles in traditional crafts involves incorporating biodegradable or recyclable materials like reclaimed wood or natural fibres into production. It also involves designing for longevity, encouraging the creation of modular or repairable products that extend their lifespans and enable reuse or recycling at the end of their lifecycle. Collaboration between artisans, designers, and technologists further enriches this process, with tools such as 3D modelling and algorithmic design optimising production and reducing waste while maintaining the artisanal essence of the craft.

2.2.3 Authenticity and Cultural Legacy

The pursuit of innovation through digital tools must be balanced with a profound respect for the cultural identity and material heritage of traditional crafts. Authenticity begins with a recognition of the cultural context in which a craft originated. Each traditional craft embodies the history, values, and identity of the community that created it. A compelling example is the Venini Glassworks in Murano. Founded in 1921, Venini has worked to modernise Venetian glassblowing by collaborating with contemporary designers while preserving centuries-old techniques. Collaborations with designers like Ettore Sottsass have brought innovative forms and colour palettes to Murano glass, allowing the craft to thrive in modern markets without compromising its cultural roots [24]. By engaging with local lace-makers and integrating their expertise into modern designs, this initiative ensures the survival of the craft while adapting it to contemporary design contexts.

In Europe, traditional crafts are deeply intertwined with the environmental and cultural significance of their materials, serving as both a reflection of regional ecosystems and a testament to centuries of cultural heritage. These crafts are often rooted in the careful selection and use of locally available resources, which not only define the aesthetics and techniques of the craft but also connect them to the identities and traditions of the communities that produce them. For example, natural materials such as clay, wood, wool, or flax in European crafts often mirror the landscapes and climates of their regions of origin. In Scandinavia, wood carving evolved in response to the abundance of forests. Mediterranean countries like Italy and Spain are renowned for their ceramic traditions, which are shaped by the availability of high-quality clay and the long history of interactions across cultures in these regions.

Traditional European crafts also exemplify a relationship with the environment. Many of these practices embody sustainable principles, such as using renewable resources, minimising waste, and respecting natural cycles. For example, the cork industry in Portugal is deeply connected to the stewardship of cork oak forests, which are critical for biodiversity and carbon sequestration. This craft demonstrates how traditional knowledge can support ecological balance by harvesting cork bark without harming the trees.

There is a growing movement to integrate traditional practices with contemporary design methodologies, emphasising sustainability and cultural preservation. By drawing on the environmental awareness embedded in these crafts, modern makers are redefining the role of materials in design, ensuring that traditional crafts remain relevant in addressing today's ecological and cultural challenges. Crafts exemplify the connections between materials, environment, and culture. They serve as living repositories of sustainable practices and cultural narratives, offering invaluable lessons for how human creativity can harmonise with the natural world.

Authenticity in design also requires empowering the communities that are custodians of traditional crafts. Collaborative projects involving artisans as co-creators preserve the knowledge and skills embedded in their craft. The European Artistic Crafts Days, organised by the Institut National des Métiers d'Art in France, promotes artisan workshops and public events across Europe. These events provide opportunities for artisans to showcase their work, connect with designers, and foster collaborations that respect and elevate traditional techniques. The Crafting Futures initiative, launched by the British Council, provides another example of collaborative and ethical engagement. The program emphasises co-creation and knowledge exchange by connecting European designers with artisans from rural communities in Romania, Poland, and Hungary. The initiative has supported textile and woodcraft projects that combine traditional motifs with contemporary design aesthetics, ensuring that the crafts retain their cultural significance while appealing to broader markets.

As designers engage with traditional crafts, they must also navigate ethical considerations regarding intellectual property and cultural appropriation. Authenticity requires acknowledging the craft's origins and ensuring its cultural significance is not exploited or commodified without credit. Initiatives such as the UNESCO Creative Cities Network promote ethical practices by encouraging member cities to safeguard intangible cultural heritage and involve local communities in decision-making processes. Designers like Christien Meindertsma**,** known for her work on material transparency, demonstrate how to honour authenticity in design. Her projects, such as the "Flax Project," trace the entire lifecycle of materials, revealing their origins and traditional processing methods. This commitment to transparency ensures that the craft's cultural and material significance is preserved for future generations [17].

Authenticity and cultural legacy are critical elements in the traditional crafts and modern design dialogue. By respecting the cultural identity of crafts, preserving their material heritage, and fostering ethical collaborations, designers can ensure that traditions endure while remaining relevant in contemporary contexts. This approach honours the communities behind these crafts and enriches the global design landscape with a deeper appreciation for cultural diversity and heritage.

2.3 Challenges and Opportunities

The key to fostering a synergistic relationship between craft and design is balance. Allowing manual artistry to inform digital processes ensures that the craft's cultural, tactile, and emotional qualities are retained. Conversely, leveraging digital tools to enhance manual practices introduces efficiency and new creative possibilities without compromising authenticity. An example of this balance can be seen in the work of Erwan and Ronan Bouroullec, French designers known for blending hand-drawn sketches with advanced computational design. Their iconic "Algae" modular partition system began as a series of hand-drawn organic shapes, which were later refined using digital modelling and mass-produced through injection moulding [24].

A primary challenge lies in the loss of material connection resulting from overreliance on digital tools, ranging from 3D modelling software to automated fabrication processes. When designers and artisans spend the majority of their time interacting with virtual renderings rather than physical substances, they risk becoming detached from the subtle tactile cues and embodied knowledge that inform craft-based practices. This phenomenon is frequently discussed in terms of "deskilling" or a reduction in "hands-on" expertise [23, 7]. According to Sennett, making is inextricably linked to practical wisdom: a process that unfolds through tactile engagement and repetitive experimentation. In digital design, however, tactile experimentation is largely substituted by screen-based interactions, potentially narrowing the sensory feedback loop. Ingold [14] similarly posits that material interactions are foundational to cultivating "thinking-through-making," a form of cognitive practice that emerges from the direct handling and manipulation of materials. When this dialogue between maker and matter is mediated primarily by software, the "textility of making," or the continuous interplay of the hand, eye, and raw substance, may be diluted. This distancing has broader cultural and historical implications. Traditional techniques often carry narratives of place, identity, and heritage, passed down through generations of craftspeople [1]. By relegating craft processes to digital approximation, practitioners risk eroding the "lore" of making: those tacit, context-specific insights that ensure practices remain vibrant and rooted in local culture. Consequently, while digital technologies can undoubtedly expedite production and foster innovation, they also invite a form of "alienation" from material engagement that can compromise both creative intuition and the cultural richness of craft traditions. Maintaining a balance, wherein digital tools serve as a supplement rather than a replacement for material experience, is thus crucial for sustaining the tactile intelligence at the heart of artisanal knowledge.

Another challenge involves the perception of the craft relative to design, rooted in a long-standing hierarchy that views craft as narrowly manual while design is framed as conceptual, market-driven, and intellectually rigorous. Institutions, schools, and professional bodies tended to elevate design above craft, which was often relegated to decorative or purely functional applications. This view overlooks the substantial ideation embedded in craft processes, where exploratory making, material sensitivity, and iterative refinement inform creative decision-making to a degree that rivals any design studio. The divergence between craft and design has been perpetuated by a narrative that compartmentalises creative thinking: design is seen as strategic and outward-facing, while craft is perceived as rooted in tradition and inward-looking. Yet, in many workshop environments, craftspeople routinely conceptualise, adapt, and troubleshoot, reflecting a form of "process innovation" that parallels or exceeds that of professional designers. The hand–mind engagement inherent in craft means that ideas are not simply imposed on material but discovered through making, bridging aesthetic ambition with practical know-how. Furthermore, skill-based engagement enables a deep form of problem-solving that can yield conceptual breakthroughs. Thus, craft and design can be understood as distinct yet equally creative modes of practice, each contributing valuable insights into how objects are conceived, produced, and contextualised. Overcoming the hierarchy requires recognising craft as a domain where conceptual and practical intelligence converge, affirming that innovation is often sparked through physical engagement with materials rather than detached planning alone.

The convergence of craft and technology fosters collaboration between artisans, designers, and technologists and drives a broader democratisation of artisanal practices and knowledge. Initiatives like the Doppia Firma Initiative by the Michelangelo Foundation exemplify how partnerships can bridge traditional craftsmanship and digital innovation. By connecting designers with master craftspeople, these collaborations explore how digital modelling and prototyping can refine processes while preserving the artisanal depth that gives these creations their cultural value. Such efforts innovate and ensure that traditional practices remain relevant in a modern context, where creativity and cultural heritage coexist with cutting-edge tools.

This spirit of integration is further amplified by the transformative potential of digital technologies like virtual reality (VR) and motion capture. These tools democratise access to traditional crafts by breaking down barriers of geography and resources. Aspiring artisans and designers can immerse themselves in the tactile and spatial experiences of creating artisanal objects through VR simulations, learning techniques that once required physical proximity to master artisans. Similarly, digital archives of gestures and processes created through motion capture preserve endangered craft traditions and make them widely accessible. These platforms not only educate but also provide spaces for co-creation, where designers and craftspeople can collaborate virtually, transcending cultural and geographical boundaries.

The democratisation of craft goes even further with the rise of digital fabrication labs, online tutorials, and open-source platforms. These resources empower a diverse range of participants to engage with and reinterpret craft traditions. Digital tools such as parametric design software, laser cutters, CNC milling machines, and 3D printers lower the barriers between idea and execution, allowing individuals to rapidly prototype and refine their ideas. The maker movement [10] champions this access to personal-scale manufacturing, enabling the wide-ranging public to contribute to the evolution of the craft. This renewed engagement revitalises craft traditions, particularly in regions where artisanal knowledge may be at risk, by allowing diverse audiences and younger generations to connect with and adapt these practices to contemporary contexts.

By blending accessibility, collaboration, and innovation, integrating technology into craft transforms traditional practices into dynamic, evolving systems. However, this transformation is not without its challenges. Striking the right balance between preserving the tactile authenticity of craft and embracing the efficiencies of digital tools requires careful consideration. While technology can streamline production and inspire new aesthetics, it must remain a complement to, rather than a replacement for, the artisanal essence that gives craft its unique cultural and emotional resonance.

Striking the right balance between preserving artisanal authenticity and embracing innovation is thus a dynamic process. While technology can streamline production and spark novel aesthetics, it must not overshadow the tactile essence of craft. Recognising the challenges and opportunities fosters a robust, evolving dialogue: one in which craft remains vital, and design extends its cultural and creative horizons.

3. Methodology of the Design Pilot

The *Design Pilot* aims to investigate how designers can effectively harness digital tools not only to drive innovation but also to sustain, reinterpret, and evolve the craft traditions they engage with. This exploration seeks to position digital integration as a bridge between traditional craft-making and contemporary design practices, fostering a dialogue that respects the craft's cultural and material integrity while unlocking creative possibilities. The methodology of the Design Pilot is rooted in an interdisciplinary approach, bringing together designers, artisans, and technologists to collaboratively experiment with tools such as computational modelling, digital fabrication, and augmented reality. By embedding these tools within traditional craft workflows, the pilot seeks to identify methods that preserve the craft's tactile and cultural essence while enhancing efficiency, adaptability, and aesthetic potential. Through iterative processes of co-creation and testing, the pilot highlights the symbiotic relationship between handcraft and technology. It emphasises how digital tools can extend the possibilities of traditional techniques, allowing for the creation of hybrid forms and new design applications while maintaining a connection to the artisanal roots of the craft. This integration supports the preservation of endangered techniques and empowers craftspeople to adapt to evolving markets and production contexts. The methodology focuses on contextual adaptation, recognising that craft traditions are shaped by their cultural and material environments, and by tailoring digital tools to these unique contexts. The Pilot ensures that innovation respects local knowledge and practices. Ultimately, the *Design Pilot* aims to provide a replicable framework for integrating technology into craft processes, demonstrating how tradition and innovation can coexist to sustain and enrich both fields.

Within this perspective, the notion of the project becomes central to the methodology, not as an abstract plan detached from making, but as a dynamic space of dialogue between conception and material realisation. In design, a project can be understood as the fundamental unit of intentional action, whether or not it results in a finalised artefact. Whereas artists create "works" for audiences, designers develop "projects" for users. To practice design is therefore to engage in project-based thinking: an approach that structures intentions, anticipates uses, and frames possible transformations. In the *Design Pilot*, design assumes a central mediating role in the dialogue with craft. It is not positioned above craftsmanship, nor does it instrumentalise it; rather, design functions as a reflective and strategic layer that enables exchange between tradition and innovation. Through the project, the design articulates questions, scenarios, and hypotheses that are then confronted with material knowledge and artisanal expertise. The anticipatory phase (modelling, simulating, visualising, prototyping) interacts directly with the tacit intelligence embedded in craft practices. Insights from the workshop reshape digital explorations, while digital experimentation opens new conceptual and formal horizons for the hand-based practice. Design, in this sense, becomes a space of translation. It translates between digital language and material gesture, between future-oriented speculation and inherited technique, between user-oriented thinking and maker-oriented knowledge. The project operates as the framework within which this translation occurs. Rather than separating thinking from making, the *Design Pilot* cultivates a continuous conversation between them, where each iteration strengthens the mutual understanding between the designer and the craftsperson.

However, it is essential to clarify that within the *Design Pilot,* we deliberately remain in the phase of the project. The objective is not to fully realise or industrially produce the designed outcomes, but to push the exploratory dimension of the project as far as possible through digital tools. The pilot operates primarily within the space of conception, speculation, and advanced prototyping. Digital modelling, simulation, and parametric experimentation allow the team to test limits, generate variations, and envision applications that may not yet be materially executed. In this sense, digital tools amplify the scope of the project phase, enabling deeper investigation without necessarily moving into full-scale production. This positioning reinforces the idea that innovation in craft does not depend solely on completed artefacts. The value of the *Design Pilot* lies in expanding the horizon of possibilities within the project itself: mapping what could be made, how it could be made, and how tradition might evolve, even when the final object remains at the level of advanced projection. By placing design at the centre of a sustained dialogue with craft, the *Pilot* affirms its role as both a critical and creative practice: one that connects cultural heritage with technological potential, and that shapes future trajectories without disconnecting them from their material and human foundations.

3.1 Listening and Understanding the Needs of Designers

The first step in the *Design Pilot* methodology is to address the challenges and opportunities faced by designers who work at the intersection of digital and traditional techniques. This process begins by examining how digital technologies, e.g. computational design, 3D scanning, and digital fabrication, can enhance design processes while preserving the craft's cultural and material essence. One significant challenge lies in maintaining a balance between the precision and efficiency offered by digital tools and the tactile, intuitive qualities inherent in traditional craft practices. While technologies can streamline workflows and introduce new creative possibilities, there is a risk that these tools might overshadow or disconnect designers from their material and cultural context. This tension underscores the importance of ensuring that digital integration supports artisanal knowledge and handicraft, rather than supplanting it. To navigate this balance, the *Design Pilot* emphasises active collaboration with designers. By involving practitioners directly in the development, experimentation and adaptation of digital tools, the methodology ensures that real-world challenges and insights shape the development of new approaches. Designers' practical experiences are essential for identifying how digital tools can enhance, rather than dilute, their creative control. This collaboration also helps uncover innovative ways to merge manual artistry with technological precision. Central to this step is the idea that creative control must remain with the designer. Digital tools are seen not as replacements for traditional methods but as extensions that allow designers to push the boundaries of what is possible in form, texture, and application. At the same time, the direct feedback and flexibility inherent in traditional craft processes remain crucial to retaining authenticity and originality. As such, the *Design Pilot* explores how designers can use digital tools to engage more deeply with their material and cultural roots. For instance, MoCap or AR can document and visualise traditional craft processes, allowing designers to study and reinterpret them innovatively. Such tools bridge the gap between past and present, ensuring that historical techniques inspire contemporary creations while adapting to new contexts and markets. By examining these challenges and opportunities through a collaborative, iterative approach, the *Design Pilot* lays the foundation for a design methodology that combines the best of both worlds. It seeks to demonstrate how digital and traditional techniques coexist, creating a framework for designers to innovate while preserving the cultural integrity and tactile richness central to the crafts they engage with. This step ensures that design remains connected to its roots even as it evolves to meet future demands.

3.1.1 Initial Investigative Phase: Exploring Designers' Use of Craft in Practice

The first phase of the *Design Pilot* methodology focuses on understanding how designers engage with craft in their design practices, particularly when integrating traditional techniques with digital tools. Through unstructured interviews, this phase investigates the motivations, strategies, and challenges designers face when incorporating craft into their work. This process ensures that the methodology reflects how craft informs contemporary design, emphasising its cultural, material, and aesthetic dimensions.

Interviews: Unpacking the Role of Craft in Design

The interviews delve deeply into how designers draw on craft traditions in their creative processes. The interviews aim to uncover:

- Craft as Inspiration: How designers use traditional craft techniques or motifs as sources of creative inspiration.
- Material Engagement: How familiar with craft materials, such as wood, ceramics, or textiles, informs their design decisions?
- Integration of Craft: Practical methods designers use to incorporate handcrafted elements into digital workflows, including prototyping, finishing, or visual storytelling.
- Cultural Narratives: How designers use craft to communicate cultural identity, heritage, or local traditions in their projects.

These interviews also address how designers balance the authenticity of craft with the precision and efficiency of digital tools, highlighting instances where digital processes enhance or detract from their engagement with craft.

Outputs of the Investigative Phase

The insights gathered during this phase will form a comprehensive understanding of how designers use craft in their design practice**.** The findings will include:

- Key motivations for incorporating craft into the design include cultural storytelling, material experimentation, and aesthetic enrichment.
- Practical approaches for merging craft with digital workflows, including examples of hybrid techniques.
- Challenges and limitations in using craft, particularly when working at scale or integrating with contemporary tools.

This phase ensures that the *Design Pilot* aligns with the lived experiences of designers who see craft as vital to their practice.

3.1.2 Co-Creation: Designer-Led Development of Digital Tools and Workflows

The second key methodological tool in the *Design Pilot* is the co-creation process, which prioritises active collaboration between designers, artisans, and technologists. This approach ensures that the development of digital tools and workflows is directly informed by the practical knowledge, creative processes, and cultural insights of the practitioners who engage with them. Co-creation fosters innovation and promotes the relevance, usability, and cultural sensitivity of the tools being developed.

Co-creation is grounded in several core principles that ensure the development process is both practical and responsive to the needs of designers. At its core is the principle of practitioner-driven insights, where the experiences, challenges, and aspirations of those actively engaged in craft-based design serve as the foundation for innovation. Their firsthand knowledge directly informs decisions about tool functionality, interface design, and the integration of workflows, ensuring that the outcomes are relevant and tailored to their specific practices. Another key principle is its iterative development, which emphasises the importance of designing, testing, and refining tools and workflows through multiple rounds of feedback. This process allows for continuous improvement, ensuring solutions remain adaptable to real-world contexts and evolve in response to practitioners' changing needs. Finally, collaborative innovation plays a central role in co-creation. By combining the expertise of artisans, designers, and technologists, this approach generates hybrid solutions that leverage the strengths of traditional craft-making and contemporary technology. Together, these principles create an inclusive, co-creative environment that is adaptive and focused on producing tools and methodologies that enhance craft and design practices.

Steps in the Co-Creation Process

- Engagement with Practitioners: Co-creation begins with structured workshop sessions where designers articulate their needs and aspirations. These sessions focus on understanding how practitioners currently use digital and traditional tools, the limitations they face, and the features or processes that could enhance their practice.
- Prototyping Tools and Workflows: Based on the input gathered, prototypes of digital tools and workflows are developed. For example:
    1. Digital Tools: Software for 3D modelling, augmented reality interfaces, or motion capture systems designed to document and reinterpret craft techniques.
    2. Workflows: Guidelines for integrating digital fabrication with manual finishing or combining computational design with traditional material processes.

Prototypes are presented to practitioners for initial evaluation, enabling early feedback on usability, functionality, and cultural fit.

- Hands-On Testing and Feedback: Practitioners test prototypes in real-world contexts, such as workshops or collaborative projects. This hands-on phase allows for a detailed evaluation of how well the tools align with their creative processes. Feedback sessions focus on:
    1. Identifying barriers to adoption (e.g., technical complexity, lack of material responsiveness, engagement challenges, etc.).
    2. Refining features to enhance accessibility and usability.
    3. Exploring how tools can better support cultural and material authenticity in craft practices.
- Iterative Refinement: Insights from testing are used to refine the tools and workflows. Multiple iterations ensure that the final outputs are practical, culturally respectful, and capable of enhancing creative and functional aspects of craft-design integration.

- Collaborative Documentation and Training: Co-creation culminates in the collaborative development of documentation and training materials, ensuring practitioners can confidently adopt and adapt the tools. This includes tutorials, case studies, and usage guides co-authored with practitioners to reflect their expertise and insights.

Outcomes of Co-Creation

The co-creation process ensures that digital tools and workflows are designed with key priorities, making them practical and meaningful for the practitioners who use them.

- By aligning digital tools with practitioners' real-world workflows, they become more intuitive and adaptable to diverse contexts.
- Practitioners' inputs ensure that digital tools respect and preserve the cultural narratives and material traditions fundamental to craft practices.
- Actively involving practitioners fosters trust and a sense of ownership, promoting the widespread adoption of the resulting innovations.

Co-creation transforms digital integration into a collaborative journey, enabling designers to shape the tools and workflows to sustain and evolve their practices. This approach ensures that the *Design Pilot* produces innovative outcomes rooted in the needs of the craft community.

3.2 Mapping "Design" Occurrences across the RCIs

The diversity of each RCI, encompassing distinct materials, techniques, cultural traditions, and technological integrations, creates a compelling need to understand how design is used and practised in each specific context. Each RCI represents unique conditions, ranging from the type of craft (e.g., glassmaking, woodworking) to the cultural narratives and resources that shape its practices. This variability means that the roles of design, methods, and tools can differ significantly. By mapping "design" occurrences across the RCIs, it becomes possible to identify how local conditions influence design approaches, such as adapting traditional techniques to up-to-date workflows or integrating digital tools to enhance efficiency and creativity. Understanding these nuances ensures that the Craeft project respects and supports the individuality of each RCI, while also identifying shared opportunities for collaboration, innovation, and methodological refinement. This mapping exercise ultimately strengthens the capacity of the project to bridge tradition and innovation in culturally and materially relevant ways.

3.2.1 Tracking and Analysing "Design" Across Representative Craft Instances

To fully understand how design is integrated and practised within each Representative Craft Instance, it is essential to adopt a methodology that documents and analyses the diverse contexts, institutions, and local practices involved. This process provides a comprehensive picture of how design interacts with traditional craft practices, materials, and cultural heritage in each unique setting. The approach highlights the diversity of design practices and identifies shared patterns and opportunities for collaboration across the RCIs.

Contextual Analysis: Understanding Local Environments

The first step in this analysis is to examine the cultural, material, and economic contexts that shape each RCI.

- Craft traditions are deeply rooted in the cultural identity of a region, often carrying symbolic meanings and narratives passed down through generations. Understanding these cultural dimensions allows a richer appreciation of how design builds upon and contributes to these traditions.
- The availability and historical use of local materials influence design decisions, from the choice of medium to the techniques employed.
- Economic factors, such as market demand and the positioning of craft in global trade networks, further shape how design functions within each RCI, balancing heritage with commercial viability.

This contextual analysis helps identify the broader forces that shape how design is perceived and utilised in each RCI.

Institutional Documentation: Identifying Key Stakeholders

Equally important is the role of institutions in fostering and guiding design practices.

- Design schools and crafts workshops serve as hubs where traditional techniques are taught alongside design thinking, allowing for the integration of old and new approaches.
- Museums and cultural organisations contribute by preserving and showcasing craft traditions while engaging with contemporary design to make these practices relevant to contemporary audiences.
- Design studios bring together artisans and designers to experiment with innovative methods, often bridging the gap between manual crafts and digital technology.

By examining these institutions, the mapping process captures the structural support and collaborative dynamics that facilitate design practices in each RCI.

Local Practices: Capturing Craft-Design Integration

The core of the analysis lies in capturing local practices, particularly how design and craft are intertwined.

- Closely observing workflows to identify the stages of production where design plays a pivotal role, whether in ideation, prototyping, or finishing.
- The use of tools, traditional and digital, is another critical aspect, as it demonstrates how artisans and designers balance manual techniques with modern technologies.
- Design’s impact on aesthetics, from shaping functional forms to creating intricate patterns, is explored to illustrate its creative contributions.
- Successful examples of collaboration between designers and artisans.

These practices are documented through artefact analysis and on-site observations.

Comparative Analysis: Cross-RCI Patterns and Divergences

Once data has been collected from individual RCIs, a comparative analysis is undertaken to identify commonalities and divergences in design practices across contexts. This step highlights shared strategies for integrating design with the craft while revealing unique adaptations that reflect the specific cultural and material conditions of each RCI. By comparing these findings, the analysis uncovers opportunities for knowledge exchange and collaboration between RCIs, fostering a sense of interconnectedness within Craeft.

The results of this mapping process are synthesised into a comprehensive framework that includes case studies, visual documentation, and comparative insights. By tracking and analysing design occurrences across RCIs, this methodology provides a deeper understanding of the role of design in sustaining and evolving craft traditions and establishing a foundation for innovative, culturally sensitive, and collaborative approaches to integrating design with craft.

3.2.2 Flexible Workshop Formats: Adapting to Craft, Material, and Design Cultures

To ensure applicability across diverse craft traditions and the Representative Craft Instances (RCIs within the Project, the *Design Pilot* employs a framework of flexible and modular workshop formats. This flexibility allows the methodology to respond to differences in material cultures, technical infrastructures, participant profiles, and levels of digital familiarity. Rather than imposing a fixed structure, workshops are configured according to the specific craft ecosystem in which they take place.

Three guiding principles structure this adaptability:

- **Contextual relevance** ensures that each workshop is rooted in the sociocultural, material, and technical specificity of the craft involved. Activities are aligned with local practices, tools, and narratives, preserving identity while opening space for innovation.
- **Participant-centred design** acknowledges the diversity of attendees, from emerging designers to experienced artisans. Workshops are shaped around their expectations, skills, and professional realities, ensuring accessibility and meaningful engagement.
- **Progressive exploration** enables gradual integration of digital elements. Workshops may begin with foundational craft techniques and progressively introduce experimental approaches, allowing participants to build confidence while expanding their creative vocabulary.

Within this flexible framework, two complementary formats are activated depending on context:

- **Hybrid Craft–Design Workshops.** These sessions create a shared space where traditional techniques and contemporary design thinking intersect. Designers and artisans collaborate to reinterpret established practices through new lenses. Digital tools are introduced as complementary instruments, supporting visualisation, analysis, or variation, while maintaining the primacy of material engagement. The focus lies on co-creation as well as cultural and technical translation, positioning design as a medium through which craft heritage can be reframed for contemporary contexts.

- **Experimental and Technology-Driven Workshops.** In settings where participants are prepared to explore advanced digital integration, workshops encourage speculative experimentation. Technologies such as computational design, 3D printing, augmented reality, or parametric modelling are used to challenge conventional limits. The aim is not technological performance alone, but the generation of hybrid prototypes that merge computational precision with tactile sensibility.

Each format remains modular and scalable. Activities are adjusted according to available technological resources and infrastructure, ensuring that digital integration remains realistic and context-sensitive. Through this flexible architecture, the *Design Pilot* sustains inclusivity while preserving cultural and material relevance.

3.3 Conception Phase

The conception phase structures how workshops and Pilot activities are designed, implemented, and refined. It operates through an iterative planning cycle that ensures responsiveness to participant feedback, craft-specific constraints, and evolving insights. Rather than a linear progression, this phase unfolds as a dynamic loop of planning, action, evaluation, and adjustment.

3.3.1 The Iterative Planning Cycle

The cycle begins with defining objectives, scope, and expected outcomes for each pilot activity. This definition is informed by case studies and institutional experiences from the participating RCIs, which provide grounded examples of how design and craft intersect in practice. These references guide the selection of tools, workshop formats, and thematic orientations.

1. **Implementation Phase.** Workshops are conducted in real-world settings, emphasising hands-on engagement and collaborative experimentation. The structure remains adaptable, allowing facilitators to respond to emerging challenges or unexpected insights. Particular attention is given to observing how participants interact with materials, digital tools, and each other.
2. **Feedback Collection.** Structured feedback is gathered through discussions, questionnaires, and facilitator observations. Participants reflect on their experiences, challenges, and learning outcomes. This stage captures both technical evaluations and cultural reflections, providing a multidimensional understanding of the workshop's impact.
3. **Refinement Phase.** Collected feedback informs adjustments to subsequent activities. Refinements may involve recalibrating the balance between manual and digital processes, introducing alternative tools, or modifying exercises to better align with material traditions.
4. **Reiteration and Expansion.** Revised formats are re-tested and progressively stabilised. Through repeated cycles, the methodology becomes increasingly robust and transferable. This iterative structure ensures that the *Design Pilot* remains adaptive while progressively consolidating its framework.

3.3.2 Developing Workshop Formats: Balancing Tradition with Digital Innovation

While Section 3.2.2 defines the adaptable typologies of workshops, this section focuses on how individual workshop sessions are internally structured to articulate the dialogue between craft and digital design.

Workshops are conceived as staged learning environments in which participants move through distinct but interconnected phases.

Engagement with Traditional Craft Practices

Each session begins with immersion in material processes. Participants explore foundational techniques, gestures, and narratives that define the craft tradition. This grounding reinforces manual expertise and highlights the embodied knowledge embedded in tools and materials.

Digital Extension and Exploration

Once participants have engaged materially, digital tools are introduced as exploratory extensions. These may include:

- **Motion Capture (MoCap)** to record and analyse artisanal gestures, making tacit movements visible and preservable.
- **Virtual Reality (VR) Sketching** to prototype forms in immersive environments before fabrication.
- **3D Scanning** to digitise artefacts for study, reinterpretation, or variation.
- **Interactive Simulators** to test structural or functional parameters before physical execution.

The objective is not to replace manual processes but to expand interpretative and generative capacity. Digital phases often operate in dialogue with craft experimentation: a hand-made prototype may be scanned and modified digitally; a digitally modelled structure may later be realised through traditional fabrication techniques.

Balancing and Integration

The final stage of workshop development ensures that traditional and digital components form a coherent workflow. Hybrid processes are constructed deliberately, demonstrating how computational precision and tactile authenticity can reinforce one another. Participants are encouraged to adapt tools critically, aligning them with their aesthetic language and cultural context.

Through this structured progression, workshops move beyond simple tools or processes demonstration. They become environments where participants experience how design can mediate between heritage and innovation. By clearly distinguishing flexible format typologies (3.2.2) from internal workshop structuring (3.3.2), the methodology avoids redundancy while maintaining coherence across scales, from strategic planning to practical implementation.

3.4 Steps, Timelines, and Milestones for Pilot Execution

The successful execution of the *Design Pilot* requires a clear timeline with defined steps and milestones to guide the process from initial planning to outcomes. Below is a breakdown of the key phases and their associated timelines:

3.4.1 Initial Planning and Setup (M18–M24)

The initial phase of the *Design Pilot* focuses on establishing a robust foundation through detailed preparation and strategic planning:

1. Undertake comprehensive preliminary research and contextual analysis for each RCI, delving into its unique cultural, material, and technical dimensions.
2. Identify and engage key stakeholders, including designers and institutional representatives, to ensure collaborative and informed planning.
3. Design the methodology, workshop formats, and pilot activity framework, carefully tailored to reflect the distinctive characteristics of each RCI.
4. Secure the necessary resources, tools, and venues, laying the groundwork for an effective and seamless pilot Implementation.
5. Prepare informed consent processes wherever personal data is processed (interviews, recordings, etc.)
6. By M24, finalise the methodology and pilot setup, and address all logistical, technical, and cultural considerations.

3.4.2 Pilot Launch and Initial Execution (M24–M28)

The initial execution phase focuses on implementing and evaluating the pilot activities in real-world settings, ensuring active collaboration and practical insights:

1. Facilitate the first round of workshops and pilot activities, prioritising hands-on engagement and meaningful collaboration with designers.
2. Evaluate the practicality and effectiveness of the planned activities, collecting early feedback to assess their impact and relevance.
3. Meticulously document workflows, tools, and techniques employed during the sessions to inform subsequent refinements and analysis.
4. By M28, complete the first round of pilot execution, capturing key insights and identifying areas for improvement to refine future activities.

3.4.3 Mid-Pilot Review and Refinement (M28–M30)

The mid-pilot phase focuses on analysing outcomes, refining methodologies, and preparing for the final phase of execution:

1. Conduct a comprehensive analysis of feedback from designers, identifying key successes and challenges encountered during the initial activities.
2. Refine workshop formats, tools, and workflows based on these findings, ensuring they align more closely with designers' needs and project objectives.
3. Re-implement the updated activities, incorporating adjustments to enhance their effectiveness and relevance.
4. By M30, complete the mid-pilot review, integrate refinements and lay the groundwork for the final implementation phase.

3.4.4 Final Execution and Outcome Consolidation (M30–M36)

The final phase of the *Design Pilot* focuses on consolidating efforts, implementing refinements, and documenting impactful results:

1. Conduct the concluding round of workshops and pilot activities, ensuring all refinements and improvements are fully integrated into the sessions.
2. Prioritise the documentation of best practices, successful methodologies, and tangible outcomes, creating a comprehensive record of the pilot's achievements.
3. Gather final feedback from participants and assess the overall impact of the activities on both individuals and RCIs, identifying lasting contributions and areas for future exploration.
4. By M36, compile a comprehensive report encompassing outcomes, case studies, and practical guidelines for effectively integrating traditional and digital practices, providing a robust foundation for scaling and future initiatives.

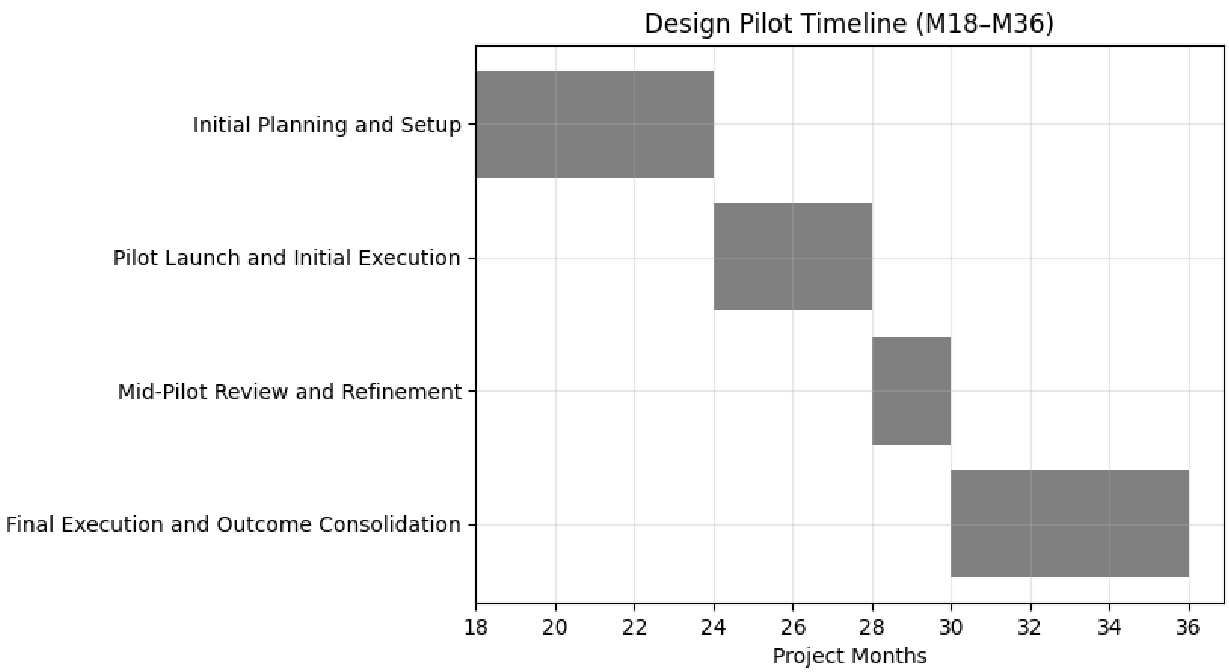


Figure 1. Design Pilot Timeline.

The *Design Pilot* methodology establishes a framework that fosters, through design, a deep synergy between craft heritage and digital innovation. Grounded in listening, mapping, and co-creation, this approach ensures that the integration of digital tools enhances rather than detracts from the cultural and material authenticity of craft traditions. By actively engaging with designers, mapping the unique contexts of each RCI, and designing flexible workshop formats, the pilot exemplifies how tradition and innovation can coexist in mutually enriching ways. The relationship between craft and design benefits immensely from the judicious application of digital technology. Digital tools amplify creative possibilities and enable preservation, adaptation, and storytelling within craft practices. This methodology's emphasis on understanding local contexts and involving designers in co-creative processes ensures that these tools are adapted to the needs and aspirations of craft communities. Looking ahead, the *Design Pilot* sets the stage for forming new partnerships and extending digital integration into other craft domains beyond the current RCIs. By applying the lessons learned to broader contexts, the methodology is a replicable model for other craft sectors, expanding its impact on global craft and design communities. Ultimately, the *Design Pilot* lays the groundwork for a long-term transformation in the crafts sector. It harmonises tradition with technology, ensuring craft practices endure and evolve to meet the creative, cultural, and future economic demands. This synthesis of heritage and innovation creates a sustainable pathway for reimagining the role of craft in contemporary design and beyond.

4 Technological Innovation

The deliverable draws on three clusters of Craeft technical components.

A. **Product-design and appearance prediction**. D6.2 interfaces with craft-specific simulators that start from 3D models to support reasoning by previewing outcomes for moulds, coatings (glazes), engraving, and multiple glass compositions. PBR is rendering the backbone for consistent appearance previews.
B. **Motion, gesture, and knowledge infrastructure**. D6.2 uses the motion pipeline to reconstruct practitioner activity as a 3D avatar from video, segment recorded practice into elementary actions, and attach semantic roles to those actions. The resulting assets are 3D tools, action lists, and synchronised recordings. More importantly, they are registered as events in a knowledge base and made available online for review, enabling shared analysis and design discussion. In the Limoges track, this is complemented by the Interactive Plaster Simulator, which intentionally abstracts away full-body depiction to foreground tool-material interaction and action-level understanding.
C. **Fabrication and prototyping toolchain**. D6.2 connects digital design to making via 3D printing for rapid prototyping, and via a dedicated additive/subtractive toolkit in Unity (RevolutionSolid) that supports interactive solid editing (e.g., additive, subtractive, mass-preserving operations) as part of the broader “technological innovation” dimension. This is implemented in prototype workflows: CAD → STL → slicer → FDM print, and complementary subtractive preparation, i.e. CNC machining in the wood case study.

The following two subsections represent extensions and specialisation of these technologies for the design pilot.

4.1 Scene representation and understanding

Initially, we digitised in 3D the plaster-throwing tools used in the process and represented them in the knowledge base. Then we recorded the process using an egocentric camera, capturing the practitioner's perspective and hand movements, and a scene overview, providing a stable external reference for workspace interactions. Using the recordings, we reconstructed the practitioner's motion as a 3D avatar. Using event logs from the video data, we semi-automatically segmented the crafting process into elementary plaster-throwing actions. The extracted movements were semantically structured, linking each action to a functional role. The recording was registered as an event in the knowledge base, and the digital assets from the session were linked to it and made available online through Web browser access for review. This includes the 3D models and the synchronised audio-visual recordings. In Figure 1, shown is the registration of the recording event in the knowledge base (left), the list of recorded actions (middle), and the collection of video segments (right).

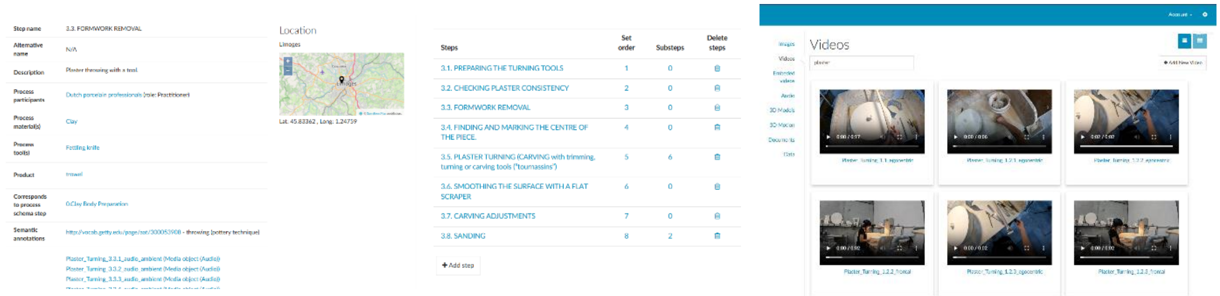


Figure 6. Event registration (left), action collection (middle), and recordings preview (right).

Following the workshop findings, our study focused on tools and body posture during the actions. The motion-extracted 3D avatar effectively captured the hand and body movements, aligning with real-world observations. Including 3D-scanned tools enhanced the accuracy of tool-material interactions, enabling a more faithful simulation of practitioner techniques. Deviations are observed in fine-scale, due to the complexity of modelling material behaviour. The simulation provided a meaningful approximation but would benefit from more advanced material calibration and experimental validation through high-speed imaging.

An interactive physics-based application of the plaster-throwing provides an introduction to the craft and workshop. The tools, models and motion data guide the virtual throwing dynamics, allowing for real-time exploration of tool-material interactions. Key components of the application include (a) 3D-integrated plaster-throwing tools, (b) gravity, inertia, and real-world dynamics constraints, and (c) real-time interaction to practice with throwing speed and tool angles. In Figure 2, shown are two views from the overview and worn camera (left column, top and bottom, respectively). The rest of the columns show the reconstruction of body posture (top) and tool manipulation (bottom) in simulation.

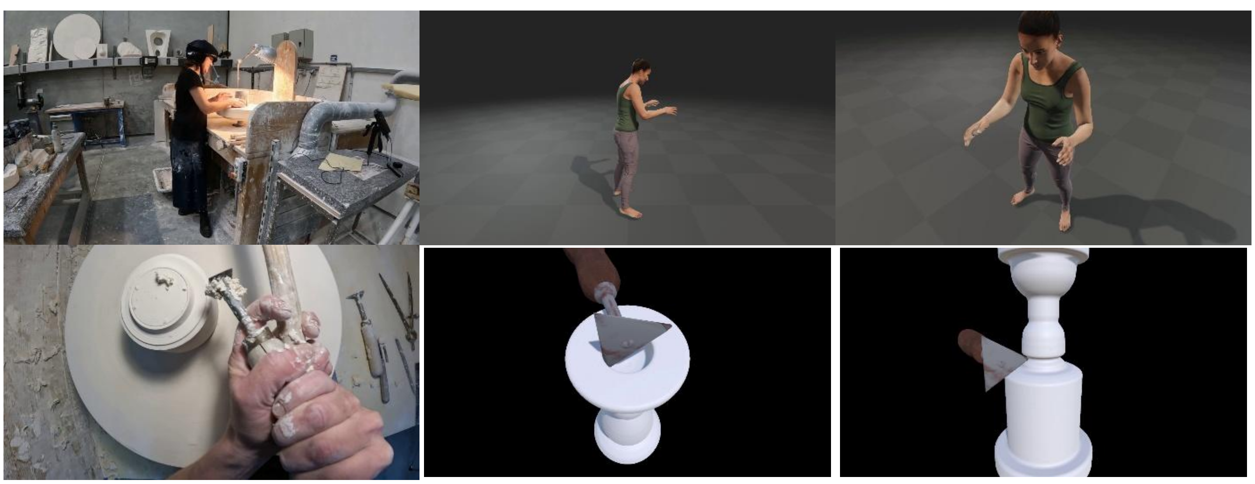


Figure 7. Ethnographic videos of plaster throwing (left) and virtual reenactment (middle, right) © ARMINES / FORTH.

4.2 Physically Based Rendering for Ceramic Process States

Physically based (PBR) rendering was used in the Design Pilot as a design support tool: to communicate a proposal visually and to help designers anticipate how form and surface appearance evolve across successive production stages.

The workflow supports two practical needs that recur in ceramic design contexts: (i) compensating for predictable dimensional change across firings, and (ii) previewing the object consistently in distinct material states, namely plaster, fired porcelain, and glazed porcelain.

4.2.1 Dimensional change across firings

Ceramic objects do not retain the same dimensions throughout the production chain. In the porcelain context, the artefact transitions from an initial plaster stage to fired porcelain, and—when glazed—undergoes an additional firing cycle. Although this dimensional evolution is a known property of the craft, it becomes a design risk when the intended final dimensions must be validated early. Digitally, this is handled transparently and reversibly by applying scale factors to the 3D model. This enables designers to evaluate the same form at different “production stages” without rebuilding geometry, and to treat dimensional compensation as a controlled design parameter rather than an uncertainty.

4.2.2 PBR visualisation of material states

Beyond geometry, the perceived quality of a ceramic object depends strongly on surface optics, which differ markedly between plaster prototypes, fired porcelain bodies, and glazed porcelain. The Design Pilot, therefore, adopted a state-based rendering approach: the same 3D geometry is rendered under controlled viewing and lighting conditions using material presets corresponding to each state. This supports comparative reasoning; e.g., how a handle’s silhouette reads once glazing increases specular response; how relief details remain legible after firing; how surface roughness cues shift between plaster and fired ceramic. The approach is especially valuable when design decisions depend on subtle perceptual factors (highlight sharpness, edge contrast, perceived curvature) that are difficult to anticipate from line drawings or uncalibrated preview renders.

4.2.3 Implementation

The technical infrastructure of the rendering pipeline, material parameterisation, and the definition of porcelain-body rendering presets are reported in D3.2, Section 5.4.3, Porcelain Bodies. Here, we see how these capabilities are applied to support design iteration and cross-stage validation.

To support the design activities, FORTH developed and used a lightweight rendering software using Craeft's PBR toolbox. It is a utility that turns a 3D model into consistent, high-quality, physically based renderings and brief visualisations under controlled viewing conditions. This was used in two ways:

1. **Size validation, across firings**. Ceramic production involves predictable dimensional change across stages from plaster to fired and possibly glazed porcelain. Rendering supports the same design at different production stages by applying a scale factor. While straightforward computationally, it is

relevant to the design perspective because it lets early reasoning about proportions, ergonomics, and fit.

2. **State-based PBR previews for wet plaster, fired porcelain, and glazed porcelain**. The renderer supports rendering the same geometry under distinct material states, corresponding to key stages of the process. This enables better perception of shape and structural features, namely edges, curvature, highlight, and relief.

The images and animations produced were shared visual references during design discussions and documentation. They allow juxtaposed comparison across variants and across states/times, and potentially remote review.

The detailed technical implementation of the rendering pipeline and the definition of state presets are documented in the project's technical deliverables (notably D3.2, Section 5.4.3 'Porcelain Bodies'); here we report its role as an applied design support utility within the Design Pilot.

4.2.4 Usage

PBR visualisation was used in a two-mode manner. The goal was to support both (i) inspection of shape and surface structure, and (ii) realistic appraisal of appearance under plausible illumination conditions.

Neutral "analytical" lighting for objective assessment

We rendered designs under a neutral, artificial lighting setup with stable viewing conditions. This mode is conservative: it reduces the influence of coloured illumination and complex reflections, so that the designer can inspect **structure, silhouette, proportions,** and **surface relief** with minimal visual distraction. While such neutral lighting is standard practice in computer graphics, it is especially valuable in craft and product design contexts because it establishes a common baseline for critique; e.g., *"Is the curvature reading correctly?" "Is the ridge legible?" "Does the thickness feel right?"*

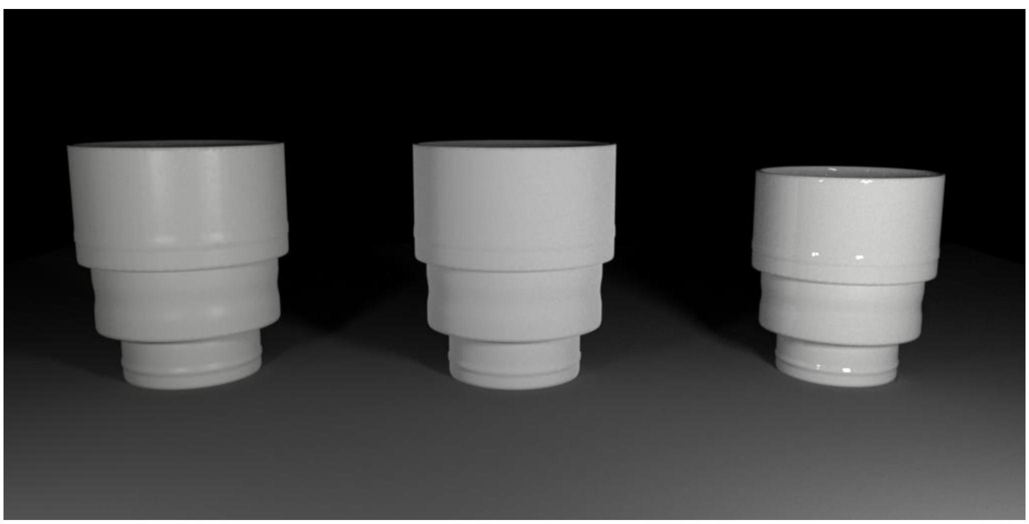


Figure 2. Neutral "analytical" lighting setup used to inspect form and surface structure with minimal illumination bias. The example illustrates how the setup supports objective inspection of structural features, e.g., edges, grooves, and shallow relief. Example body rendered as plaster (middle), fired porcelain (left), and glazed porcelain (right)

HDRI illumination to evaluate realistic appearance

We rendered the same designs using HDRI environment lighting. This mode provides a more realistic distribution of illumination and reflections, including high-frequency highlights. This helps judge how the object will be imbued with appearance in everyday or showroom-like settings. HDRI rendering tests whether design choices remain robust when exposed to realistic light-fields.

Figure 3. The same design was rendered under an HDRI environment illumination to assess realistic appearance and highlight behaviour (PBR rendering). Video: https://youtu.be/LUAFzf7tVkE

Rotational comparative videos across material states and scale

To support systematic comparison, the renderer produces rotational (turntable) videos showing matched viewpoints across three material states: (i) plaster, (ii) fired porcelain body, and (iii) glazed porcelain. These videos were prepared specifically to allow the team to compare:

1. Appearance change across states (surface response, highlight sharpness, perceived smoothness), and
2. Size change across production stages is represented through stage-dependent scaling of the same underlying geometry.

Video-based presentation proved useful for design review because it makes cross-state differences visible without requiring interactive software, and because it supports side-by-side discussion in remote settings.

Figure 4. Example layout used for review sessions, presenting rotational views in a consistent format to support cross-state and cross-variant comparison.

Is PBR worth the trouble (and the expense)?

Although a shaded viewport is extremely useful for fast inspection, it is a geometric preview: it renders surface orientation via a simplified shading model. This model captures the basics, but it is only loosely tied to how light behaves in the real world.

By contrast, even a "neutral" physically based render (PBR) under a single white point light typically provides more diagnostic shape cues. The reason is perceptual and computational: the visual system is highly sensitive to systematic intensity gradients produced by illumination, and uses them to infer local surface orientation and global 3D structure ("shape from shading"). Classic work shows that shading is a powerful depth cue, but it is also ambiguous, so viewers rely on stable regularities, such as - in our case - specular reflections on glaze or its substrate, scattering (e.g., coherent single-source lighting) to resolve the interpretation.[3]

In general, PBR tends to improve shape communication because it yields a more physically consistent relationship between curvature, shading gradients, and (when present) highlight structure and shadowing. These cues anchor the viewer's interpretation of convexity/concavity and curvature scale more reliably than generic viewport shading, and they also support material-aware judgements; i.e., how the same form reads as plaster vs fired ceramic vs glazed.[4]

Figure 5. Comparison between (left) a MeshLab shaded viewport preview (using surface normals for smooth appearance) and (right) a neutral physically based render (single white point light). PBR rendering provides physically consistent shading cues, highlights, and shadow structures, which more effectively convey perceived 3D form and curvature for design review.

[3] Ramachandran VS. Perception of shape from shading. Nature. 1988 Jan 14;331(6152):163-6. https://doi.org/10.1038/331163a0
[4] Koenderink, J. J., & van Doorn, A. J. (1982). The Shape of Smooth Objects and the Way Contours End. Perception, 11(2), 129-137. https://doi.org/10.1068/p110129

5. Use Cases

The *Design Pilot* highlights the intersection of traditional craft and contemporary technological innovation through design practices. It focuses on reimagining heritage crafts through experimental design approaches that integrate advanced tools, new materials, and interactive techniques. The case studies developed within the Pilot demonstrate how this methodology can be applied across different material cultures and production contexts, revealing the versatility and continued relevance of artisanal practices in addressing contemporary design challenges. They show craft not as a fixed legacy, but as a dynamic knowledge system: one that can evolve through design inquiry, prototyping, and interdisciplinary collaboration. Structurally, the *Design Pilot* is articulated through two complementary formats: exploratory case study and advanced case study. These formats represent different depths of engagement with the same overarching objective: strengthening craft–design transmission while enabling innovation grounded in tradition. These two formats are not hierarchical, but interdependent.

The exploratory case study, *Tapestry as Image Technology*, *Glass and Interactivity*, and *Marble and Silversmithing between Design, Craft and Cultural Heritage,* function primarily as conceptual laboratories. Their role is to open design questions by reframing craft traditions as contemporary media. In these contexts, craft is approached not only through production outcomes, but through what it can communicate and activate: tapestry as an image-making system and immersive narrative surface; glass as a material defined by transformation, behaviour, and interaction; marble and silversmithing as practices where material intelligence and cultural heritage can be translated into new aesthetic and functional propositions. These pilots prioritise experimentation, interpretation, and speculative prototyping, creating space for designers and craftspeople to test unexpected combinations of techniques, tools, and modes of engagement. These three use cases remain in a preliminary project phase: they establish initial research directions, shared vocabularies, and first exploratory tests, but have not yet been developed into fully implemented pilots with stabilised workflows, logistical frameworks, or evaluated production protocols. They nevertheless expand the cultural and conceptual territory of each craft, generating insights that can later inform more structured implementation.

The advanced case study, Limoges porcelain and woodcarving at CETEM, operates as a materially grounded testing environment in which the *Design Pilot*'s methodological perspectives and operational guidelines are examined in depth. In its initial development phase, the *Pilot* concentrated exhaustively on the Limoges porcelain case study, using it as a rigorous framework to refine collaboration formats, logistical coordination, and pedagogical structures in a context where heritage, education, research, and industry are tightly interconnected. The conception and initial implementation of the Porcelain Design Pilot thus became a critical test bed for hybrid workflows that combine tacit workshop knowledge with contemporary design methods and digital fabrication tools. Complementing this, the woodcarving pilot at CETEM broadened the scope by addressing a different craft ecosystem and a distinct set of constraints. By integrating CAD/CAE tools, FDM 3D printing, and CNC machining into woodcarving processes, it directly links design development to execution, reducing uncertainty between design intent and carving practice and strengthening communication between designers and craftspeople.

The decision to focus more extensively on Limoges is therefore methodological rather than preferential. Limoges offers a uniquely dense ecosystem in which heritage, education, research, and industry are structurally interconnected. The presence of a historically rooted porcelain tradition, an advanced art and design school, specialised research facilities, and active industrial stakeholders creates a rare environment where the full spectrum of craft–design transmission can be observed and tested simultaneously. It provides a comprehensive case in which material knowledge, technological innovation, pedagogical experimentation, and market-oriented production intersect within a single territorial framework. As such, Limoges functions as a paradigmatic case study: it captures, in a concentrated form, the structural, cultural, and operational complexities that the *Design Pilot* seeks to address. By applying the principles of the *Design Pilot* within this rich institutional and territorial ecosystem, valuable insights have been gained into the effectiveness, adaptability, and scalability of the proposed methodologies. The challenges encountered were: technical translation between digital and manual processes, coordination among interdisciplinary actors, and balancing heritage preservation with innovation. These have generated practical solutions that inform the continuous evolution of the *Pilot*. The knowledge derived from this implementation phase serves as a robust foundation for its rigorous and context-sensitive application across other RCIs, ensuring that craft–design transmission remains both rooted in tradition and responsive to contemporary technological and cultural dynamics.

Seen together, the exploratory and advanced use cases form a coherent progression of the *Design Pilot*'s logic. The exploratory pilots establish new frames: craft as image, as interactive behaviour, as cultural translation, while the advanced pilots translate these frames into robust methods that can be replicated, taught, and adapted across contexts. This combination ensures that innovation is not detached from heritage, and that heritage is not limited to preservation: the *Design Pilot* positions craft–design transmission as an active, evolving process, capable of responding to contemporary technological and cultural dynamics while remaining anchored in the precision, sensibility, and intelligence of traditional making.

6 Exploratory Case Studies

6.1 Case Study 1: CERFAV / Glass and Interactivity: The Material in Motion

The *Glass Design Pilot* emphasises the importance of movement, literal and metaphorical, in glass as a medium. Glass, inherently fluid during its formative process, embodies motion and transformation. This characteristic extends to the craft itself, where each generation of artisans develops new ways to engage with the material, reflecting broader cultural and technological shifts. The *Design Pilot* encourages participants to interrogate this notion of movement, pushing them to consider how integrating digital tools and interactivity can redefine the essence of glassmaking.

From September 30 to October 4, 2024, students from the *Créateur Verrier* program (32nd cohort in Glass Creation) explored various ways to make their glass creations interactive. Guided by designer Auguste Hazemann and supported by the CERFAV team, they extensively experimented with FabLab's resources. The workshop bridged traditional glassblowing techniques with innovative digital tools, encouraging students in Glass Creation to rethink the relationship between materiality and interactivity in their work. Participants stepped back and critically assessed their creative processes through hands-on experimentation and reflective discussions. This reflective approach enriched their understanding of glass as a medium and introduced new possibilities for integrating design and technology.

6.1.1 Auguste Hazemann: Collaborator in the Glass Design Pilot

Auguste Hazemann, a designer and researcher in digital arts and humanities, brings a unique perspective to the *Design Pilot*. With a background in object design from the École Nationale Supérieure des Arts Décoratifs de Paris (ENSAD), Auguste has cultivated a practice that bridges traditional craftsmanship and digital innovation. His work emphasises the sensory and technical qualities of objects, exploring how digital and electronic technologies can serve as interactive and narrative media. Currently pursuing a PhD at the DeScripto research laboratory at the Université Polytechnique des Hauts-de-France, Auguste's design-based research focuses on the relational dynamics between humans and non-humans (objects) while rethinking the role of technology. His approach rejects purely solution-oriented design, instead fostering a dialogue that positions humans within their technological environment. Inspired by biodiversity, his projects explore how objects and devices communicate autonomously, inviting users to discover connections and modes of interaction.

Auguste's work with CERFAV builds on his long-standing fascination with glass as a material of expressive and functional potential. His earlier collaboration with glassmakers at CIAV led to *Spiro*, a lamp inspired by the symbolic and functional act of the glassblower's initial breath. By integrating sensors and coding, Auguste transformed the act of blowing into an interactive element, placing the gesture at the heart of the object's functionality and narrative. Auguste continues to explore how digital technologies can augment traditional glassblowing techniques. His hands-on experience, including learning glassblowing at NID in India, has enriched his ability to bridge traditional craft with modern design. His work at CERFAV focuses on understanding how digital tools, such as sensors, coding, and interactive design, can enhance the materiality and storytelling potential of glass while respecting its heritage.

Auguste Hazemann's contribution to the *Design Pilot* highlights the potential for combining craft and digital innovation, creating a dialogue between tradition and technology that aligns with CERFAV's mission to advance the art and science of glassmaking.

6.1.2 Glass Design Pilot: Glass and Interactivity—The Material in Motion

The *Glass Design Pilot*, titled *"Glass and Interactivity: The Material in Motion"*, focused on creating hybrid objects that bridge craft practices and digital technology. The workshop encouraged participants to critically explore integrating traditional glassmaking techniques with interactive digital elements. To achieve this, designers and artisans engage with concepts drawn from the humanities, such as anthropology, history, and philosophy, fostering a reflective approach to their creative practices.

Through initial discussions and activities, participants were introduced to methods for critically analysing their work and situating themselves within a broader community of practices. They also receive hands-on training in electronics and programming, enabling them to develop a language of interactivity. This exploration challenges them to question what these technologies can contribute to traditional craft-making and how interactive objects are perceived by audiences.

A key challenge of the workshop was avoiding superficial combinations of craft and technology, e.g. simply embedding a Bluetooth speaker into a glass case. Such a combination would render the case interchangeable with other materials like plastic or wood, undermining the specificity of the glass medium. Instead, the interaction must become an inseparable part of the object, deeply tied to the creator's intention and the material's unique qualities. Achieving this requires a reflective approach, encouraging participants to create meaningful connections between form, function, and interactivity.

After the workshop, participants were required to present a functional prototype of their creations. In addition, they documented and communicated their research and production process through an exhibition and oral presentation, detailing their intentions, creative journey, and reflective practices. This approach ensures that the CERFAV *Design Pilot* not only promotes technical innovation but also deepens the understanding of how tradition and technology can coalesce to create meaningful, innovative works.

6.1.3 Integrating Reflexivity into the Glass Design Pilot Methodology

The *Design Pilot* methodology developed at CERFAV emphasises the integration of reflexivity as a core component of its approach. This element is essential in bridging traditional craft practices with digital innovation while maintaining a deep connection to the cultural, material, and social dimensions of craft practices. Through guided workshops and reflective practices, participants were encouraged to critically engage with their materials, techniques, and the broader implications of their creative work.

Material Awareness in Design

Central to the methodology is the notion that materials like glass are not neutral entities but deeply embedded in cultural, environmental, and historical contexts. By exploring the materiality of glass, participants are prompted to consider its connections to specific territories and resources, such as the forests of Lorraine and the traditional processes of sourcing potash. This material awareness reinforces the CERFAV *Design Pilot's* aim to contextualise craft within its local heritage, helping designers to make informed and meaningful choices about how they incorporate materials into their creations. The reflective component of the methodology asks participants to interrogate questions such as: *Why choose this material? What narratives does it convey about its origins? How can these narratives be integrated into the design process?* These inquiries are crucial for ensuring that the use of glass and, by extension, any material that respects its heritage while opening pathways for innovation.

Craft Heritage and Social Dynamics

The CERFAV *Design Pilot* methodology also emphasises the role of craft as a cultural and social practice, shaped by historical relationships and workshop dynamics. By situating their work within the lineage of glassmaking traditions, participants are encouraged to reflect on how their creations can honour this heritage while addressing contemporary challenges. This involves questioning how social hierarchies, gender roles, and consumer relationships within the craft industry have evolved and how design can challenge or reinforce these dynamics. For example, the hybridisation of glass and electronics, a focal point of the CERFAV pilot, provides an opportunity to explore interactivity not as an add-on but as an integral aspect of the object. Participants are guided to think critically about how new technologies can transform the aesthetic and functional language of glassmaking, fostering innovation while remaining sensitive to its traditional context.

Reflexivity in the Design Process

Reflexivity is woven throughout the CERFAV *Design Pilot* to foster deeper engagement with both craft and design. Students and practitioners are encouraged to ask critical questions about their creative processes, the implications of their choices, and the narratives their work conveys. This reflexivity is supported through structured workshops that combine hands-on experimentation with discussions about cultural heritage, environmental sustainability, and the potential of digital tools. In this way, the CERFAV *Design Pilot* methodology positions reflection not as a secondary consideration but as a driver of innovation. By encouraging participants to articulate and justify their creative choices, the methodology ensures that the integration of traditional and digital practices is meaningful, purposeful, and rooted in personal and cultural authenticity.

Outcomes Aligned with the Design Pilot

The emphasis on reflexivity culminates in outcomes that align with the *Design Pilot's* broader goals. Participants develop functional prototypes that blend traditional and digital elements and create narratives articulating cultural and philosophical dimensions. These outcomes are showcased through exhibitions and presentations, demonstrating the potential of the *Design Pilot* to transform how craft is perceived, practised, and communicated in contemporary design contexts.

By embedding reflexivity into its methodology, the *Design Pilot* ensures that the integration of tradition and technology is innovative and respectful, creating a foundation for the sustainable evolution of craft practices.

6.1.4 Integrating Movement, Materiality, and Interactivity

In today's world, digital technologies profoundly reshape objects and our interactions with them. Glassmaking, too, has felt the influence of digital tools, from computer-aided design to advanced production technologies. However, this shift is not without challenges. For many artisans, digital techniques can feel detached from the material or even a loss of ownership over their craft. The high-profile example of Lalique’s “Impossibles Vases,” digitally designed but with high market value, raises questions about the role of craft when objects become partially or entirely digital.

Through the workshop, the Design Pilot provides a space for glassmakers to reflect on these transformations, express their experiences, and explore ways to integrate digital tools meaningfully into their practice. Rather than viewing technology as a replacement for traditional techniques, participants are encouraged to see it as a complementary tool that enriches their craft.

Humanist and Ecopoetic Approaches to Interactivity

The workshop invites participants to reframe their understanding of objects and interactivity. Drawing on the ideas of thinkers like Bruno Latour, it introduces the concept of objects as "agents" within society, or active participants that shape human action and connection. In this context, interaction embodies these objects and highlights their active roles. Participants are encouraged to consider their cultural, historical, and poetic dimensions, moving beyond the purely functional to develop objects that resonate on a deeper level.

Several principles guide this exploration:

1. Objects as Storytellers: Glass objects carry layers of meaning, from technical know-how to social customs and potential future narratives. Participants are encouraged to approach their work as both encyclopaedic and poetic, reflecting the richness of human history and the possibilities of new interactions.
2. An Ecopoetic Perspective: Glass objects are seen as integral to their environment, participating in the broader movement of the world. This perspective fosters care for the material and its context, encouraging collaborative rather than exploitative relationships.
3. A Critical Approach to Technology: The workshop emphasises the importance of maintaining a balanced relationship with digital tools. These tools are part of a broader set of techniques, used thoughtfully and without overreliance. Experimentation and practice allow participants to master these technologies while retaining creative autonomy.

From Reflection to Creation

The Glass Design Pilot combined reflective inquiry with practical experimentation. Participants engaged in hands-on activities, using digital tools such as sensors and interactive elements to explore how motion and interactivity could enhance their creations. They learned to articulate their ideas and translate complex narratives into tangible objects, experimenting with simple, functional prototypes. Ultimately, the workshop emphasised the strength of interactive objects in their ability to create meaning. By integrating humanist perspectives, ecopoetic insights, and digital techniques, participants developed works that balanced tradition and innovation, honouring the heritage of glassmaking while envisioning its future within a rapidly evolving technological landscape.

6.1.5 Students' Projects Examples

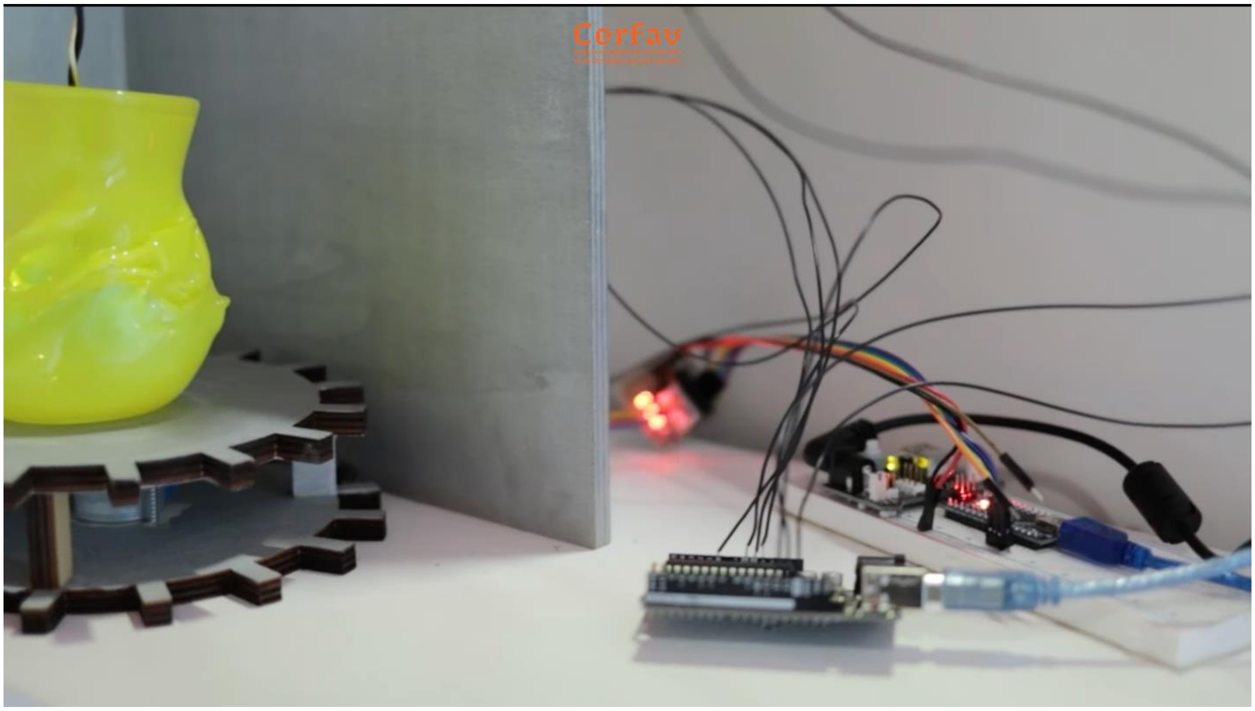


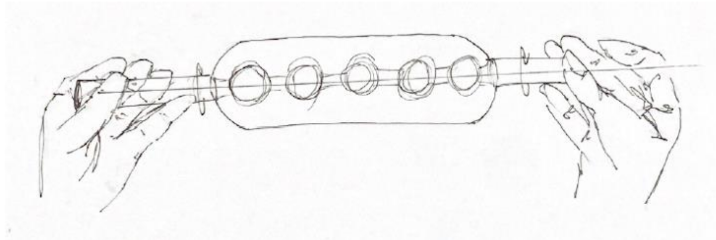
Figure 6. Workshop Glass and Interactivity: The Material in Motion, led by August Hazemann, project by Justine Ressot Faire Chanter le Verre (2024) CERFAV © CERFAV / Julia Schaff.

Making the Glass Sing

The project *Make the Glass Sing* (*Faire chanter le verre*) by Justine Ressot investigated how variations in glass thickness and light transmission can generate a distinctive sensory identity for each object. Differences in material density shape the passage of light through the glass, metaphorically giving each piece a unique "voice." The project also introduced a transferable experimental framework, proposing that additional objects could be examined within the same setup to analyse and compare their individual "vocal" signatures

Off-Centred Gestures

The project untitled *Décentrés* (*Off-Centred*) by Mathilde Étienne, explores the technical challenge of centring in glassmaking, a core skill developed during training. It pays tribute to the numerous unsuccessful attempts that form part of the learning process, reframing imperfections as a source of creative potential. The installation features rotating glass objects containing bubbles whose movements reveal subtle misalignments. While well-centred bubbles appear stable, off-centred ones create a distinctive visual "dance," transforming technical flaws into an aesthetic element. Inspired by scientific glassware and informed by a year of flame-working practice, the project highlights the importance of rotation in shaping viscous glass and ensuring precision. By emphasising the expressive qualities of imperfections, the work invites viewers to reconsider errors not as failures but as opportunities for visual and material exploration within contemporary glassmaking.



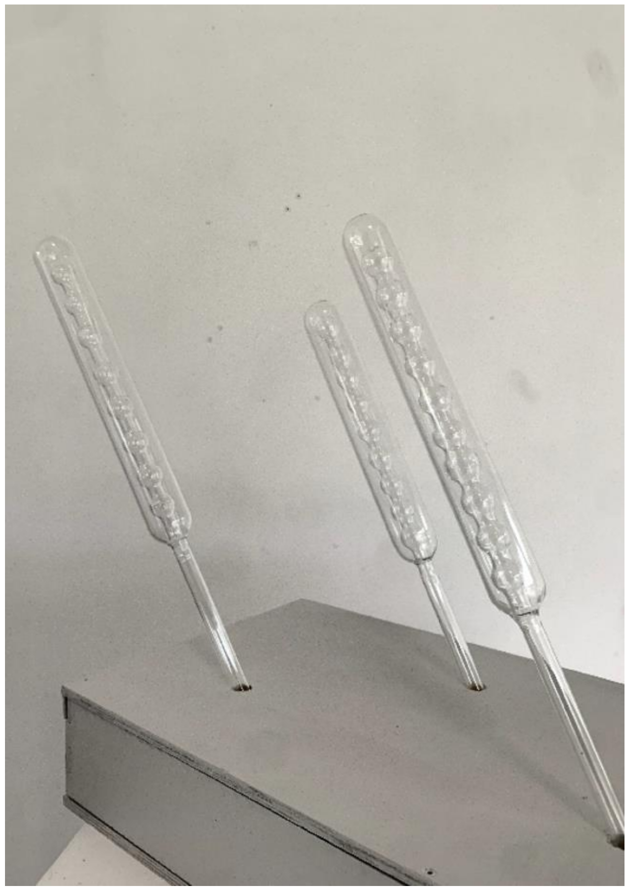


Figure 7. Workshop Glass and Interactivity: The Material in Motion, led by August Hazemann, project by Mathilde Étienne Décentrés (2024) CERFAV © CERFAV / Julia Schaff.

Showing the Temperature of Glass

As a third example, the project *What does glass say?* (*Que dit le verre?)* Nolwenn Félix explores the transformation of glass during heating, highlighting how colour variations indicate changes in consistency and guide the glassblower's actions. As the material is exposed to a blowtorch flame, it shifts through distinct hues: red signals that the glass can be blown, pink indicates softening, orange marks an optimal state for drawing points, pale pink is suitable for soldering, and white suggests that the glass is approaching a near-liquid state and becomes more difficult to control.

Developed within an interdisciplinary workshop, the project reflects an initial learning curve associated with unfamiliar technical and computational components. Despite early challenges in understanding the processes and achieving the desired outcome, the student gradually overcame these difficulties through experimentation and iterative problem-solving. The final piece offers a visual interpretation of the glassblower's perspective, inviting viewers to observe the material as it reacts to heat and "comes to life" through colour. By emphasising visual perception as a tool for understanding material behaviour, the project aims to foster greater appreciation of glassmaking practices and encourage audiences to engage with the craft from the practitioner's point of view.

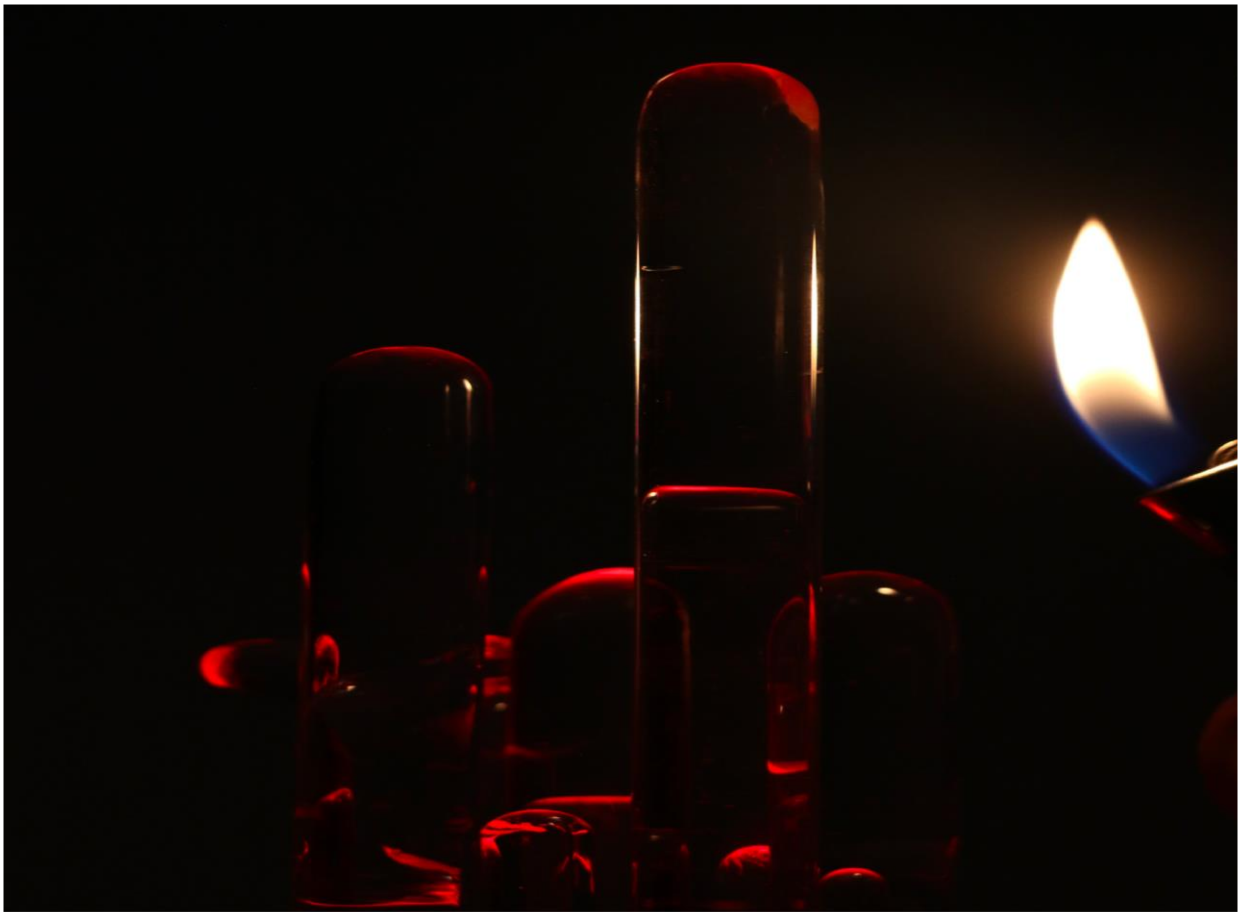


Figure 8. Workshop Glass and Interactivity: The Material in Motion, led by August Hazemann, project by Nolwenn Félix. What does glass say? (Que dit le verre?) (2024) CERFAV © CERFAV / Julia Schaff.

More information about the workshop restitution phase can be found in this video: https://www.idverre.info/formation/retour-sur-le-workshop-verre-et-interactivite-la-matiere-en-mouvement-avec-auguste-hazemann-et-arnaud-kaba/

6.2 Case Study 2: CNAM / Tapestry as Image Technology: Between Gesture and Illusion

In the *Tapestry Design Pilot*, we explore an alternative narrative of tapestry weaving that goes beyond its traditional perception as a heritage artefact. Tapestry is examined for its monumental textile characteristics, ability to create illusion through the faithful reproduction of a design template, and its creative process, which functions as an analogue to an image-making language. The tapestry emerges as more than a decorative or historical object. It is positioned as a potential immersive tool, capable of engaging viewers on a multisensory level. It connects traditional craftsmanship with modern design and digital innovation. It is also explored as an instrument of information, capable of conveying complex narratives, an extension of language through its woven symbols and patterns, and a memory medium, preserving cultural stories and histories within its fibres. This approach highlights the tapestry's dual nature as a physical object and a technological process, bridging tradition and contemporary practice.

5.1.2.1 Lauriane Obry: Weaving Tradition and Innovation into Design

The *Tapestry Design Pilot,* led by designer Lauriane Obry, exemplifies her unique ability to bridge the realms of traditional craftsmanship, contemporary design, and digital technology. Trained as a *licière* (a traditional tapestry weaver) at the Manufacture des Gobelins, she began her career deeply rooted in the rich heritage of French artisanal weaving. Building on this artisanal expertise, Obry pursued master's studies in design, graduating from ENSCI – Les Ateliers, one of France's most prestigious industrial design schools. There, she started reimagining tapestry-making as a space where heritage weaving techniques intersect with innovative, contemporary design practices. She leverages digital technology as a crucial tool to achieve her vision. She explores how traditional weaving can be augmented to create functional, interactive, and sustainable designs that push the boundaries of what tapestry can be, through computational design and digital fabrication processes. This project earned her the renowned Bourse Agora for Research in 2023 and recognised her ability to innovate within the framework of artisanal practices. It became the foundation for the *Tapestry Design Pilot*, where Lauriane will expand her exploration of tapestry-making as a contemporary design practice. Lauriane Obry sees the loom not only as a tool for weaving but as a platform for dialogue between past and future, craft, and technology. At the core of Lauriane Obry's practice is the belief that design and craft are inseparable. Her work redefines the value of artisanal objects in a technological age, showcasing how heritage techniques can evolve to meet present-day demands. For Obry, weaving is not only a craft but a method of storytelling, sustainability, and innovation.

Her dual identity as a *licière* and a designer enables Lauriane Obry to seamlessly merge the tactile, material world of craft practices with the abstract, problem-solving nature of design. This hybrid approach defines her role in the *Tapestry Design Pilot*, where she reimagines traditional tapestry-making through the integration of digital technologies. Under her direction, the pilot explores how weaving can evolve beyond its decorative origins into a functional, interactive medium. Her work in this context remains poetic and deeply rooted in the essence of material and place while addressing contemporary challenges and opening new possibilities for design innovation.

5.1.2.2 From Historical Innovation to Contemporary Design in the Tapestry Design Pilot

Initially, woven compositions relied on simple rhythmic lines to delineate colours and forms. However, the *hachure* technique at the end of the 14^{th} Century marked a transformative moment in tapestry-making. By interweaving lines of varying sizes and rationalising them into a shared visual language among weavers, *hachure* enabled half-tones and optical effects that produced the illusion of volume. Without explicit guidance from the *cartonnier* (the designer of the cartoon), the *licier* (the weaver) had to integrate these linear effects intuitively, ensuring the proportions of the drawing, the blending of colours, and the quality of the textile were all maintained. The result was a woven "technical drawing," where *hachure* lines of varying lengths and thicknesses gave the composition a sense of depth and realism, modelling drapery, flesh, and creases to bring movement and relief to life. This immersive potential transformed the tapestry into a medium that interacted dynamically with viewers, enhancing its realism and expressive power.

In this way, tapestry reveals itself as a sophisticated system where the visual language of design (*hachure*) intersects with the immersive potential of the woven medium. This perspective on tapestry as a technology of image-making provides the foundation for reimagining in the *Tapestry Design Pilot*. The pilot explores how traditional techniques like *hachure* can inspire modern design practices, particularly through integrating digital tools. Just as *Hachure* once introduced a new way to model light, volume, and interaction within a woven medium, the design pilot uses contemporary technologies to expand the mediation of tapestry.

Lauriane Obry treats the loom as a platform for artistic expression and technological experimentation. The pilot reimagines tapestry as a functional and interactive system, much like its historical predecessors, while leveraging modern design processes to create pieces that resonate with today's technological concerns. This approach positions tapestry as a decorative or heritage craft and a dynamic and forward-thinking medium with untapped potential in contemporary design.

5.1.2.3 Tapestry as Image Technology: Between Gesture and Illusion

The *Tapestry Design Pilot* explores how traditional weaving techniques can intersect with contemporary technological advancements to create new forms of artistic and functional expression. At its core, the pilot examines the untapped potential of tapestry as a medium for immersion and virtuality, offering a tactile and visual alternative to digital experiences. While digital technologies often dematerialise interactions, tapestry provides a counterpoint as a physical, tangible medium capable of creating immersive environments and optical illusions. Building on its legacy of innovation, exemplified by techniques like *hachure*, the pilot reimagines tapestry as a bridge between the physical and the virtual, opening new avenues for exploration.

The pilot addresses a central question: how can a medium rooted in tradition and materiality respond to contemporary demands for immersive and interactive experiences? The answer lies in leveraging the tapestry's unique qualities, namely tactile presence, narrative capacity, and adaptability, while integrating modern tools such as augmented reality (AR), stereoscopy, and interactive technologies. These tools enable the creation of new narratives and dynamic experiences that enhance engagement and accessibility.

AR enhances the visitor experience by offering high-definition visuals of woven elements, highlighting the quality of stitches, vibrancy of colours, and subtle textures. This detailed view reshapes tapestry as a medium for storytelling, encouraging a deeper appreciation of its craft and artistic value. The pilot also employs "low-tech" stereoscopy to evoke notions of relief and realism. By using optical effects, visitors experience the tapestry as both a physical and virtual object, blending tangible and digital dimensions. This approach virtualises the woven surface, presenting tapestry as an immersive, interactive art form. Interactivity plays a central role in the pilot, redefining museum engagement. Visitors use smartphones to interact with encoded information within the tapestries, unlocking animations, detailed visuals, and scaled interpretations. These interactions foster curiosity and offer new ways to explore the art, creating a personalised and dynamic experience. The pilot reexamines tapestry's historical role as an "art of the multiple." Traditionally woven in multiple versions, each unique yet sharing a common origin, tapestry gains new dimensions through digital enhancements. Visitors can explore alternative versions of the artwork, revealing details, animations, and scaled proportions, enriching its narrative and artistic potential.

The pilot redefines tapestry as a medium for information, interaction, and immersion, combining traditional craft practices with cutting-edge technologies. It shifts its role from a static heritage object to a dynamic interface that engages with artistic, ecological, and technological challenges. The pilot asks critical questions about the tapestry's relevance in the digital age, such as how it can balance its physical materiality with the possibilities of digital and interactive media. Through its innovative approach, the *Tapestry Design Pilot* demonstrates how traditional craft-making can evolve to meet the demands of present-day design and technology, ensuring tapestry remains a living, relevant, and innovative art form.

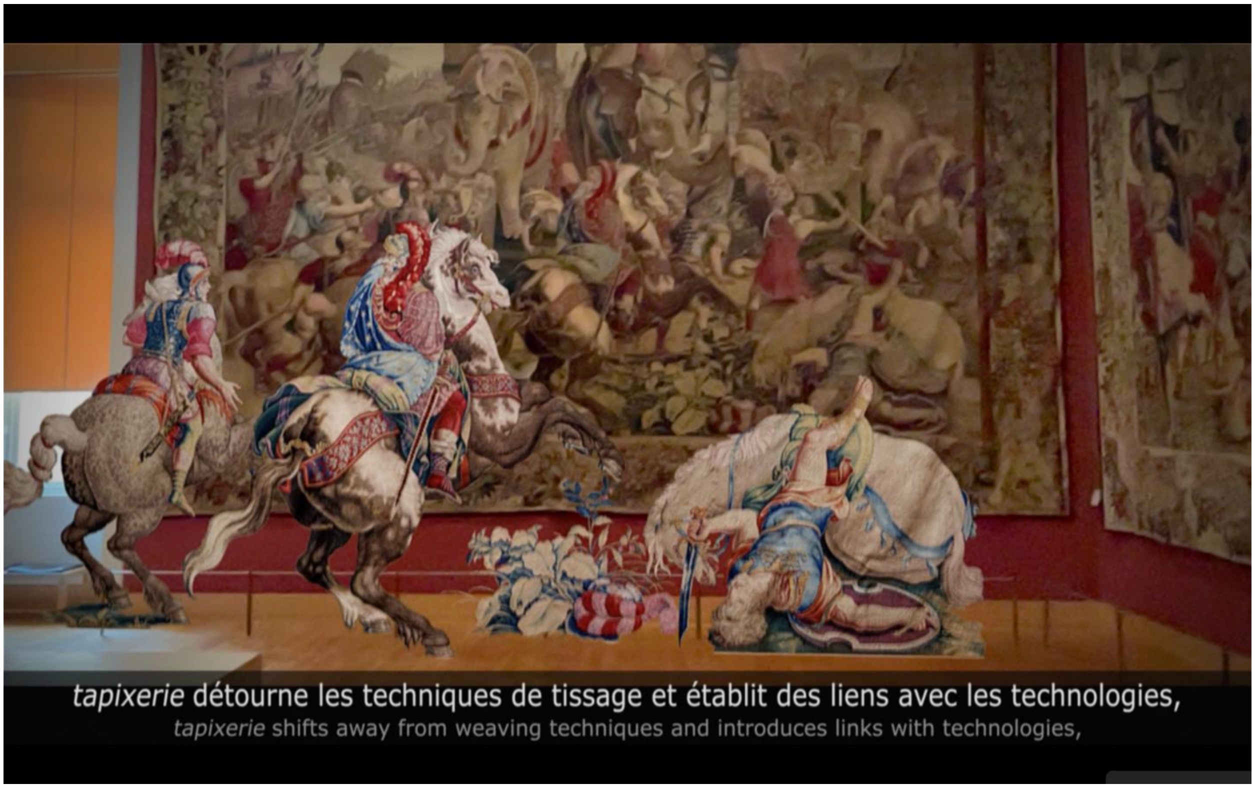


Figure 9. Tapixerie (2022) / Lauriane Obry.

6.3 Case Study 3: PIOP / Design, Craft and Cultural Heritage

The *PIOP Design Pilot* emphasises the role of design as a medium for storytelling, preservation, and cultural expression. Drawing inspiration from the Foundation's Museum collections, the pilot supports designers in creating objects that reflect historical craft-making while addressing modern design contexts.

6.3.1 PIOP Collaboration with Silver & Marble Designer

Within the framework of the Design Pilot, PIOP contacted designers with whom it has collaborated on the production of museum-related by-products. A first exploratory semi-structured interview was conducted online with Mr Georgiadis, a designer who creates jewellery using marble and silver. The interview included questions on the designer's professional background, his personal understanding of the concept of "design" and the significance of craft practice, his overall creative process, and his use of digital technologies.

Achilleas Georgiadis has been collaborating with PIOP for the past three years. On behalf of PIOP, he has exclusively created a series of seventeen different pieces of jewellery inspired by the collections of PIOP's museum network, such as the Museum of Marble Crafts, the Silversmithing Museum, the Open-air Waterpower Museum and the Silk Museum.

PIOP values a deep connection between design, culture and heritage. Supporting designers who draw inspiration from the museum's collection proves that PIOP sees design as a way to bridge the past and present. Allowing traditional crafts and historical themes to inform contemporary creative practices. This approach suggests that PIOP views design not just as a functional or aesthetic pursuit but as a medium for storytelling, preservation and cultural expression. It aims to foster innovation while maintaining respect for cultural heritage, creating a space where modern design can thrive within the context of history. Additionally, by selling these designer objects in museum shops, PIOP emphasises the importance of accessibility and cultural engagement, making design an integral part of the educational and experiential mission of its museum's network.

PIOP's vision on design appears to promote creativity, cultural relevance and an ongoing dialogue between past and present, where design serves both artistic and educational purposes.

6.3.2 Achilleas Georgiadis

Achilleas Georgiadis is a designer with a ten-year career in creating unique jewellery and art objects. His work is deeply rooted in the intersection of traditional craftsmanship and contemporary design, making him a pivotal collaborator in the *PIOP Design Pilot*. He began his professional journey with a strong foundation in ceramic technology, exploring the design of ceramic objects before transitioning into jewellery design. In 1996, he established his jewellery design workshop, where he developed his expertise working with diverse materials, particularly metal and marble. As a founding member of Jewellery Art Workers (J.A.W), a collaborative workshop specialising in jewellery and art objects, Achilleas Georgiadis exemplifies the collaborative spirit essential to contemporary design practices. His involvement with J.A.W highlights his commitment to fostering creativity and innovation within a community of like-minded artisans and designers.

Over the past three years, he has worked closely with PIOP to create exclusive jewellery pieces inspired by the rich cultural heritage represented in PIOP's museum network. This collaboration includes designs from the Museum of Marble Crafts and the Silversmithing Museum. For this collaboration, he produced a series of 17 jewellery pieces, blending traditional materials such as marble and silver with contemporary aesthetics. These designs are deeply inspired by the historical and cultural narratives encapsulated in PIOP's collections. His work bridges heritage and innovation, referencing traditional techniques and motifs while introducing modern design sensibilities. His design reflects a profound respect for cultural heritage and the role of materials in storytelling. His ability to reinterpret traditional crafts through the lens of contemporary design aligns seamlessly with PIOP's vision for the Design Pilot. By integrating marble and silver, materials central to the museum's narratives, he emphasises cultural and material specificity, ensuring each piece resonates with the heritage it represents. His work demonstrates how traditional crafts can be revitalised and adapted to today's contexts without losing their essence. This approach enhances the cultural value of PIOP's museum network and serves sustainable and innovative craft-design integration. His work in the *Design Pilot* highlights the importance of storytelling through materials within the broader framework of heritage and innovation.

Designer Presentation

Achilleas Georgiadis is a self-taught silversmith with nearly 35 years of experience in contemporary jewellery. Originally trained in ceramics, he began his professional career designing ceramic objects before establishing his own jewellery workshop in 1996. He is also a founding member of J.A.W. (Jewellery Art Workers), a collective dedicated to jewellery and art objects.

Georgiadis prioritises form and shape over the intrinsic value of materials. His work is guided by a philosophy that celebrates raw and unworked qualities of materials, emphasising simplicity, autonomy, and craftsmanship. He experiments with diverse materials, including metal, marble, ceramics, bone, and fabric, often using traditional techniques to better understand their properties. Preferring handwork to mechanised processes, he favours methods such as forging rather than pressing metal, allowing him to maintain autonomy and full creative control over each piece. He emphasises traditional techniques, working predominantly by hand without modern tools like laser cutting.

Originally from Athens, and after living in Athens and Thessaloniki, Georgiadis relocated to the village of Pyrgos, Tinos, seeking a change from urban life. From this rural location, he started to incorporate local materials like marble into his jewellery designs. In Pyrgos, he established a workshop and store, where he creates and sells his jewellery. The workshop serves as both a creative space and a retail outlet, particularly during the tourist season. Georgiadis's creative process often starts with stored ideas and elements he wants to explore. He rarely starts from scratch, instead building on previous concepts and designs. Overall, he values the simplicity and beauty of minimally worked materials, drawing inspiration from ancient jewellery and the natural aesthetics of materials. He believes that traditional craft practices are declining, but also sees a growing appreciation for handmade, unique pieces in the market.

In his work, he faces challenges such as finding skilled labour and dealing with the limitations of working in a remote location like Pyrgos. Furthermore, he occasionally collaborates with other craftspeople for technical tasks, such as laser cutting fabrics, but prefers to maintain control over the majority of the creative process. Georgiadis appears sceptical about the role of digital technology in traditional craftsmanship. He believes it requires significant time and effort to integrate into traditional methods and prefers the uniqueness and personal touch of handmade pieces. Nevertheless, he acknowledges the potential of digital tools for specific tasks but does not see them as a replacement for traditional techniques.

Designer link: https://www.jewelryjove.com/

Traditional Crafts Practice

Georgiadis's approach to traditional craftsmanship is deeply rooted in a commitment to handcrafting, a connection to nature, and a dedication to preserving and innovating within the traditions of his craft. He values traditional craftsmanship techniques, emphasising the importance of creating jewellery by hand. He prefers to work without modern tools like laser cutters, relying instead on manual techniques that have been used for centuries. He believes in understanding materials through primitive techniques, often working with materials in their raw form. This approach allows him to grasp the full potential of the materials he uses, such as metal and marble. His tools and methods are similar to those used by ancient craftsmen, such as hammers, files, and chisels. He mentions that his tools are roughly what a craftsman would have had in 2000 BC, highlighting the timeless nature of these techniques.

He also acknowledges the challenges of traditional craftsmanship, such as the difficulty of finding skilled labour and the time-consuming nature of handcrafting. Despite these challenges, he remains committed to traditional techniques, valuing the uniqueness and personal touch of handcrafted pieces. Nevertheless, he is concerned about the decline of traditional craftsmanship and the loss of skills that have been passed down through generations. He believes in the importance of preserving these skills and techniques, ensuring that they continue to be valued and practised in the modern world.

Design Approach

For Georgiadis, design is deeply rooted in traditional craftsmanship, a connection to nature, and a commitment to simplicity and innovation. His approach emphasises the artistic potential of materials and the importance of hands-on techniques in creating meaningful and beautiful jewellery. He is primarily interested in the form and shape of jewellery rather than the intrinsic value of the materials. He aligns with the concept of contemporary jewellery, which prioritises artistic expression and design over the preciousness of materials. He believes in the potential of any material to be transformed into a piece of art through craftsmanship. This philosophy leads him to experiment with a wide range of materials, including marble, ceramics, bone, fabric, and even primitive materials found in nature. Consequently, his design process is influenced by the natural environment and the materials available to him. For example, his move to Pyrgos led him to incorporate local marble into his designs, reflecting the natural beauty and resources of the area. Moreover, he enjoys exploring the possibilities of different materials and techniques, often pushing the boundaries of traditional jewellery making.

Georgiadis also values traditional, hands-on techniques and prefers to work without modern tools like laser cutters. He believes that understanding and working with materials using primitive methods can lead to a deeper connection with the craft. This leads to the uniqueness and personal touch of handcrafted pieces. He believes that each piece should have its own character and story, reflecting the individuality of the craftsmanship. Furthermore, he appreciates the beauty of simplicity and minimalism in design. He is inspired by ancient jewellery, where simple twists and turns of metal could create something beautiful, emphasising the elegance of minimal manipulation. In his work process, he prefers to create pieces entirely by himself, from start to finish. This autonomy allows him to fully realise his artistic vision without relying on other craftsmen or modern technologies. While for Georgiadis, artistic expression is important, he also considers the practical aspects of design, such as the reproducibility of pieces for commercial purposes. He understands the importance of creating designs that can be replicated while maintaining their unique qualities.

Design-based Work Process

Georgiadis' general work process includes the following steps:

- Initial Concept and Ideas: He often begins with ideas and elements stored in his mind from years of experience. He rarely starts from scratch, instead building on previous concepts and designs that he has been contemplating.
- Material Exploration: He is deeply interested in the materials he works with. He experiments with a variety of materials and often starts by understanding the raw and unworked qualities of these materials.
- Design and Sketching: While he primarily relies on his mental repository of ideas, he also makes sketches and drawings to capture his designs. However, these drawings are often informal and may get lost, serving more as temporary notes rather than detailed plans.
- Handcrafting Techniques: He fully engages with the materials and brings his artistic vision to life.
- Prototyping and Experimentation: He enjoys exploring the possibilities of different materials and techniques, often pushing the boundaries of traditional jewellery making. This experimental approach allows him to discover new forms and designs.

- Attention to Detail: He pays close attention to detail, particularly when working on small surfaces. He believes that even minimal changes can significantly alter the final piece, and he strives for precision in his work.
- Reproducibility and Production: While he values artistic expression, he also considers the practical aspects of design, such as the reproducibility of pieces for commercial purposes. He understands the importance of creating designs that can be replicated while maintaining their unique qualities.
- Autonomy in Creation: He prefers to create pieces entirely by himself, from start to finish. This autonomy allows him to maintain control over the creative process and ensure that each piece reflects his personal touch and craftsmanship.
- Collaboration for Technical Tasks: Although he primarily works alone, he occasionally collaborates with other craftsmen for specific technical tasks. For example, he may work with specialists for laser cutting fabrics or other complex processes that require specialised equipment.
- Finalising and Selling Pieces: His workshop in Pyrgos serves as both a creative space and a retail outlet. He creates pieces throughout the year and sells them during the tourist season. His store allows him to showcase his work and connect with customers who appreciate handcrafted jewellery.

Digital technologies

Georgiadis' perspective on digital technologies in his work is characterised by a preference for traditional techniques and a cautious approach to integrating digital tools. He recognises their potential but remains committed to the hands-on, artisanal aspects of jewellery making.

He expresses scepticism about the integration of digital technology into traditional craftsmanship. He believes that digital tools and techniques do not align with his hands-on, traditional approach to jewellery making. In his work, while he acknowledges the potential of digital tools for specific tasks, he prefers to work without them. He mentions that he does not use modern tools like laser cutters, which are common in contemporary jewellery making.

Despite his limited use of digital technologies, Georgiadis is aware of their possibilities and capabilities. He understands that digital tools can offer precision and efficiency in certain aspects of jewellery production. For this reason, he occasionally collaborates with other craftsmen for specific technical tasks that may involve digital tools. For example, he may work with specialists for laser cutting fabrics or other complex processes that require specialised equipment.

Design Work Examples

Figure 10. Marble and silver rings designed by Achilleas Georgiadis / Jove Jewellery, in collaboration with PIOP / Museum of Marble Crafts.

Figure 11. Marble and silver earrings designed by Achilleas Georgiadis / Jove Jewellery, in collaboration with PIOP / Museum of Marble Crafts

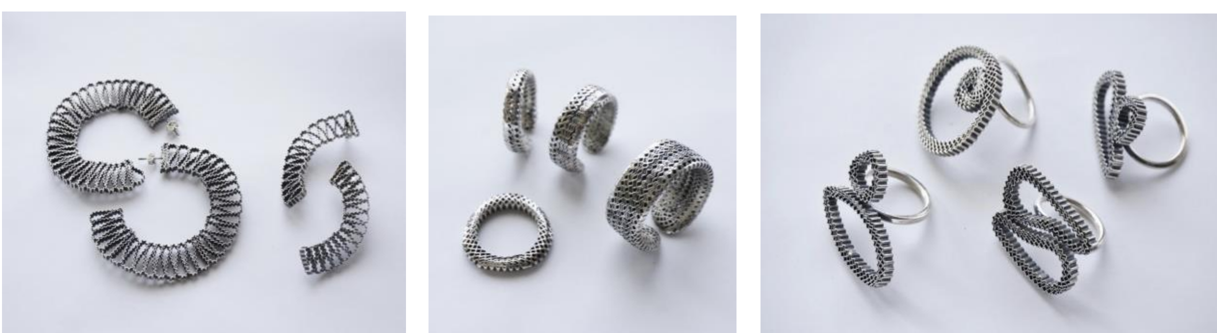


Figure 12. Silver jewellery designed by Achilleas Georgiadis / Jove Jewellery

6.3.3. Technological Development: Gestural Visualisation and Experimentations

Georgiadis expressed an interest in watching the hands' movement without the rest of the environment, i.e. tools, material, surrounding environment. For this reason, we conducted a recording of him making silver jewellery at his workshop. We used a GoPro camera mounted on his head to get an egocentric perspective of his hands while working.

To better understand hand movements in jewellery making, Georgiadis's process was recorded using a head-mounted GoPro camera, with a deliberate focus on capturing his manual gestures. In collaboration with ARMINES, the footage was analysed to isolate hand movements from the surrounding environment and produce short experimental visualisations. These experimentations consist of five-second video segments presenting segmented gestures through various modes of visualisation and analysis.

The results highlight the highly intricate nature of silver jewellery-making. The practice involves extremely small materials whose manipulation is difficult to observe, even when recorded digitally. Although hand gestures appear more explicit once the environment is abstracted, the precision and scale of the movements remain challenging to capture and examine in detail. These findings underline the technical complexity of the craft and the limitations of current digital recording methods in fully representing fine manual skills.

Figure 13. Egocentric view of Achilleas Georgiadis working process (2025) / PIOP

Figure 14. Egocentric view of Achilleas Georgiadis working process (2025) / PIOP

The entire video can be found here: https://youtu.be/r6AbRrPGGuY.

Figure 15. Gestural Representation Experimentations based on Achilleas Georgiadis working process (2025) / PIOP-ARMINES

6.3.4 Design as a Tool for Heritage Preservation

The project emphasises the use of design to preserve and reinterpret cultural heritage. Designers collaborating with PIOP draw material and thematic resources from its museum network, including the Museum of Marble Crafts and the Silversmithing Museum. By working with traditional motifs, materials, and techniques, the pilot ensures that these elements are adapted and integrated into modern creative practices.

The *Design Pilot* will explore how traditional crafts can coexist with modern design methodologies and technologies. While rooted in historical practices, the initiative encourages innovation by incorporating digital tools and processes. This allows designers to experiment with new forms and techniques while maintaining a strong connection to the craft's heritage. An important aspect of the pilot is the production of objects for sale in museum shops. Inspired by the museum collections, these pieces provide visitors with tangible connections to the cultural narratives presented in the exhibits. This approach helps bridge the gap between heritage and contemporary audiences, making cultural traditions accessible and relevant.

6.3.5 A Platform for Sustainable Craft-Design Practices

The *Design Pilot* fosters a sustainable approach to craft and design by ensuring that traditional practices remain relevant in today's creative industries. By supporting collaborations between designers and the museum network, the initiative provides a practical framework for integrating heritage into contemporary design while creating cultural engagement and education opportunities.

In summary, the *PIOP Design Pilot* seeks to create a dialogue between past and present by supporting the reinterpretation of traditional crafts through contemporary design practices. It is a platform for exploring how heritage can inform innovation while remaining accessible and meaningful to modern audiences.

7 Advanced Design Pilot

7.1 Case Study 1: CNAM / Limoges Porcelain

The Limoges pilot is closely connected to the École Nationale Supérieure d'Art et de Design de Limoges (ENSA Limoges), internationally recognised for the excellence of its ceramic and porcelain programme. Within this institution, the porcelain studio constitutes one of the most advanced and comprehensive porcelain facilities in Europe, embedded in a higher art and design school. It operates as an experimental and professional platform that brings together professional designers, master craftspeople, technical experts, researchers, and design students in a highly innovative collaborative model. This configuration enables a multilayered process of transmission, combining tacit workshop knowledge, specifically mould-making, casting, glazing, firing, and surface treatment, with contemporary design methodologies, project-based experimentation, and critical reflection. A central component of this ecosystem is the CCE Research Lab (*Céramique comme Expérience* - Ceramics as Experience). Developed as a research residency programme within ENSA Limoges, the CCE positions ceramics as both a material practice and an experiential research field. Situated within the broader ceramic landscape of Limoges, an internationally renowned centre for porcelain production supported by industries, research centres, and specialised enterprises, the laboratory fosters dialogue between traditional techniques and digital technologies. By integrating 3D modelling, additive manufacturing, and advanced prototyping into ceramic processes, the CCE expands the design phase to include experimental material testing and hybrid production strategies. As a centre of expertise and innovation, the CCE encourages encounters between artists, theorists, teachers, students, and technicians, creating a shared space of reflection on gestures, tools, and conceptual approaches. Its objective is to move beyond inherited typologies and standardised models historically associated with porcelain production. Through rigorous experimentation, it engages critically with tradition, understanding its technical constraints and cultural codes, and reinterpreting it through contemporary design inquiry.

7.1.1 Pilot Methodological Implementation in the ENSAD Limoges Context

The Design Pilot is embedded in the continuity of the activities conducted in collaboration with the ENSAD Limoges throughout the project. From the beginning, this sustained collaboration with this institution has taken multiple forms, most notably the preparation and implementation of the ethnographic protocol on the school's premises in early 2024. The implementation of the protocol thus benefited from the school's institutional structure and involved various members of the teaching team as well as external expert collaborators, whose expertise is linked to their long experience in the region's porcelain industry. As it has been mentioned in D.1.1, the history of this school is closely intertwined with the region's porcelain industrial development, as well as with its heritage and museum frameworks. The origins of ENSAD Limoges are directly linked to the industrial development of the region during the 19th century, which led to the gradual reconfiguration of teaching devoted to the decorative arts. In this context, the creation of a museum specialising in ceramics was accompanied by the opening of the municipal school of fine arts applied to industry in 1867, housed in the premises currently occupied by the Adrien Dubouché Museum.

Within this context, the approach of the Design Pilot dedicated to Limoges porcelain is informed by the dynamic interplay of pedagogical, industrial (at varying scales from big manufacturers to small workshops), and heritage dimensions. This case study makes it possible to examine several facets of contemporary design within the specific context of the porcelain milieu, including the relationship between design, craft, and industry; design methodologies and work processes; pedagogical approaches in an art school setting; evolving engagements with digital technologies; and research practices through design. The profiles and professional practices of the designers involved in the project have informed the collaborations developed to engage both professional design practice, within the framework of this Pilot, and design teaching in formal settings. These complementary forms of collaboration have contributed to articulating the relationship between design practice and its pedagogical approaches. Activities conducted in partnership with the school that are specifically oriented toward education and training are presented in a dedicated section of D6.1.

By applying the Pilot's approach to this framework, the aim is to highlight several key dimensions that define its distinctive character: the dual emphasis on artistic and design-based principles at the core of its pedagogy, its commitment to experimentation, its human and social dynamics, its ethos of collaboration, its historical and heritage significance, and its connections with local industries. This Design Studio project was set up in the school's 1000 m^2 Ceramics workshop [2], which is divided into two complementary areas. The porcelain area functions like a small manufacturer, integrating all stages of production, from moulding to glazing, with specially adapted equipment such as electric and gas kilns. A second area is dedicated to non-porcelain clays, allowing for modelling, sculpture and throwing, and the workshop also includes a decoration and oxide laboratory. Teachers can help students to think about production as designers. Designers stop at the plan for their object, and then the manufacturer or craftsperson makes it. At ENSAD Limoges, through the design project, students learn the technical gestures that enable them to understand all the stages in craft and industrial production: model, mould, casting, stamping, firing, enamelling and decorating.

7.1.2 Design Pilot Collaboration Rationale

This case study is based on a collaborative process developed with Jessie Dérogy and Anne Xiradakis, two object-oriented designers and members of the teaching staff at ENSAD Limoges, where they serve respectively as teachers in ceramic design and head of the ceramics workshop. The Pilot approach draws on the complementarity of their perspectives, which contributes to shaping its conceptual and methodological orientation.

With very different practices, their research-based design work draws on traditional porcelain and ceramic production techniques from a contemporary perspective. Dérogy and Xiradakis share several converging orientations that position their practices within a reflective and research-driven approach to contemporary ceramic design. Both ground their work in an examination of the intersection between craft and industry, approaching ceramic production as a space for experimentation and for creative, material, and technical research. This experimental perspective informs their respective methodologies, which are characterised by the integration of a critical dimension toward the creative tools and production systems of contemporary design. Their practices also reflect a shared engagement with the gestural aspects of craft-making, the materiality of objects, their shifting status, and the expansion of their possible uses, as well as with the growing range of techniques available within ceramic production and its potential.

This collaborative process was thoughtfully conceived based on the methodological guiding principles established for the Design Pilot. This perspective seeks to emphasise open dialogue, highlight interdisciplinary experience and enable collective reflection on digital tools and resources. Structured in several phases, this methodological approach includes a crucial stage whose objective is to understand, in a precise manner, the interests and needs of the collaborating designers, stressing the importance of exchange and active listening. This preliminary research stage aims at the principles, techniques, values, and traditions interwoven in design practices. It consisted of a series of exchanges and unstructured interviews with the designers that allowed for in-depth research into these issues, and carried out organisational and coordination tasks. The researchers introduced the CRAEFT project and explored the designers' interests in the project objectives and the orientation of the design pilot. A clear and practical framework for collaboration was also defined, by the logistical and material context of the school, addressing the institutional, curricular and pedagogical limitations inherent in working in the school environment. The needs and requirements of the designers were considered to ensure the effective development of the collaborative framework.

Based on this preliminary assessment and in relation to the initiatives developed within the project framework, particularly the possibilities offered by advanced rendering techniques, a thematic line was defined focusing on the gestures involved in porcelain production. This second phase revolved around co-creation and collective reflection on a series of tailor-made digital tools. These digital tools were designed to draw attention to the gestural dimension of porcelain techniques and to facilitate visualisation and analysis by creating a certain distance from the material dimensions and tools during the production process. Taking as a starting point the video archives resulting from the application of the ethnographic protocol and the recording sessions that took place in the school's ceramics workshop a few months earlier, it was decided to choose a specific sequence from the process of manufacturing a piece of porcelain. The idea was to focus on the gestures associated with plaster turning.

Within the framework of the collaboration with ENSAD Limoges, the development of the *Design Pilot* is structured around two interconnected axes. The first involves the conception and implementation of hybrid workshops integrated into the school's pedagogical structure, conducted on its premises and aimed at design and art students. These workshops were conceived using digital tools to experiment with them, refine their use, and assess their pedagogical and creative potential.

The second axis comprises a series of activities dedicated to exploring the design project through the professional practices of Jessie Dérogy and Anne Xiradakis. After an initial phase of experimental proposals by both designers, a proposal by Anne Xiradakis was chosen for further development. Due to its characteristics, this proposal for the creation of objects allowed for a more direct approach to one of the specific needs within the design project's focus, applying the advanced rendering techniques developed within the framework of the project.

7.1.3 Hybrid Design-Craft Workshops

7.1.3.1 Workshops Approach

The Design Pilot integrated two complementary workshops conceived as experimental environments for creative exploration. Beyond their pedagogical value, further developed within Pilot 1, *Education and Training*, these workshops prioritised design research and encouraged participants to examine creative processes as drivers of innovation in contemporary ceramic practice.

The methodological approach was grounded in the flexibility of the workshop format. This adaptability supported an iterative design process in which analysis, experimentation and reflection evolved in parallel, fostering a learning environment attentive to multiple dimensions of knowledge production. Both workshops were intentionally designed as hybrid spaces in terms of structure and content. They facilitated a dialogue between traditional porcelain manufacturing techniques and advanced digital tools, combining hands-on material experimentation in the ceramics studio with virtual modelling, gesture visualisation technologies and additive manufacturing. This convergence created a dynamic space for discovery, enabling participants to move between physical and digital environments, compare production methods and critically reflect on the evolving relationship between craft knowledge and technological mediation.

By placing gesture at the centre of the creative process, the workshops functioned as platforms for collaborative exploration among designers, researchers, technicians and students. Their configuration and focus contributed to rethinking the potential for dialogue between craft practices and contemporary design methodologies within the context of art education.

7.1.3.2 Workshops Timeline

1st Phase: *Ghost Gesture* Design Workshop (M18-M24)

- Initial consultation with designers from ENSAD Limoges to define the thematic focus of the workshop (M16–M20).
- Preparation of the necessary materials (digital tools) and pedagogical framework in collaboration with FORTH and the design teaching team of ENSAD Limoges (M18–M21).
- First workshop implementation in November 2024 at ENSAD Limoges (M21).
- Systematic data collection to document workshop outcomes and gather specific feedback on the Simulator first version (M21).
- Comprehensive evaluation of the workshop and reporting (M22–M24).

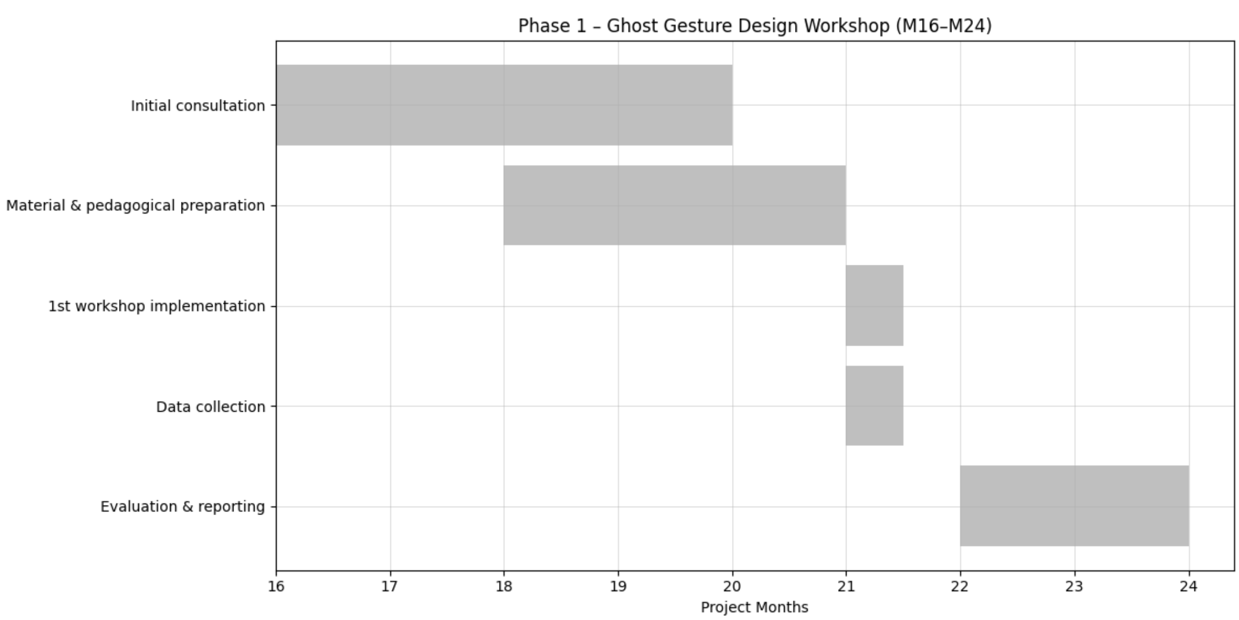


Figure 16. Timeline of Limoges Porcelain Design Pilot- Phase 1 (June 2024 - February 2025).

2nd Phase: *Plaster Simulator* Design Workshop (M24-M36)

- Enhancement of the simulator development process through the integration of initial feedback collected during the first workshop, leading to five iterative versions developed in collaboration with FORTH and design and porcelain experts (M24–M32).
- Pedagogical framework and material preparation for the second workshop (M28–M33).
- Systematic data collection for the documentation of workshop outcomes (M33–M35).
- Comprehensive workshop evaluation and report production (M33–M36).

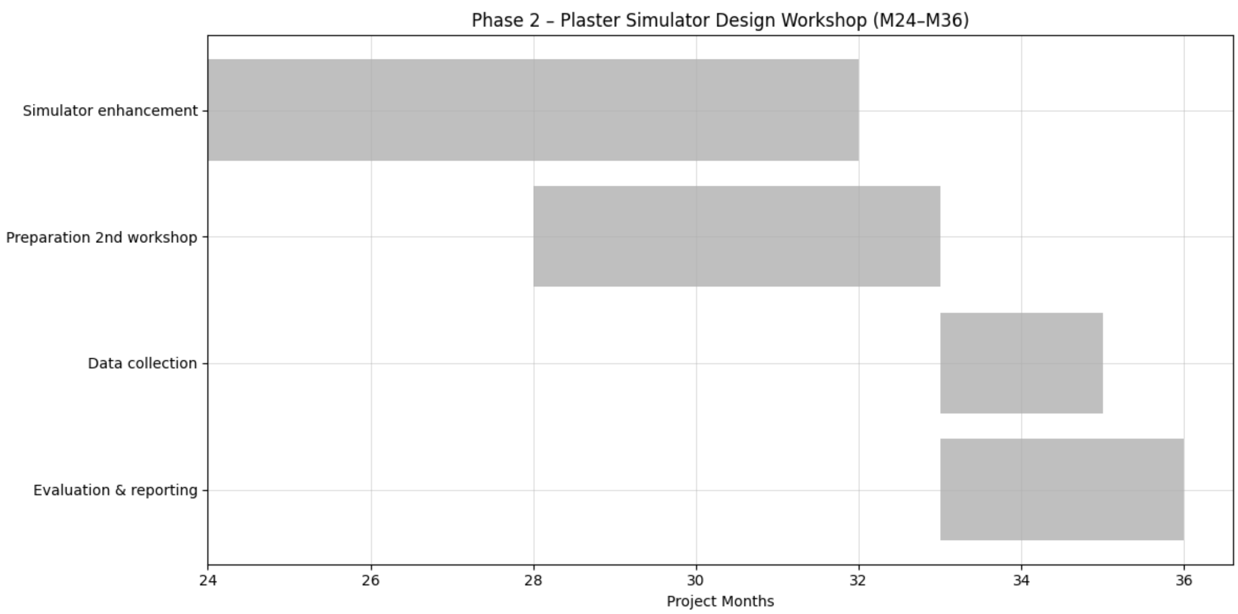


Figure 17. Timeline of Limoges Porcelain Design Pilot- Phase 1 (February 2024 - February 2025).

7.1.3.3 Ghost Gesture Design Workshop [November 2024]

Workshop Approach, Format and Structure

In line with the Pilot's methodology, after initial discussions with the designers, a thematic line was defined focusing on the gestures involved in porcelain production. One of the objectives was to explore this dimension of making as a source of experimentation and creative development. Based on these reflections, the designers devised a flexible workshop format that would allow them to continue exploring these issues and, at the same time, test the series of digital tools developed by Forth with the participation of a group of students. The initiative sought to establish a dialogue between the traditional practices of porcelain production and emerging digital technologies, using gestures as a bridge between tradition and innovation.

Drawing inspiration from the ‘ghost gesture’, a term associated with motion capture technology, the designers focus on often-overlooked gestural, postural and bodily dimensions of porcelain know-how. Although the notion of ghost gesture is often associated with the idea of residual gesture, how it is evoked in the project has more to do with the exercise of abstracting a technical gesture of a craftsperson about the tools they use and the materials they work with.

Based on this thematic orientation and translating the interests of the designers, the researchers asked FORTH to develop a series of personalised digital tools adapted to the specific needs of the workshop. Using the videos recorded with both an egocentric camera and a front camera during the protocol application, focusing on a sequence of great technical complexity, the plaster turning, it was decided to work from different gestural representations of the same action. This phase, which requires great dexterity in the handling of the turning tools (*tournassins*) on the material in constant transformation. The plaster changes consistency and dries out during this process. This serves as a vantage point for observing, describing and analysing the technicality of the gestures involved. A series of experimental tools was developed by FORTH to represent these gestures through various digital media, including:

- **Avatars 3D**, which offered a visual and dynamic embodiment of the gestures, translating and simplifying the movements of the practitioner
- **Hand tracking** captures the precise movements of the artisan's hands, generating a pattern that geometrises the particular structure of the practitioner's body.
- **Skeleton-based view,** which, based on the frontal video recording of the technical action, translates the moving posture and body schema of the practitioner, allowing a more analytical perspective of the movements.

As a counterpoint to this series, a fourth tool was added to complete the series, the ***Plaster Simulator,*** which allowed for a simulation of the work of plaster turning, precisely without showing the gestures that allow for the use of tools and their effect on the material.

Through this multimodal approach and in line with the experimental nature of the tools, the workshop format was constructed with a flexible perspective that sought to combine phases of analysis, documentation, guided practice, and free practice, alternating with the use of digital media and experimentation with materials present in the ceramics workshop.

Aimed at a group of a maximum of 10 students at the school, the workshop was included within a pre-existing pedagogical device at the school, The Ceramic Studio, which is characterised by the dimension of exploration, discovery and creative research into ceramic practice. The workshop was organised over four consecutive days, allowing for an in-depth and consistent exploration of its methodological and thematic perspective. The pedagogical programme was organised into three working groups, each focusing on one of the tools.

The workshop's goal was threefold: to visualise the gestures involved in porcelain making, to enhance the transmission of posture and movement techniques for teaching purposes, and to encourage innovation in porcelain design through digital tools.

Workshop Development and Implementation

The Limoges Porcelain Design Pilot Workshop held at ENSAD Limoges from 5 to 8 November 2024 involved two CNAM researchers, the two designers who led and co-facilitated the workshop, and 9 participating students.

Over four days, the workshop was attended by first- and second-year design and art students, who were introduced to the general lines of research of the Craeft Project and the specific theme, focus and structure of the workshop. After this introduction, they were presented with the set of experimental digital tools developed by FORTH and had to choose which one they wanted to work on during the workshop. Each working group, formed by three students, chose one of the digital tools (3D avatar, hand tracking and skeleton-based view). It was decided that the Porcelain Generator would be excluded from this initial phase to allow students to focus specifically on gesture-oriented tools. This hands-on workshop focused on exploring the traditional gestures in manufacturing a piece of porcelain. The aim is to develop production scenarios, imagining and materialising new tools, objects and gestures through different media. The workshop programme unfolded as follows:

1-day:

- Introduction Phase: Presentation of the research project, the workshop approach and the set of digital tools.
- Tool Selection Phase: Each working group chose a digital tool to work with during the workshop.
- Analysis Phase: The first task is to observe the gesture associated with the selected tool. Each group took the time to analyse what is visible in the gesture, what remains unseen, and what can be imagined about its execution.
- Reproduction Phase: The students reproduced the gesture, trying to embody and memorise it, to deepen their understanding.

2-day:

- Extraction Phase: The students tried to remove the gesture from its original context to examine it with a fresh eye.
- Translation Phase I: The students attempted to translate the gesture into a different medium, without using tools, focusing on applying the gesture and recreating a form using various materials related to ceramics: reproducing the gesture using clay to create a form and repeating the process with plaster, exploring different stages of the material.

3-day:

- Translation Phase II: The students continued to reproduce the gestures on other materials, using the tools present in the ceramics workshop.
- Translation Phase III: The students sought similar gestures in other work fields or everyday activities and documented this research through various media (video, photo, drawing). The goal was to find parallels between the movements and identify their applications outside ceramics.
- Performance Insight Phase: The students were shown excerpts from the audiovisual documentation of the performance *Made in China* by Fabrice Mazliah (2019), a choreography based on the interaction between a dancer and a piece of porcelain, based on the piece's affordances and its associated gestures of use.

4-day:

- Dual Experimentation Phase: The students were able to directly explore the technique of turning plaster using traditional tools and to discover the possibilities of its simulated version, the Porcelain Generator, and compare both experiences.

- Assessment phase: The workshop concluded with a group discussion in which the students reflected on their experience during the workshop, sharing insights into how they analysed, interpreted and experimented with the gestures, materials and ideas proposed.

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Figure 18. Ghost Gestures Design Workshop, Porcelain Workshop, ENSAD Limoges (2024) © Inés Moreno / CNAM.

The students were asked to document each stage of the workshop in groups and elaborate a written summary of their reflections with a compilation of the materials produced.

The workshop encouraged students to combine physical and digital methods, engaging in a process that combined gesture analysis with material manipulation. The methodology emphasised a collaborative approach, and the pedagogical framework integrated both traditional and modern design approaches. Through a combination of 3D avatars, hand tracking, skeleton-based views and a Porcelain simulator, participants explored these movements in digital form and applied their insights to hands-on work experimentations with clay and plaster.

Workshop Reflective Assessment

In the last part of the workshop, an evaluation was carried out with the students to assess their experiences and, above all, to attest to the effectiveness of the tools and methodologies.

The 3D plaster lathe simulator was appreciated for its innovative potential to visualise forms, although participants considered that the tool could benefit from a more intuitive interface and greater immersion. The students who combined the simulator experience with trying out work on the traditional lathe reported a richer and more complete experience. Some comments revealed that the time spent on analysis sometimes interrupted the flow of practical experimentation. Many students expressed a desire for more direct interaction with the materials, as this would enable them to connect theory with practice. Suggestions for improvement included incorporating gloves to enhance the sensory experience of digital tools. The evaluation highlighted the potential of a video documentation and archiving platform to support distance learning. The students considered the platform a useful educational tool, providing easy access to learning content and allowing them to review techniques and concepts away from the workshop. These comments reflected a continued willingness to bring digital tools into dialogue with traditional craftsmanship, creating new platforms of experience and development to improve technical learning and foster student creativity.

Figure 19. Ghost Gestures Design Workshop, Porcelain Workshop, ENSAD Limoges (2024) © Inés Moreno / CNAM

The workshop successfully demonstrated the potential of digital technologies to enrich the porcelain manufacturing process, combining the experience of traditional craftsmanship with the possibilities of contemporary design. Despite the challenges encountered in using the tools, the participants left the workshop with a greater understanding of gesture analysis and material manipulation. The exchanges will calibrate the methodological device to integrate the analysis and material experimentation. The insights gathered during the workshop will serve as a basis for future improvements in digital tools. Integrating these tools in the context of traditional porcelain production space affords interesting possibilities for innovation, offering a new way to engage with craft-making while opening up new avenues for ceramic-based contemporary design practices.

7.1.3.4 Plaster Simulator Design Workshop [November 2025]

Workshop approach and framework

As part of the Design Pilot development and following an initial exploratory workshop dedicated to experimenting with the creative potential of a series of digital gestural representation tools, the second hybrid workshop focused on in-depth experimentation with a single tool: the plaster turning simulator created by FORTH. The simulator had already been the subject of specific reflection on its creative potential by one of the designers involved in the project. This second workshop allowed us to continue this perspective and approach this tool not only as an education-oriented device. This second phase placed the *Simulator* within a broader perspective of design research, examining how digital simulation can encourage creative exploration while remaining based on artisanal processes.

The ENSAD Limoges provided a particularly relevant institutional framework for the development of this Pilot, based on its dual focus on art and design, combined with its strong links to the region's porcelain industry. The school's general orientation helped to reinforce an integrative version of contemporary ceramic design at the intersection between traditional workshop practices and the possibilities offered by digital technologies. The workshop's approach was based on this framework to build a hybrid device that combines virtual simulation, traditional workshop techniques and additive manufacturing, namely ceramic 3D printing. To broaden this perspective within the design pilot, this second workshop incorporated a collaboration with the Ceramic Research Laboratory as Experience (CCE). This laboratory develops a dedicated research residency programme that introduces students to innovative manufacturing techniques. Building on a strong regional ecosystem of institutions, research centres, and industry, the lab fosters both fundamental and applied research, combining traditional crafts practices with digital technologies such as 3D modelling and printing. As a centre of expertise and experimentation, CCE fosters collaboration among designers, artists, researchers, educators, and technicians, supporting the creation of original works that challenge conventional standards while upholding strong artistic rigour and an advanced technical approach.

Methodological Perspective: Hybrid Workshop Environment

This multilateral collaboration aimed to explore the relationships between traditional plaster turning, digital modelling via the *Simulator*, and 3D printing technologies in ceramics. Within this ecosystem, the simulator functioned as a central interface connecting multiple modes of ceramic manufacturing. The workshop design combined several technical environments and devices: on the one hand, the plaster wheel in the porcelain workshop; on the other, the simulator, 3D modelling software, and 3D ceramic printers in the CCE laboratory.

Workshop participants were able to move from traditional plaster turning to digital modelling programmes and ceramic 3D printing, exploring the possibilities of producing the same object using different technical processes. From a comparative perspective, this parallel production revealed how digital and traditional workshop-based techniques can complement each other. In this way, the Simulator could become a platform for experimentation and mediation where forms can be tested, scaled and translated through different media.

Figure 20. Examples of 3D printed ceramic pieces, Plaster Simulator Workshop, ENSAD Limoges, CCE Research

The workshop was conceived as an experimental design environment rather than a purely instructional format. Students first explored the simulator freely before modelling a ladder-shaped object from a dimensionless reference drawing, which required autonomous decisions about proportion and structure. The models were exported for 3D printing but also reproduced on the plaster wheel, allowing for direct experimentation with the dialogue between virtual conception and its various physical and material translations. Moving between the laboratory and the porcelain workshop ensured that all participants experienced a diversified sequence of porcelain production, from digital modelling to material fabrication.

Development of the *Plaster Simulator* as Design Research

This second workshop provided an opportunity to test and evaluate the Plaster Simulator following several months of continuous development carried out through the collaboration of FORTH developers, CNAM researchers and designers, and porcelain specialists from ENSAD Limoges. The interdisciplinary design process was characterised by ongoing translation, adjustment and refinement between the objectives of technological formalisation, embodied in the application, and the realities of workshop practice. This iterative exchange ensured that the tool remained responsive to professional knowledge while supporting the accurate digital representation of material processes. The collaboration also brought into focus the uneven visibility of ceramic practices. While techniques such as pottery and wheel throwing benefit from well-established visual and cultural references, others, including plaster turning, remain comparatively underrepresented. This observation highlighted the importance of documenting and formalising these practices in order to support their transmission, recognition and integration into contemporary design and training contexts.

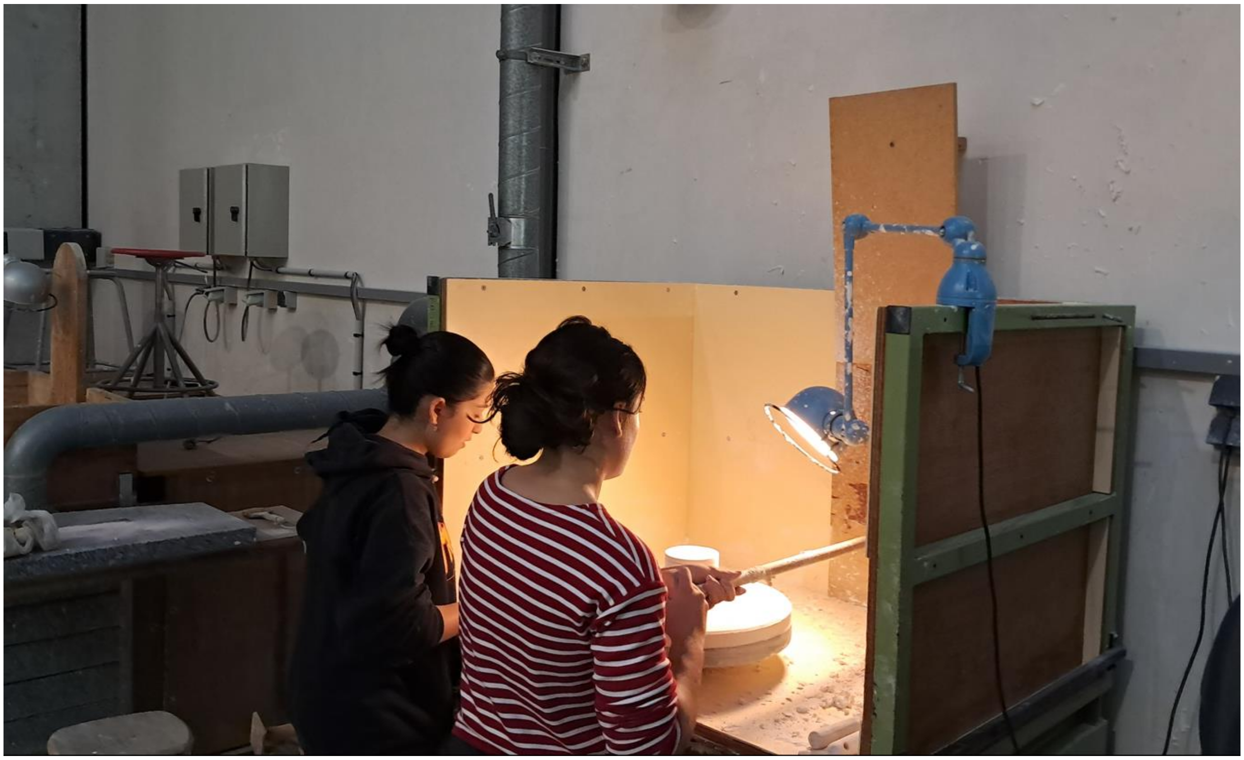

Figure 21. Plaster Simulator Workshop, Porcelain Workshop, ENSAD Limoges (2025) © Inés Moreno / CNAM

Beyond the pedagogical or documentary dimension of the *Simulator* and in line with the general methodological approach of the Pilot, this second workshop offered the opportunity to explore aspects related to its creative potential and to reflect on its implications for enriching design research processes. The active involvement of the teaching team allowed for a specific reflection on the different design learning methodologies in the context of this school.

This second phase of in-depth testing of the tool highlighted the potential of the *Simulator* as a platform for creative exploration. By enabling rapid experimentation without material limitations, it encourages iterative design processes and facilitates the testing of formal hypotheses before production. It allows users to conceive and create shapes that extend beyond the limitations of conventional material and technical practices. The possibility of exploring geometries that are difficult or impossible to produce using traditional porcelain-making techniques, while still taking into account the structural, geometric, and technical constraints inherent to ceramic 3D printing, positions the *Simulato*r as a tool for formal exploration.

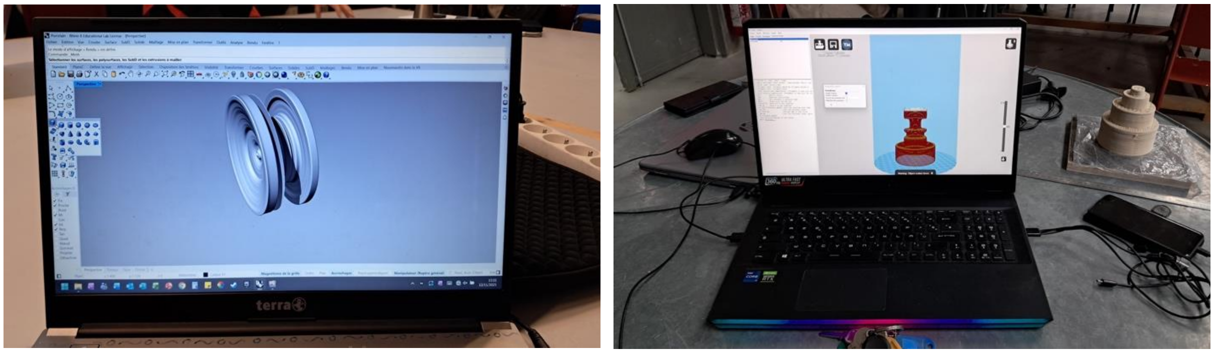

Figure 22. Plaster Simulator Workshop, CCE Laboratory, ENSAD Limoges (2025) © Inés Moreno / CNAM

Reflective Assessment

The evaluation examined the potential and limitations of the Simulator as a creative tool through multiple data collection methods, including on the spot feedback, a collective reflective session held at the end of the workshop to gather insights on both the tool and its dynamics, a post workshop online questionnaire, and individual interviews with experts in the relevant techniques, 3D modelling, and traditional plaster wheel practice. Drawing on the collected data, the Simulator demonstrates strong potential as a creative learning environment that encourages active engagement with form. It supports the early understanding of shaping principles, process sequencing, and material logic, while allowing users to visualise, test, and refine ideas before workshop practice. By enabling experimentation without immediate material constraints, it promotes a reflective and action-oriented approach to making and positions itself as a valuable resource for craft, design, and artistic education. Clarifying its pedagogical role, whether as an initiation tool, a space for experimentation, or a preparatory interface for production, would further support its integration into both formal and informal learning contexts.

During the evaluation, it was observed that introducing a greater variety of tools, including turning tools of different sizes and shapes, could expand the Simulator's creative potential. Users also recommended enabling the creation of new tools beyond those currently found in the workshop, as well as allowing existing tools to be adapted or repurposed. Participants highlighted the importance of ergonomic clarity, intuitive navigation, and a well-structured workspace to support fluid creative engagement. An expanded and flexible toolset, together with predefined shapes, could further diversify the range of achievable forms, while improved interoperability with 3D software would reinforce the connection between conceptual design and material production.

Figure 23. Ceramic 3D printed pieces, Plaster Simulator Workshop, CCE Laboratory, ENSAD Limoges (2025) © Inés Moreno/ CNAM

7.1.4 Focusing on Gesture as a Cross-cutting Theme, Medium and Tool for Innovation

In line with the research orientation of the CRAEFT ethnographic protocol, gesture, skill and, in general, the embodied dimension of know-how are at the core of the Design Pilot in the Limoges Porcelain case study. Despite its elusive nature, the know-how dimension is important when striving to deepen understanding and improve the transmission of craft knowledge.

The designers' participation in the Pilot was partly driven by their shared interest in the gestural dimension of know-how, as a tool for analysing technical action, a vector for transmission and a source of creative exploration within the design field. The role of one of the designers, Jessie Dérogy, who is also the pedagogical coordinator of the ceramics workshop, was instrumental in the choice of the representative gestures of porcelain production in the specific context of Limoges, which were documented and studied by the project Consortium. One of the specificities of the traditional craft-making of porcelain in Limoges relies precisely on the plaster turning on the wheel. Although this sequence was documented in detail during the protocol application, the designers considered it necessary to delve deeper into its complex technicality and, specifically, into the gestural and bodily expertise that it involves. It was decided to construct the Porcelain Design Pilot, in its dual aspect of pedagogy and design research, based on this sequence of gestures that are highly conditioned by the use of two types of tools: a wooden stick (*pichouret*) to stabilise the movement in combination with a range of turning tools (*tournassins*). The designers' research orientation was to distance themselves from the determinism of traditional tools and material constraints and focus on the production gestures. One of the designers involved, Anne Xiradakis, had developed several projects explicitly integrating the gestures of use in her object design process. In this sense, the Pilot approach was an extension of this perspective, focusing on the particularities of production gestures and their significant potential as a tool and source of innovation in contemporary design practices. By focusing on gestures, the Pilot approach seeks to redefine innovation in craft-oriented design practices through the dialogue between traditional porcelain making and digital technologies. Along with the documentation produced during the application of the ethnographic protocol, these digital tools not only preserve knowledge of craft techniques but also deepen our understanding by revealing dimensions of the practice that are not easily perceptible to the naked eye, even for its practitioners. While the workshop format allowed for a guided accompaniment towards a more precise awareness of the crucial role of gestures within a technical process, the designers delved deeper into the idea of the gestural dimension of traditional know-how augmented through digital tools, as a means of enabling innovation and the exploration of new forms of transmission, creation and expression.

7.1.4.1 A Collaborative Approach to Digital Tools Development

Collaborative Development Process

The Pilot's perspective is integrated into the methodological approach of the CRAEFT project and its commitment to interdisciplinarity as a mode of understanding and conducting research. In the same way that the protocol developed in the project involves the convergence of various disciplinary traditions in the social sciences and crucial contributions from research in computational sciences, the integration of design is conceived in similar terms. The framework was guided by social science researchers, based on the specificity of the practices, methods and professional values of object design as a discipline. One of the objectives of this collaborative framework was to address different ways of understanding technical gestures based on different disciplinary traditions that mutually enrich one another. The initiative developed in the context of ENSAD Limoges reveals how digital technologies can be rethought and fruitfully combined with traditional skills to improve the design process, refine teaching methods and unlock new possibilities for creative exploration.

At the centre of this Pilot's perspective lies the willingness to explore the possibilities of the successful development of digital tools that arise from the collaborative conversation between researchers, artisans, designers and technological developers. At ENSAD Limoges, the development of digital tools was a collaborative endeavour, led by the designers alongside researchers and students. This process took place in several phases and had to deal with certain challenges, especially the predictable mismatches that arise when different cultures and professional visions engage in open dialogue. In the same vein, another critical aspect was the task of social science researchers to understand the prospective needs of designers, translate these requirements, and communicate them clearly to the technology partners. The latter, for their part, had to adapt existing technologies to meet the designers' needs and interests. This resulted in translation and interdisciplinary readjustment, which were overcome thanks to constant listening and the necessary doses of mutual adaptation and flexibility.

Experimental Testing

The experimental testing and analysis phase of digital tools was carried out at various levels. During the first presentation at a meeting before the workshop, the designers discovered how their proposals in tool conception had been interpreted and materialised. One of the main objectives of this tool co-creation phase was to develop a series of different modalities of gestural representation that would allow different analytical perspectives to be deployed and compared concerning the chosen manufacturing sequence. In this sense, the tools developed and proposed by FORTH met the designers' expectations in their variety and multiplicity of points of view. Some of the designers' requirements were unmet, such as the complete abstraction of skeleton-based eye-tracking or hand-tracking by eliminating the background from the original video. This aspect did not prevent the experimentation and testing stage. Although still in the early stages of technological development, the proposed tools aroused great interest and some surprise among the designers, who rediscovered traditional porcelain techniques in a new light. A key feature of the experimental testing was its emphasis on iterative refinement.

On the one hand, the experimentation and testing of the series of tools was carried out individually by each designer, with the dual objective of generating recommendations for the improvement of the tools and developing a reflection on the place of this type of tool within their research, creation and production processes in design. This phase also allowed them to choose a particular tool that they found interesting from a technical, pedagogical or creative point of view. By focusing on one tool, they could carry out a more detailed and in-depth analysis, make more precise and accurate recommendations and be able to imagine innovative design projects. On the other hand, the workshop was conceived to implement, reinforce, and diversify the testing and analysis phase of the toolkit by the participating students to verify its potential as a means of learning and formal experimentation. The workshop format by thematic groups allowed for the structuring of the different angles of experimentation and the channelling of the students' collective experiences. During the workshop's testing sessions, participants provided valuable feedback on the usability and functionality of the tools. Initial tests revealed both strengths and weaknesses in the design of the tools. While the digital tools were useful for visualising and analysing the gestures, the students found that direct interaction with the materials was essential for deepening their understanding of the movements.

Analysis of Findings

The experimental testing phase provided crucial insights into how digital tools could enhance porcelain-making, offering new perspectives on this traditional craft. This testing phase also revealed that the tool's analysis was most effective and engaging for the participants when combined with hands-on experimentation. Each tool provided a detailed visualisation of the subtleties of the gestures involved in plaster turning, revealing the precision and dexterity required by the process. Their analysis allowed the designers and students to observe these specific gestures in new ways, including the sense of unfamiliarity that analytical distance provides. The digital tools were tested both by the designers and by the students who participated in the workshop and in the early stages of development. The feedback and recommendations included here refer to the first version of these tools. Since then, these tools, especially avatar representation, have been considerably improved.

Gestural Visualisation Toolkit

Tool 1: Hand-Tracking Visualisation Mode of Plaster Turning Processes + Real-Time Hand and Body Schema Tracking

Figure 24. Hand-tracking of Plaster Turning representation © FORTH

The hand tracking visualisation mode aims to capture and represent the intricate hand movements involved in craft processes, plaster turning, in this case, translating them into a digital or visual outline. By tracking the hand and body in real-time, this mode highlights the complex relationship between gestures, tools and the transformation of the material. The system maps the positions of the hand, the joint angles and the body posture during the turning process, providing an interactive view of the crafting process.

Early Feedback and Recommendations from Designers and Design & Art Students

- Precision of Gestures: The mode effectively captures the fluidity and complexity of hand movements, making complex gestures more understandable.
- Geometrisation: the schematisation of movements provides an interesting way of studying gestures, emphasising their relationship with tools and materials.
- Visual Clarity: The visualisation highlights the angles of the joints and the positions of the fingers, which helps to dissect the subtleties of the craft.
- Movement Continuity: At times when visibility is limited (for example, when parts of the hand are obscured), the system seems to 'guess' the movements, which introduces inconsistencies in the representation.

Tool 2: Skeleton-Based Gestural Representation

Figure 25. Skeleton-Based Gestural Representation © FORTH

Early Feedback and Recommendations from Designers and Design Students

- Lack of Realism: The gestures, particularly the movements of the fingers, feel surreal, almost detached from actual practice. Issues of proportion arise, such as the size discrepancy between the hands. For example, the hand in the foreground appears unnaturally large compared to the other.
- Interpretation Challenges: There are difficulties in understanding the depicted action, partly due to visibility problems, such as the relationship between the front and back elements or the perceived distances.
- Technical Considerations: When visibility is obscured, there's an impression of improvisation, as though the gestures are imagined rather than precise. This imaginative quality introduces ambiguity.
- Perception Issues: The representation of the system of lines and points creates confusion in the understanding of the position.

Suggestions for Refinement

- Face Abstraction: The face should be rendered as abstract as possible, focusing less on its details and more on the position of the head relative to the body.
- Improving clarity: It is essential to accurately represent the position of the limbs and the flow of gestures to eliminate ambiguities and ensure movement consistency.

Tool 3: Insights and Challenges in Avatar-Based Representation of Gestures

Figure 26. Avatar representation based on Plaster Turning gestures © FORTH

The representation of the plaster turning gestures using an avatar has been developed from an interpretation of the technical action, using as a source the videos recorded with a front camera during the application of the protocol. Eliminating the workshop space, the tools and the materials, this mode of representation seeks to focus on the gestures, postures and bodily behaviour of the practitioner during the execution of the action. This type of avatar is interesting to practitioners who discover another way of visualising a technical sequence, but it presents some challenges and leaves room for further improvements.

Early Feedback and Recommendations from Designers and Design Students

- Point of view and visibility: One of the problems lies in the point of view. In particular, the visibility of the hands is often obstructed by the position of the arms, which causes the gestures to be partially or completely hidden. This limitation highlights the need for an avatar that allows for dynamic manipulation of perspective, such as rotational views, to improve clarity.
- Rhythmic and movement constraints: The fluidity and coherence of the gestures are interrupted by a ‘choppy’ rhythm, making it difficult for observers to follow or interpret the sequences with precision. The quality of the representation of the movement could be improved to give an impression of continuity and fluidity. The avatar's movements are perceived as sluggish, reducing the fluidity and realism of gesture representation. Enhancing the responsiveness and naturalness of movements could significantly improve user perception.
- Length and sequential limitations: The brevity of the sequences exacerbates the aforementioned challenges, as it limits the amount of information provided.
- Identification Challenges: Abstraction from the context makes it difficult to recognise the specific production sequence that served as the source for developing the avatar. The cold and inhuman

aspect of the avatar can limit the connection of users who have difficulties recognising their gestures in the avatar, making it difficult to identify with it. The spasmodic nature of the movements creates a sense of distance from the user's actual practice.
- Increasing Self-awareness and reflections on Practitioner Bodily Behaviour: The avatar provides a unique perspective, revealing that users are often more static during shooting than they perceive themselves to be. This feedback can be valuable for self-reflection and improving practices.
- Contextual Abstraction: The avatar's lack of contextual elements, such as tools or materials, provides a unique perspective, emphasising gesture and posture. This abstraction encourages gesture-focused analysis, which can be valuable for specific analytical or creative applications. While this approach offers new possibilities, its practical utility depends on translating these insights into actionable design elements.

Suggestions for Refinement

- Simultaneous Display of Multiple Videos: To facilitate an exhaustive analysis of the gestures from multiple perspectives, a dual-view interface will be implemented. This interface will show two avatars representing the egocentric and frontal perspectives, side by side on the same screen. Ensuring precise synchronisation between the videos will allow for perfect comparative analysis of the movements from both points of view. Priority will be given to a fluid and uninterrupted representation to improve the observer's ability to effectively grasp the dynamics of movement.
- Improved Point of View Options: To provide a more immersive and comprehensive gesture analysis experience, a visualisation system will be developed in which users can dynamically adjust their point of view by rotating perspectives or zooming in on specific areas of interest. Close-up view options will be incorporated to improve the visibility of critical gestures or actions. Users manipulate the avatar, viewing the movements from any angle to better understand gestural dynamics.

Further improvement of this visualisation tool (from M21 to M36)

A new version of this gesture visualisation tool was introduced during the second workshop, allowing participants in both workshops to compare it with the first version. Although this latest version was not subjected to detailed evaluation by users and was not directly integrated into the educational experimentation framework, its refinement allowed for a more accurate assessment of the tool's contribution to gesture visualisation.

Aligned with the Design Pilot overall approach and the broader project objectives, the tool is based on recordings captured with the frontal camera during the plaster-turning process during the protocol application, with situated gestural activity at the forefront. By removing the material, tools, technical devices, and work environment from view, it highlights the embodied dimension of productive activity. Furthermore, it supports enhanced approaches to understanding gesture through postural analysis, shifting away from perspectives focused solely on “manual” activity and instead emphasising the involvement of the entire body in technical action.

In line with the perspectives developed by designer Anne Xiradakis within this Pilot, which will be detailed later, the gestural, postural and bodily dimensions of a manufacturing process can become a source and material for creative exploration in the fields of design and art.

Figure 27. Avatar representation based on Plaster Turning gestures © FORTH

7.1.4.2 Collaborative Development of the Interactive Plaster Simulator

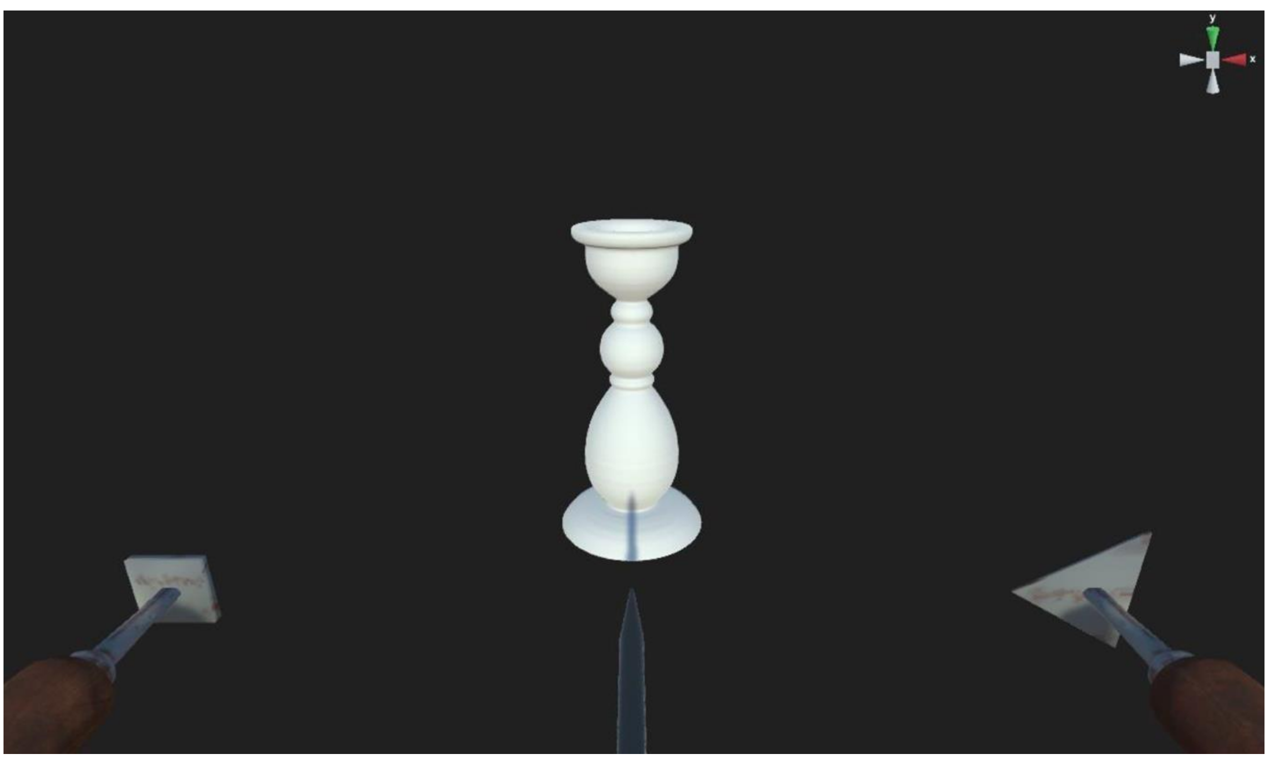

Figure 28. First version of the Plaster Simulator © FORTH

The first version of the *Plaster Simulator* was introduced during the initial *Ghost Gestures* workshop in November 2024, offering a complementary perspective to existing visualisation tools focused on gesture and posture. Unlike these approaches, the simulator abstracts human movement and represents only the virtual interaction with the material. This early version enabled users to replicate the plaster-turning process using two types of tools: turning tools (*tournassins*) for material removal and a pointed tool for marking reference points. As gestures and body movements are not depicted, users are encouraged to adopt the maker's perspective and focus on the technical action itself. Presented as a means to broaden gesture visualisation, the tool was also subject to in-depth analysis by one of the designers; the results of this assessment are discussed in greater detail below.

Early Feedback and Recommendations from Designers and Design Students

These recommendations are intended to make the Porcelain Generator more realistic, ergonomic and accessible while promoting an immersive experience faithful to the real porcelain-making process.

Visual dynamics and perception of movement

- Challenge: The object rotates so perfectly that the rotational movement is not perceptible, giving a static impression.
- Recommendation: Introduce a subtle visual effect (for example, a slight texture or a visible mark on the surface) that allows the user to perceive the rotation in real time. This could also reinforce the handmade feeling.

Note: It must be remembered that when the plaster is poured onto the work form on the wheel for modelling by turning, the cylinder is never a perfect solid of revolution. Consequently, modelling on the wheel always starts with an irregular cylinder.

Noise and sound interaction

- Challenge: The tool does not generate a sound when the plaster is scraped or material is removed, interfering with immersion.
- Recommendation: Incorporate a sound component simulating the noise of material removal (scraping). This sound dimension would enrich the user experience and strengthen the link with actual craft practice. It could also heighten awareness of the materials used.

Unrealistic tool behaviour

- Challenge: The tool works even when it shouldn't, such as when used on its flat side instead of its cutting edge.
- Recommendation: Refine the tool's constraints to reflect its actual operation, limiting its effectiveness to conditions corresponding to realistic use. This would enhance the consistency and technical accuracy of the simulator.

Lack of base and gravity

- Challenge: The tool does not account for gravity, weight or mass, and there is no visible plinth or base to anchor the object in space.

- Recommendation: Add a base or anchor point to place the object in a spatial context. Simulating the effect of gravity could also prevent the creation of unrealistic shapes in real life and improve the credibility of the designs generated.

Note: It should be remembered that the plaster is poured onto the base of the plaster wheel, which has a plaster piece in the centre (*quille*) that serves to hold the form on the wheel, to prevent it from detaching with the rotation and centrifugal force exerted.

Lack of spatial references

- Challenge: The simulator does not provide clear markers to measure the diameter, height or scale of the objects created, which makes it difficult to reproduce shapes and limits possibilities, such as creating a shape from a drawing.
- Recommendation: Integrate visual markers or measuring tools into the interface to enable users to assess the dimensions of their creations. This would make it easier to plan and document designs.

Ergonomics and handling problems

- Challenge: The transition between translation and rotation is not intuitive, and some keys do not work properly on an AZERTY keyboard, making the tool difficult to use for non-QWERTY users.
- Recommendation: Adapt the commands to take account of AZERTY keyboard configurations. For example, allow users to reconfigure keyboard shortcuts according to their preferences. Simplify the transition between translation and rotation movements by integrating a combined command or automating part of this interaction.

User experience and overall interface

- Challenge: Some functions, such as Reset (Home), are unavailable, or their operation is ambiguous.
- Recommendation: Check that all the advertised functions are functional and accompany them with clear indicators in the interface. A toolbar or drop-down menu could centralise the main options and make the experience more intuitive.

Visibility problem

- Challenge: The turning tools don't stand out very well against a black background.
- Recommendation: Lighten the background and add chromatic elements that contrast the tools and the background surface, or lighten the tools and make the metal parts appear shinier.

Further enhancement of the *Plaster Simulator* (from M21 to M36)

This interactive Plaster Simulator has undergone significant improvements since its initial presentation at the first workshop, in collaboration with designers and experts. The early versions mainly served as exploratory tools. Unlike existing virtual pottery systems that mainly simulate clay deformation, this tool models the subtractive shaping of rigid plaster blanks, which is a crucial stage in industrial ceramic production. Developed through a user-centred design process with expert practitioners, the simulator mimics the specific workflow of the workshop, from blank preparation to the geometric constraints of the turning wheel. Between M21 and M36, the system evolved through six prototypes, with expert feedback guiding the shift from generic sculpting metaphors to a more realistic depiction of workshop practice, including accurate hand positioning.

While the initial version established technical feasibility with a two-scene structure and real-time deformation of a rotating solid, it lacked workflow clarity, craft-specific constraints, and a structured interaction layer. The second version introduced tool panels, measurements, and session management, enabling repeated expert testing. However, the experience still has pottery resonances with generic centring and unconstrained turning, and it didn't correspond to the plaster turning technique. In the third version, enhanced visual realism and geometric fidelity through improved materials, lighting, and measurement tools were introduced. Expert feedback helps to shift the focus from technical refinement toward greater alignment with a more realistic plaster-turning practice. The fourth version achieved stronger workflow authenticity by introducing pouring and drying stages, cylindrical blanks, rotation-dependent cutting, and handedness modes. Tool-orientation aids and a virtual hand reinforced the embodied logic of the turning process. The fifth version builds directly upon this foundation, refining preparation, perception, and ergonomic realism to create a system recognised by experts as faithful to workshop practice. The defining contribution of this version lies in its treatment of preparation as an integral component of the craft rather than a preliminary shortcut. Version 5 had reached a high level of stability and already integrated the key recommendations provided by experts and practitioners.

In the transition toward Version 6, a second workshop was organised at ENSAD Limoges in November 2025 to further test and explore the *Plaster Simulator* within the specificities of an art and design educational context. The workshop focused on assessing the tool not only as a support for knowledge transmission but also as a platform for creative exploration, examining its capacity to inform design processes and stimulate formal experimentation.

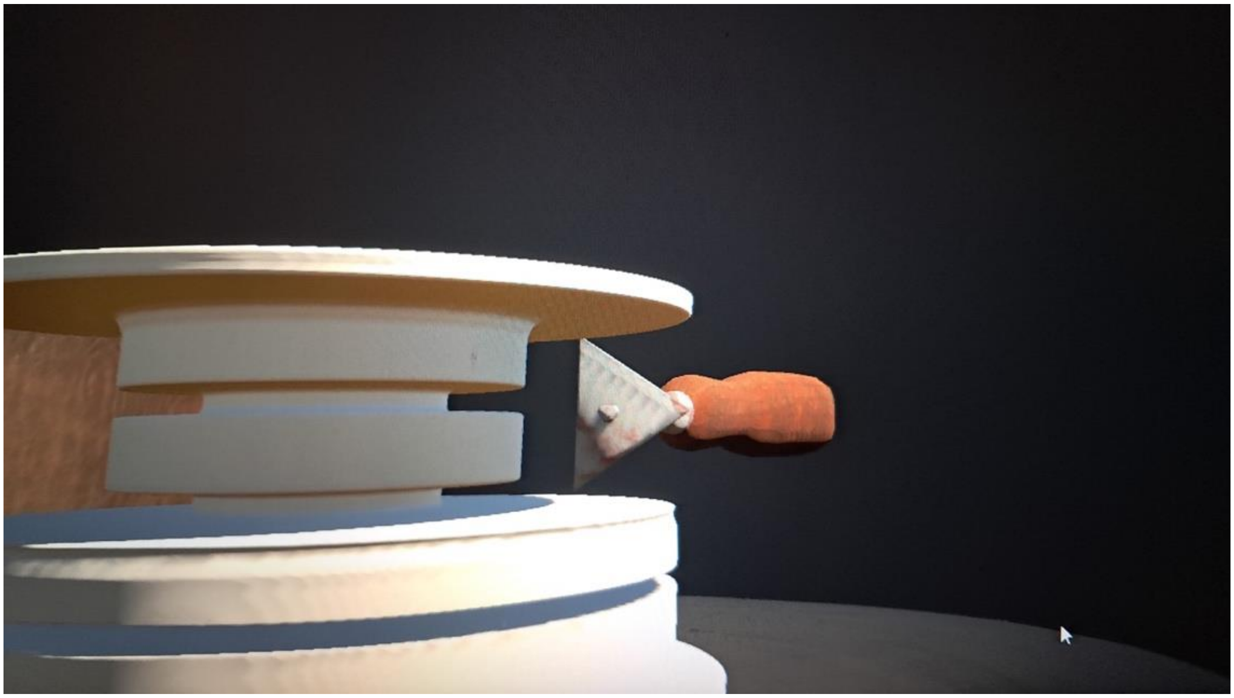

Figure 29. Fifth version of the Plaster Simulator © FORTH

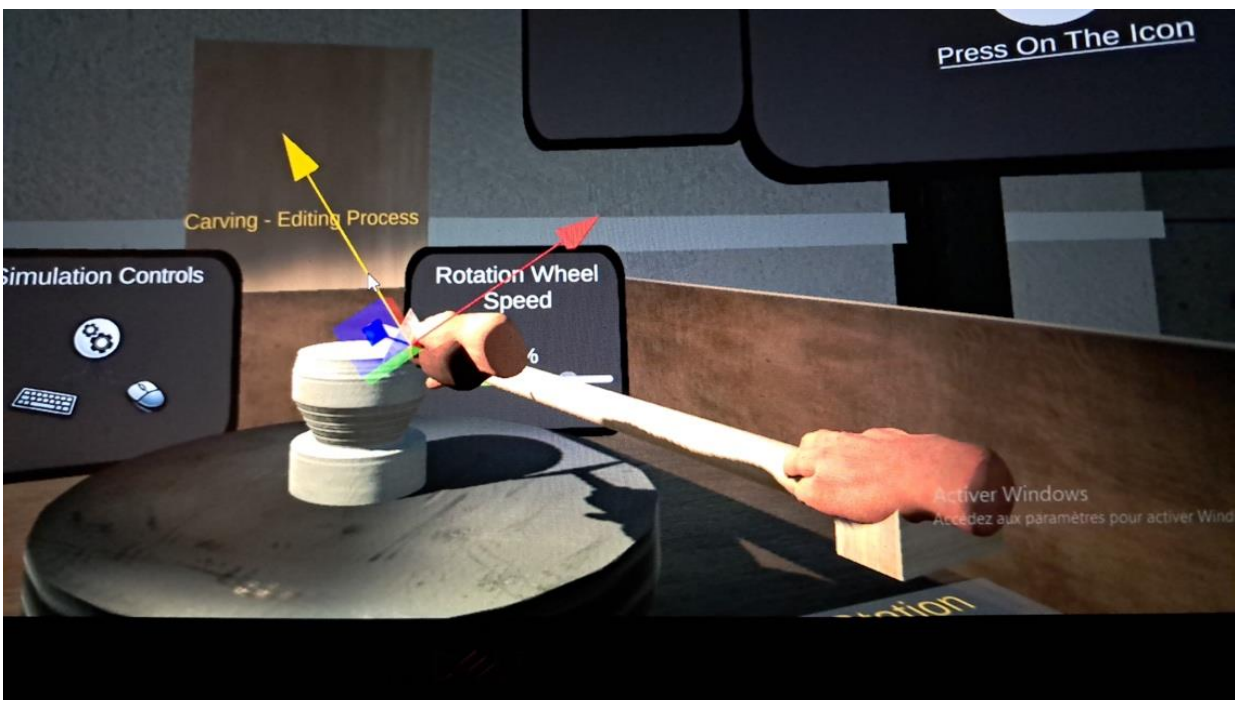

Figure 30. Sixth version of the Plaster Simulator © FORTH

7.1.4.3 Pedagogical Framework and Methodological Approaches to Design Education

In collaboration with Jessie Dérogy and other members of the school's teaching team, the designer Anne Xiradakis contributed to defining the thematic orientation, structuring the teaching programme, and implementing the workshops developed as part of the Pilot. Her involvement was particularly significant in the first workshop, dedicated to production gestures as both an object of analysis and a tool for creation. Drawing on her teaching experience, she reflected on the diversity of methodological approaches to design education within the specific context of an art school such as ENSAD Limoges. The two workshops were conceived within the framework of the Ceramics Studio, a special programme designed to experiment with ceramic techniques and aimed at students in both art and design options. These programmes are structured around a broad thematic framework that encourages participants to explore the topic freely and develop their own creative directions. The 2024–2025 edition focused on the notion of atavism and incorporated a selection of ceramic objects from the heritage collections of the Adrien Dubouché Museum.

The 2025–2026 edition, again developed in collaboration with the museum, centred on the theme "Without Hands." The thematic focus was initially proposed by Jessie Dérogy, following observations of art students' practices during ceramics workshops. These students often adopted a somewhat overly direct approach to creative practice based on an immediate relationship between the hand, the body, and the material, often without a preparatory phase of drawing or design. This approach tended to produce similar forms, characterised by an element of randomness. The introduction of the notion of "without hands" as a conceptual and creative constraint was thus intended to encourage the use of intermediaries, tools, protocols, or devices to renew formal production processes and promote more experimental approaches. For design students, this approach did not constitute a major break with tradition, as the use of tools or intermediary devices is more integrated into their practice. For art students, this framework allowed them to question their working habits and move away from an exclusively intuitive relationship with the material, thus paving the way for greater diversity in forms and creative processes. This theme seeks to encourage critical reflection on tools, gestures, and modes of production and creation, and the Ceramic Studio provides an opportunity to develop the students' individual projects grounded in their own research questions, while engaging with this guiding concept. A student project exemplifies this pedagogical approach. They experimented with the moulding technique by working directly on the moulds and gradually transforming them during production. Using a systematic approach, they explored how an object could evolve and change function as the mould was modified.

In the context of an art school, approaching the project from a design perspective involves mobilising several methodological approaches that students are gradually led to explore and appropriate. The aim is to encourage experimentation with different methods and, ultimately, the development of personal methodologies on the part of the students. Among the most common approaches are research through drawing and model making, which are seen not only as tools for representation but also as design instruments that help refine the project's concept and bring out new ideas. The exploration of materials, the study of gestures, as well as contributions from art history, research, and an understanding of social contexts feed into the project's needs. These tools can be used at different stages of the process, both upstream and during development, and can be combined in different ways depending on individual approaches. Within the *Pilot* perspective, the focus on gestures was a key starting point for exploring creative processes.

7.1.5 The Designer Gaze: Jessie Dérogy Insights and Design Proposal

Beyond experimenting with and analysing the use of the digital tools proposed in the context of the workshops and the suggestions for improvement and refinement proposed, the designers also drew on their different design practices to develop some reflections on the use of digital tools and possible creative developments in the form of design projects.

7.1.5.1 Designer Presentation and Statement of Practice

Jessie Dérogy (1993) defines herself as an experimental designer. She completed her studies in the Netherlands, graduating in 2017 with a Master of Arts in Contextual Design from the Design Academy of Eindhoven. Attracted by ceramics, in 2018, she joined the post-graduate course ‘Art and Design in Contemporary Ceramics’ at ENSAD Limoges. She currently lives and works in Limoges.

Artist link: www.instagram.com/jessiederogy/

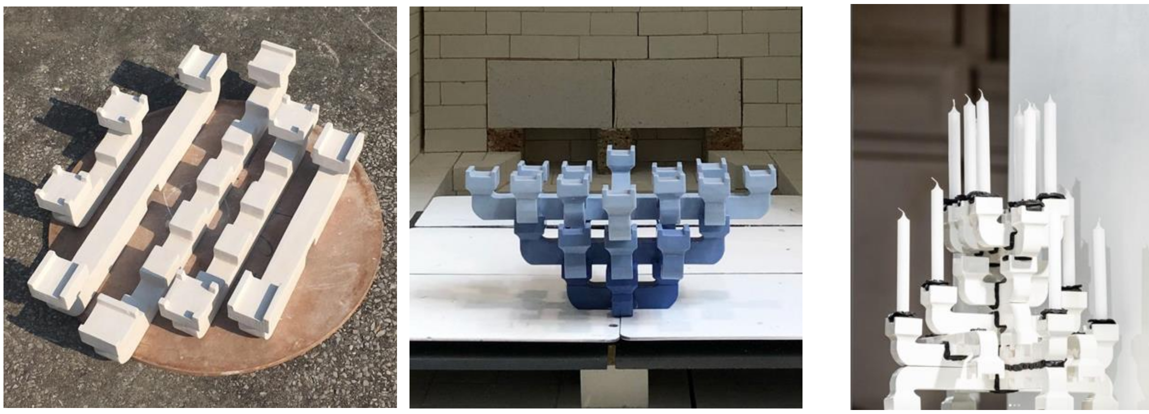

Figure 31. Gradient Dougong (2021) / Jessie Dérogy

Jessie Dérogy is fascinated by existing forms, from objects to technical pieces and from architecture to scraps of material she collects and assembles. Like a thieving magpie, she intrudes on territories, hijacking existing objects to create new structures. She forms collages with abstract functions that she intuitively assembles into ritualised objects and scenes. She has developed a deep sensitivity to materials through her ongoing research into everyday objects (their form, meaning, design and use). It is through ceramics that she is now developing her practice. Fallen in love with the material and its manufacturing processes, she finds in her creative process all the elements necessary for her work.

Somewhere between industry and craft, series and a single piece, each ceramic generates a set of elements revolving around the finished piece (mould, matrix, waste, failures, defects, firing support, etc.). These are all components that become part of his collages. Her practice is motivated by a critical approach to design (production, meaning, representation, aesthetics). Going beyond the formal conventions of object design allows her to explore and develop new narratives and aesthetics. The results of his practice oscillate between ‘functional sculpture’ and ‘sculptural object’, blurring the boundaries between art and design. As a result of her cross-disciplinary practice, she has taken part in several exhibitions dedicated to design in Europe and has been invited to group exhibitions of contemporary art. In 2022 and 2023, she won two consecutive awards (Mathias Prize) for her work in ceramics. She teaches at ENSAD Limoges, where she is head of the Ceramic Workshop.

Figure 32. Left: Magnum, vase, 45x30 cm, Biscuit and enamelled porcelain, black velvet flocking (2024).

<u>*7.1.5.2 Design Project Proposal based on the Plaster Simulator*</u>

This project explores interactions between digital virtuosity and physical gesture in the context of creation using the digital tool *Plaster Simulator*. It combines control and the unexpected, as part of an exploratory approach aimed at the material qualities and the trace of gesture, while questioning the specificities of digital and traditional creation methods. The project is structured along three lines:

- The trace of the gesture: Exploring the links between the physical gesture (the movement of the mouse or the tool in the Simulator) and its impact on the digital and physical form. How can these traces be transposed into ceramics?
- Material anomalies: Intentionally working with ‘errors or misuses of the tool to generate new surfaces, textures or forms.
- Contextual analysis of generated forms: Approach generated forms as objects of study, analysing them to give them meaning, context or function.

Using the *Plaster Simulator* reveals an immediate virtuosity: with just a few gestures, it generates complex, plastic forms that, in a craft context, would require years of mastery. However, this apparent mastery is accompanied by an absence of direct physical gestures and material interaction. In traditional ceramics, the handmade gesture leaves a tangible imprint, reflecting a dialogue between the hand, the tool and the material. This research looks at the intersection of these two worlds: what happens to the trace of the gesture when digital technology comes into play? How can we transpose this trace into physical matter, while respecting or subverting the specific features of the two modes of creation?

The *Plaster Simulator* also offers a unique opportunity to play with digital anomalies, using them differently. For example, when the tool is not used on its cutting edge but on its flat surface, it does not interact with the material as it would in a physical context. This diversion creates unexpected results and new material qualities and questions the relationship between the form generated and its surface appearance. This project proposes to study these anomalies through a comparative approach: what happens when these digital forms are translated into physical ceramic material? Surfacing work, for example, could be one route where the deliberate mishandling of the tool gives rise to textures or finishes.

The *Plaster Simulator* allows you to create shapes quickly, almost randomly, without necessarily responding to a prior intention. Unlike a traditional design approach, where the form results from a need, problem or context, here, form precedes thought. It becomes an independent entity, almost like an archaeological object whose origins, context and raison d'être need analysis. By taking these generated forms as a starting point, we reverse the traditional process: to reflect a posteriori on their meaning, contextual belonging, or potential function. How can we give them a reason for existing? This work invites critical reflection on the genesis of objects and their place in the contemporary world.

This project aims to blur the boundaries between the digital and the physical, between algorithm and gesture, and between chance and control. The dialogue between the two tools questions what these interactions reveal about the design practice. How can digital technology enrich ceramic craft and, conversely, how can craft inspire new digital approaches? Finally, what does this hybridisation tell us about the place and significance of objects in our societies today?

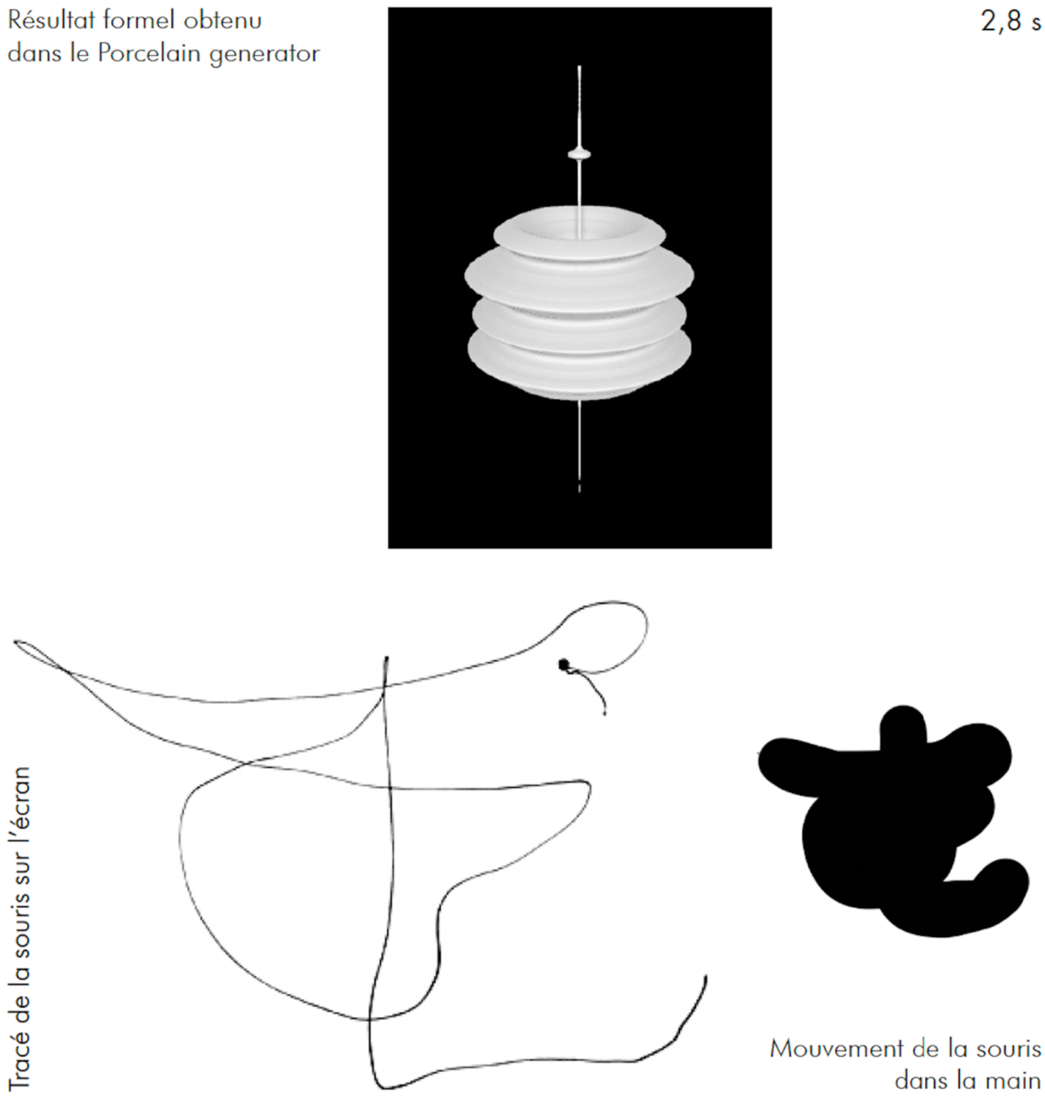

Figure 33. Design Pilot Working Materials (2025) / Jessie Dérogy

7.1.5.3 Reflections on Digital Tools Use within Design Conception and Production Processes

In my approach, digital tools occupy an ambivalent position. They are not just practical instruments for carrying out specific tasks, but sometimes 'raw materials' for reflection. Take the Porcelain Generator, for example; this tool acts more as a catalyst for shapes and ideas than as a production tool in the traditional sense. Its ability to generate shapes quickly and instinctively, without reference points such as height or diameter, makes it a conceptual support rather than a means of producing a final object. In this way, the digital tool becomes a space for experimentation, where the usual constraints are deliberately absent. This 'open' and fluid character transforms these tools into a fertile ground for exploring ideas without being limited by physical or technical imperatives. They are not seen as strictly technical instruments, but as an extension of creative thinking, sometimes even as malleable material to be shaped.

The importance of digital tools in my process varies enormously depending on the project. Some require a deep integration of digital tools to check proportions, design 3D prototypes or explore formal interactions.

In these cases, digital tools are an essential support, enabling ideas to be tested quickly and aesthetic or technical choices to be validated. In other projects, these tools may be relegated to a secondary role or even absent altogether. This depends on the nature of the project, my artistic intentions and the materials involved. Sometimes they are used to compensate for technical inexperience in a particular area or to communicate an idea more clearly to collaborators or partners.

In my view, the relevance of digital tools lies in their conscious, informed and ethical use. They must not become a reflex or an obligatory part of the creative process. Systematic or unquestioned use runs the risk of standardising practices and losing authenticity. However, when used intentionally, these tools can enrich the creative process by opening up new perspectives or proposing unexpected solutions. They also raise questions about the conceptual and ethical implications of the objects produced. For example, some tools can generate forms that defy physical laws or material constraints, forcing reflection on the relations between virtual and tangible. Furthermore, these tools impact the design, unconsciously steering creations towards uniform aesthetics or establishing a visual language specific to technology. This can enrich a project but also stigmatise entire practices if this influence is not questioned. The creative responsibility then lies in using these tools as an extension of critical thinking, and not as an end in themselves. Ultimately, digital tools are just one element in a creative ecosystem. They do not replace manual sensitivity or craft skills but complement, extend and even enrich them. Their relevance, therefore, depends on their harmonious integration into the process, considering the features of each project and its intentions.

Jessie Dérogy (January 2025)

7.1.6 Limoges Porcelain Design — Insights from Anne Xiradakis' Design Practice

7.1.6.1 Designer Presentation and Statement of Practice

Anne Xiradakis develops tableware objects. In her work, she explores various ways of generating and provoking new or ambiguous uses, drawing inspiration from the observation and reinterpretation of manufacturing and usage gestures. At the same time, her role as a designer remains deeply connected to the workshop, where she envisions alternative production processes, favouring simplified, flexible manufacturing methods that grant artisans greater creative freedom. She seeks to redefine standards in alignment with ecological concerns, incorporating elements such as reduced moulds, waste integration, free-form designs, and production techniques that embrace deformation and limitless tooling possibilities. A significant dimension of her practice lies in pairing the production of objects with a reflection on their "putting into use." This often takes the form of ephemeral events in which her creations are activated by guests, by the designer herself, or by the audience. Since 2006, her nomadic events, such as *Ephemeral Cafés* ("*Cafés Éphémères"*), *Gourmet Installations* ("*Installations Gourmandes")* and *Offbeat Dinners* ("*Dîners Décalés"*), have served as dynamic platforms where her objects are activated and engaged with by the public. She has collaborated with renowned chefs, including Guy Savoy, Inaki Aizpitarte, and Jacques Decuqet, and companies like Arc International and Bernardaud. She also shares her teaching expertise at ENSAD Limoges and the Camondo School of Design and Interior Architecture in Paris.

Designer links:

- http://annexiradakis.com
- https://www.instagram.com/annexiradakis/

Design Work Examples – Porcelain-based Objects

In the *Collection Variable*, the designer collaborated with a porcelain artisan who plays a central role in shaping the object. Rather than prescribing a fixed form, she defines a production principle and a scenario for using the object, which allows the artisan to determine the final contours of the pieces. The artisan shapes the piece by drawing its outline by pouring slip around the cavity, then filling it to the outer edge. The project seeks to highlight the maker's gesture, as the precision and character of this action give each object a distinct and individual appearance. This approach aims to strengthen the link and sense of intimacy that can exist between the maker and the object, offering a new perspective on the repetitiveness often associated with mass-produced tableware.

Figure 34. *Collection Variable* (2010): Set of three pieces with variable forms. Porcelain biscuit. Project developed in collaboration with Jean-Louis Schmitt / Anne Xiradakis (Image: Baptiste Heller)

Figure 35. Un objet / une série (2010) Set of porcelain containers in varied dimensions

This series of porcelain containers draws on a mould from the Kahla Cumulus collection, a porcelain tableware series produced by the German manufacturer Kahla/Thüringen Porzellan. A single mould is used to create a set of 50 pieces whose differing heights result from variations in the filling level. Building on this principle, adjusting the amount of material poured into the mould enables the development of a family of containers suited to diverse uses.

Figure 36. Service Guy Savoy (2004) / Anne Xiradakis

Design Work Examples – Object Activation Events

Figure 37. Café Éphémère 20 (2012) in Fukuoka, Japan, in collaboration with Bureau Baroque, as part of the Bordeaux-Fukuoka exchange anniversary celebrations / Anne Xiradakis

Figure 38. Café Éphémère (2015) Musée National de Céramique Adrien Dubouché, Limoges/ Anne Xiradakis

Anne Xiradakis creates objects designed to contain, transport and enhance food, and prefers to present them as a whole, not separated from what they were designed for. For twenty years, he has been organising “ephemeral cafés”, intimate gatherings where his pieces are handled and experimented with while guests share carefully selected food and drink, allowing the objects to reveal flexible and unexpected functions. These events allow her to test her designs and bring her work to a wider audience. She has continued to develop this approach by extending it to different environments, museum and heritage spaces, developing culinary installations and unconventional dinners in collaboration with chefs, and deepening her exploration of the relationships between design, use and the sensory experience of food.

Figure 39. ***Broken Collection, Collection 1*** **(2025) / Anne Xiradakis**

Figure 40. ***Broken Collection, Collection 2*** **(2025) / Anne Xiradakis**

Figure 41. ***Broken Collection*****, Collection 3 (2025) / Anne Xiradakis**

One of her most recent works, *Broken Collection* (2025), is a residency proposal involving the University of Applied Arts Vienna, the University of Bergen, and Ensad Limoges. It brings together creative and academic professionals to explore the future of ceramic restoration, using a war-damaged collection of 18^{th} and 19^{th}-century Chinese and Japanese ceramics. The designer developed three projects that repurpose shards and incomplete pieces, allowing users to engage with them through the experience of a meal.

7.1.6.2 Reflections on Production and Design Practices

Being a designer who thinks about production can mean ensuring that the project enables the mass production of objects that are homogeneous, stable and free of defects, as required by the market standards. But it can also mean shifting approaches from one technique to another to produce a new appearance, a new surface, as, for example, in Max Lamb's Crockery project, where he sculpts the plaster model with the tools of a stonemason, resulting in a set of pieces with a textured surface. Jessie Derogy's practice also explores these questions in Expérimentation 1, where she skips the model stage by carving directly into the mould.

Some designers are looking for new ways of approaching moulds, imagining them as more versatile, more economical and evolving towards other materials. For example, the project developed by Normal Studio during its residency at Cirva (2015-2017) involves the production of two types of mould that are easy to shape, use economical materials and reveal the material in different ways. The moulds are flexible, made of sewn textile or metal mesh, and offer a wide range of formal possibilities. Another example is François Azambourg, with the Vase Douglas *project developed at Meisenthal, who imagines a wooden mould that transforms to create a series with a shape that evolves as production progresses. The cube-shaped wooden mould only allows for fixed blowing, which gradually burns the surface of the mould, giving shape to increasingly inflated objects where the angles disappear. They also imagine objects with a minimum mould, a single plaster plate with a slight hollow, as in the Collection Variables by Anne Xiradakis, where the artisan draws the shapes and borders of the bowl, directly in the plaster. It is also possible to imagine a single mould that can be used to give shape to different pieces, as, for example, in* An Object/ A Series *(Fig. 28) by Anne Xiradakis, a set of pieces produced from a single mould.*

Tinted in the mass, as in Jessie Derogy's project with Gradient Dougong *(Fig. 24), it takes advantage of the effect of colour loss during manufacture to make the construction of the object, by level, more legible. In addition, the object's shape creates gradient colour effects by gravity; the shape creates the decor.*

A different way of thinking about production might be to consider how the maker can avoid being alienated by their work, as Gaetano Pesce tried to do with the Sansone project, where the craftsmen are also designers by choosing the colours to be poured into the mould, but also by creating patterns on the surface of the table. Another way for the designer to reconsider the stages of production is by thinking about the materials used in the project. With the Rotoman project, the Maximum collective has turned a stool on its head by incorporating daily-made compulsory samples to test the material.

Anne Xiradakis (July 2024)

7.1.6.3 Design Pilot Proposals

Drawing on a reflective analysis of her own practice, the designer developed several proposals exploring different methodological and conceptual directions. For this project, the consortium chose to focus on one of these proposals: *Freeze Frame*. Nevertheless, presenting the full set of proposals provides valuable insight into the multiple dimensions of her practice and clarifies her positioning as a designer, particularly in relation to experimentation, critical inquiry, and process-oriented research.

Working Methods and Creative Approach

For this project, the designer's approach is based on a reflection on CRAEFT documentation practices of traditional Limoges porcelain techniques, the starting point being observation practices and analytical insights using raw video footage of the Plaster Turning phase recorded as part of the ethnographic protocol. She made three different creative propositions using design methods, using these materials.

Design-Based Proposition 1: *The Sliding Project*

Based on an analysis of a series of videos documenting the plaster turning sequence, the designer has captured a sequence linked to a specific material. This action is made of several gestures that the designer moves and applies to another material, to produce a new result from the same gesture. Use a brush to apply soap to prevent the plaster we're about to pour from sticking to the central core. The circular movement of the brush in the palm, then wringing it out between the thumb and forefinger, allows the superfluous soap foam to be pressed and extracted. The hand moves in circles in the liquid plaster to activate and collect air bubbles, then throws the material away in a pressing movement to make it flow into another container to check its fluidity. *The Sliding Project* reinscribes these two gestures with soap and plaster in another context, a culinary performance presented in a video, where soap and plaster would be replaced by culinary materials such as jelly or ganache.

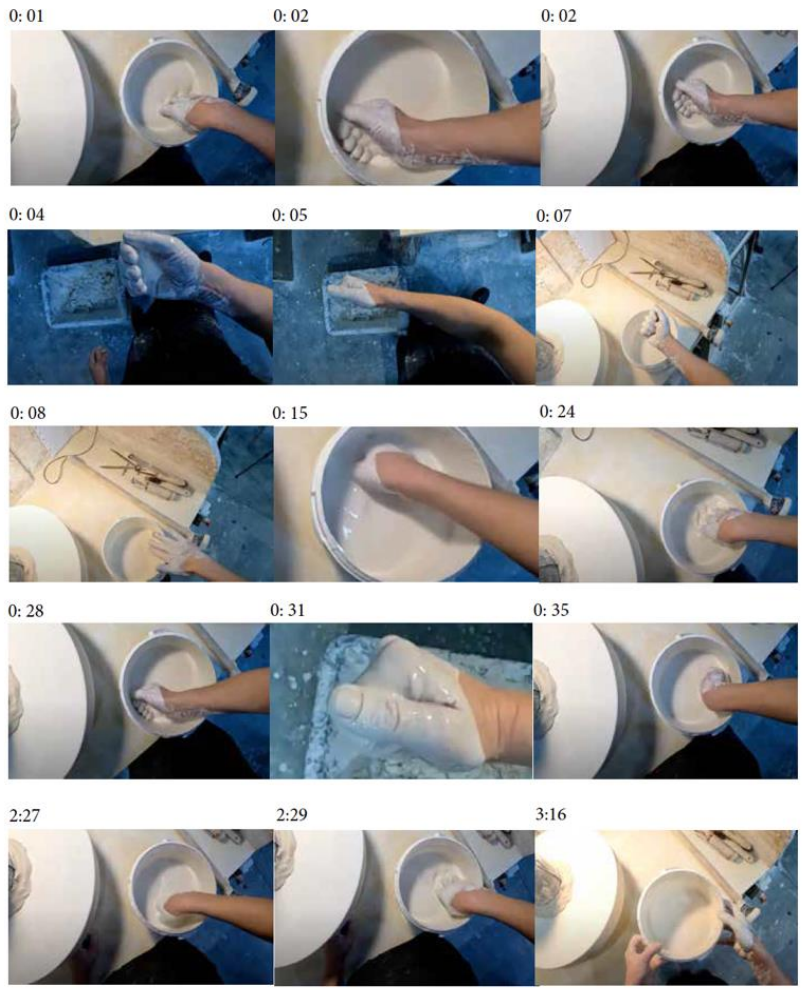

Figure 42. Proposition 2 The Sliding Project, working materials (2025) / Anne Xiradakis

Design-Based Proposition 2: Forms of Gestures. A Series of Five Experimentations

The designer puts her practice into dialogue with the video recordings of the Plaster Turning sequence to produce a series of experiments to become new projects.

The *Formes of Gestures* project explores adapting and transferring traditional gestures, particularly those used in the Japanese Tea Ceremony, to other forms, objects and materials. These gestures, which play a part in both the ceremony and the creation of objects, are delicate means of expression that establish a link between craft and hospitality, as exemplified by the practice of Tea Master Kimura Soshin. The original project was presented in two main formats, which were directly inspired by the traditional gestures of the tea ceremony:

- *Forms of Gestures 1* (Tea Ceremony): The same gesture produces different shapes. Existing gestures that use a different material to produce a new shape (pastry-making)
- *Forms of Gestures 2* (Support Object): An object that carries the gestures of another object. Existing gestures linked to an object shape give a new object shape.

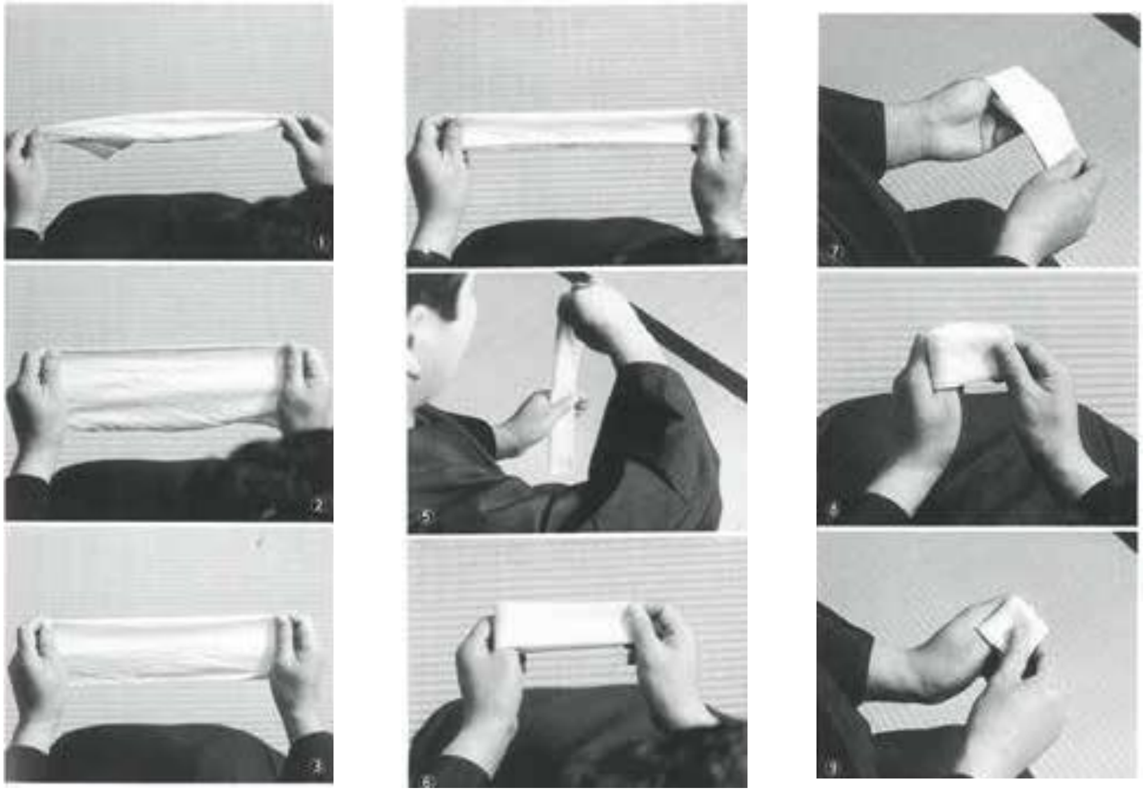

Figure 43. Gestures for learning how to fold the Chakin from a tea ceremony manual.

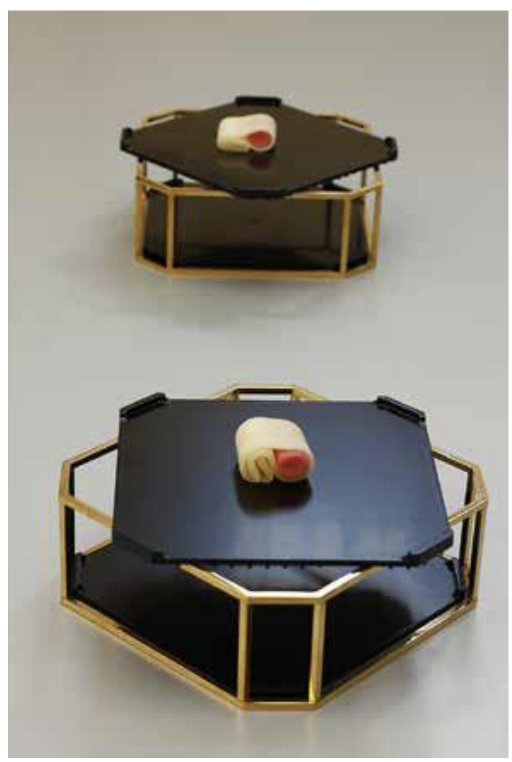

Figure 44. Left: The Tea Master, Kimura Soshin, folds the pastry like a Chakin. Right: Forms of gestures, Ceremony (2016) / Anne Xiradakis

Experimentation 1: Same gesture, different shapes

This exercise involves reproducing identical gestures, in the same device (wheel), but using other materials. For example, by replacing the raw material of ceramics with materials such as wood or porcelain, the same gestures generate new and unexpected shapes.

Experimentation 2: Transferring gestures to other tools

This experiment proposes transferring gestures associated with an object to different tools. For example, a practitioner might use stonecutting or woodcarving tools to create the shape of a cup. The aim is to see how the gesture can be modified or enhanced, using a different tool.

Experimentation 3: Reproduction with different craftspeople and tools

Using their tools, the object (a cup) is reproduced by crafts practitioners such as stonecutters or woodcarvers. Each practitioner, while subject to the same intention of reproduction, will see their gesture modified by their know-how and tools, offering a variety of unexpected results and unique interpretations. *Table tools* are a series of designed utensils transferred to a more fragile material, porcelain or glass paste, requiring the user to use a more delicate gesture, resulting in a subtle transformation of the gesture.

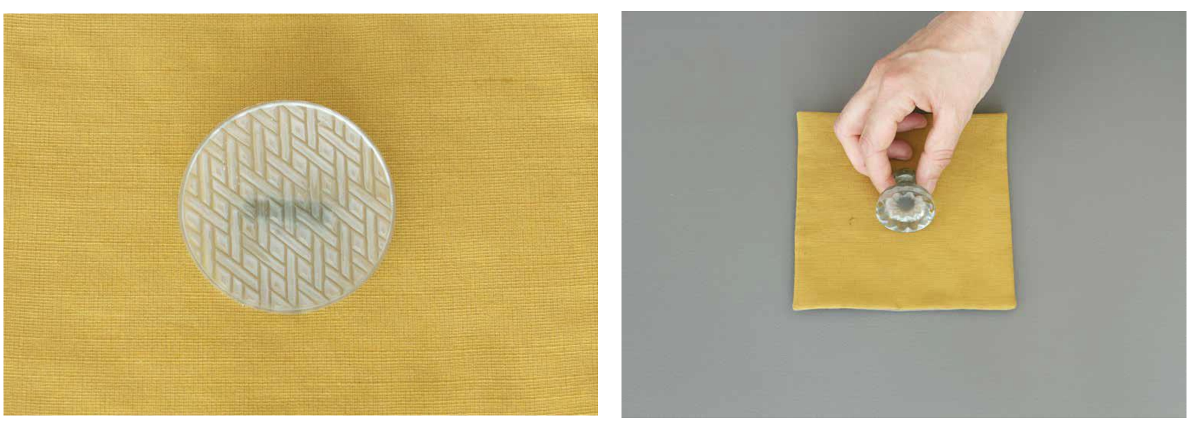

Figure 45. Table Tool 2, glass paste (2013) / Anne Xiradakis

Experimentation 4: Transferring gestures through different materials

This experiment explores how the same shape can be made through several materials, such as bamboo, plaster, cut stone or rough stone. Each material, with its specific features and characteristics, subtly influences and transforms the gesture, while adding a new dimension to the final object. *Presentation utensils Series 1-2-3*: Three series of utensils, the first formally resembles the basic utensil, then series 2 and 3 move away from it while retaining the potential of the basic utensil. (incised, stamped, shaped, etc.)

Experimentation 5: Transfer of gestures with tools whose shape has been modified

The practitioner reproduces the gestures used to create the shape of the cup using tools whose modified shape is achieved by adding the same shape, making the same shape more complex or enlarging the same shape.

Figure 46. Utensils to present Series 1-2, Villa Kujoyama (2016) / Anne Xiradakis

7.1.6.4 Design Pilot Focus: Freeze Frame (Arrêt sur Image). An Experimental Series of Five Cups Integrating the Production Process into Their Design

Project Description

For this project, the designer carefully observed and analysed the videos recorded during the plaster casting sequence, focusing on the subtleties of hand positions and the interactions between tools during various technical actions. Moments that captured crucial stages in the manufacturing process were selected and redrawn to reinterpret the source, while introducing a deliberate distance from the subject, resulting in drawings that support new forms combining tools and shapes in the process of creation. The drawing stage that followed the observations was also a means of raising awareness of gestures and actions.

This project is in line with Xiradakis's reflections on the place of gestures in the creative process, particularly manufacturing gestures. She develops design-based research that aims to reflect on how an object is able to "tell" its production process.

The idea for this project was inspired by archival documentation on the making process of the porcelain cups, to create an object presented in five distinct variations. These variations correspond to the five different production phases and incorporate the turning tools and their visible effects on the material. The result is a series of five different cups, each representing a stage in the creation of the same object. These objects embody the gestures of the production process, allowing us to "touch" the movements and gestural skills that shaped them. One of the cups literally incorporates a fragment of the turning tool used to shape it, reinterpreted as a handle. Another retains the grooves left by the metal blade of the turning tool on the plaster surface. In a third example, an accumulation of plaster produced during the turning process remains attached to the body of the cup, functioning like a handle.

When applying the ethnographic protocol at ENSAD Limoges, the recordings focused on the production of a porcelain cup with two handles. The original design of this cup, which appears at different stages and steps of manufacture in the recordings, was created by Gilles Bonnetat. Based on this model in the making, Anne Xiradakis operates suspensions, in other words, freeze frames, from the recorded video material, to crystallise salient moments in the production process. The resulting objects diverge in several directions from the initial model and reveal a new dynamic of variability and formal transformation.

Design Project Development (M21-M36)

Project Timeline

- Preliminary reflective work on the selected materials: the raw video recordings from the protocol documenting plaster-turning gestures (M21–M22).
- Development of initial design proposals (M22–M24).
- Selection and further development of the third proposal, *Freeze Frame* (M25–M26).
- Refinement of the series' technical drawings (M27–M28).
- Iterative development of the cups' 3D modelling, including the application of advanced rendering techniques through collaboration between FORTH, CNAM, and the designer (M29–M36).

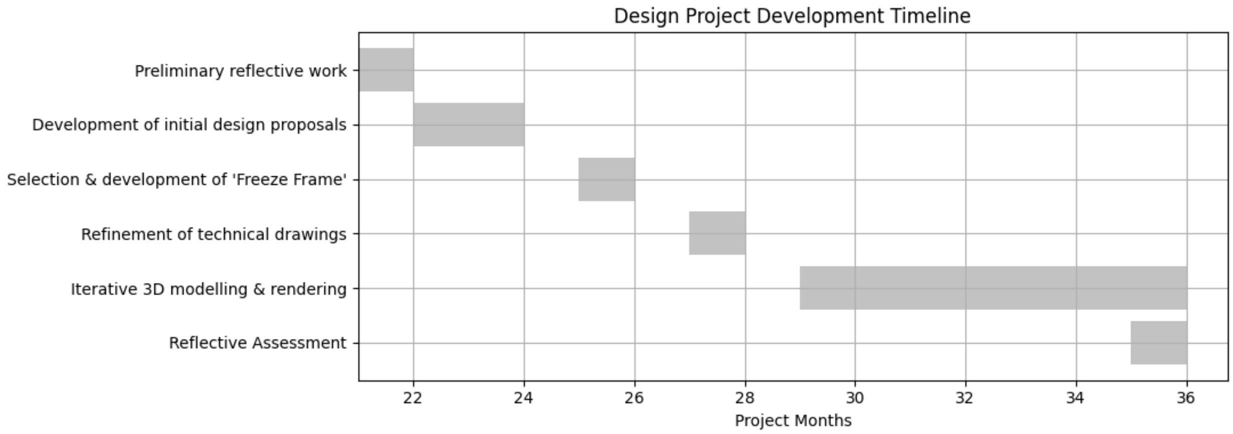

Figure 47. Timeline of Limoges Porcelain – Anne Xiradakis Design Project Proposal (November 2024 - February 2026).

Working materials (M22-M24)

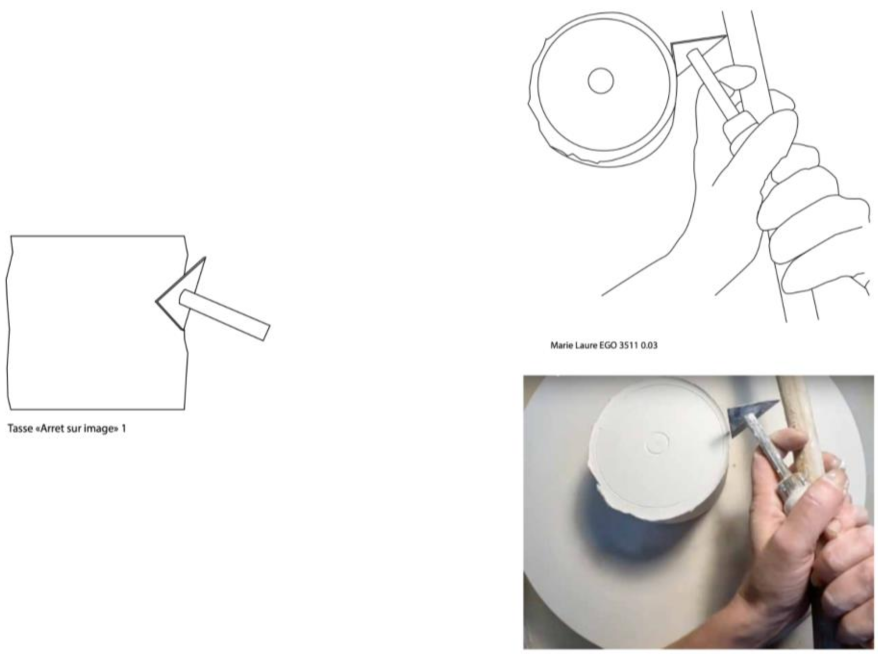

Figure 48. Anne Xiradakis, Freeze Frame Series (Arrêt sur Image) Cup # 1, developed from an original cup

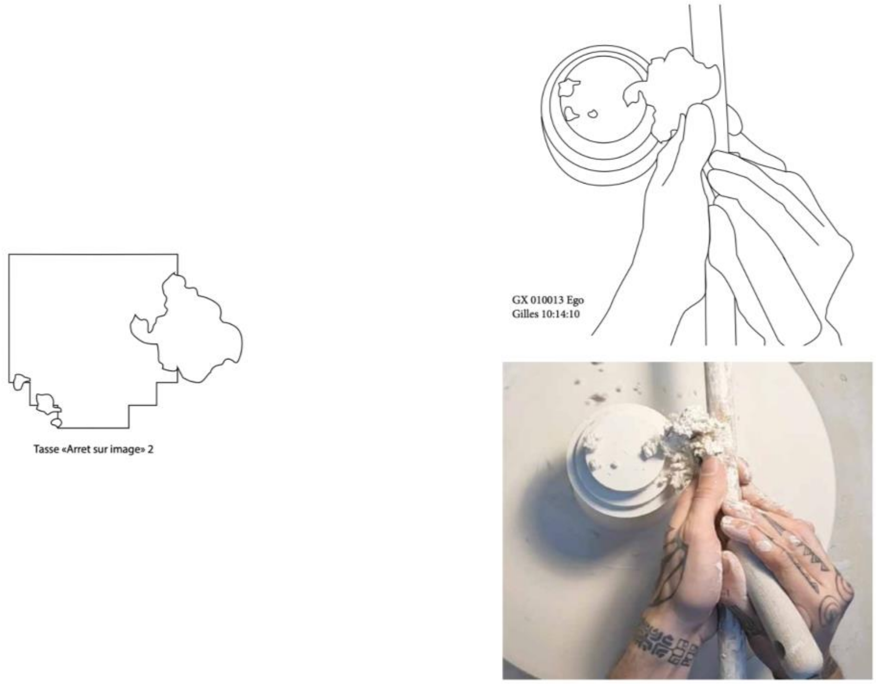

Figure 49. Anne Xiradakis, Freeze Frame Series (Arrêt sur Image) Cup # 2, developed from an original cup design by Gilles Bonnetat.

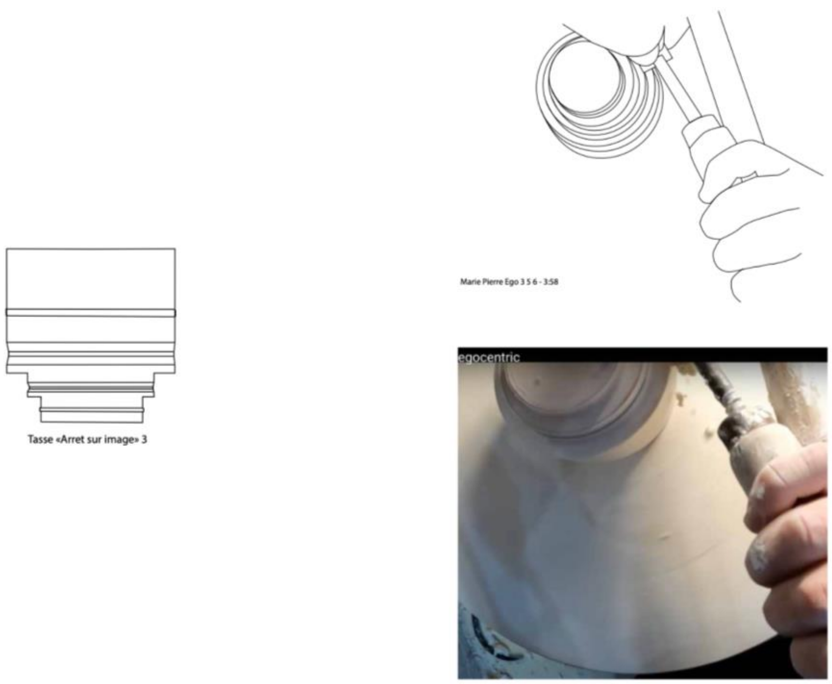

Figure 50. Anne Xiradakis, Freeze Frame Series (Arrêt sur Image) Cup # 3, developed from an original cup design by Gilles Bonnetat

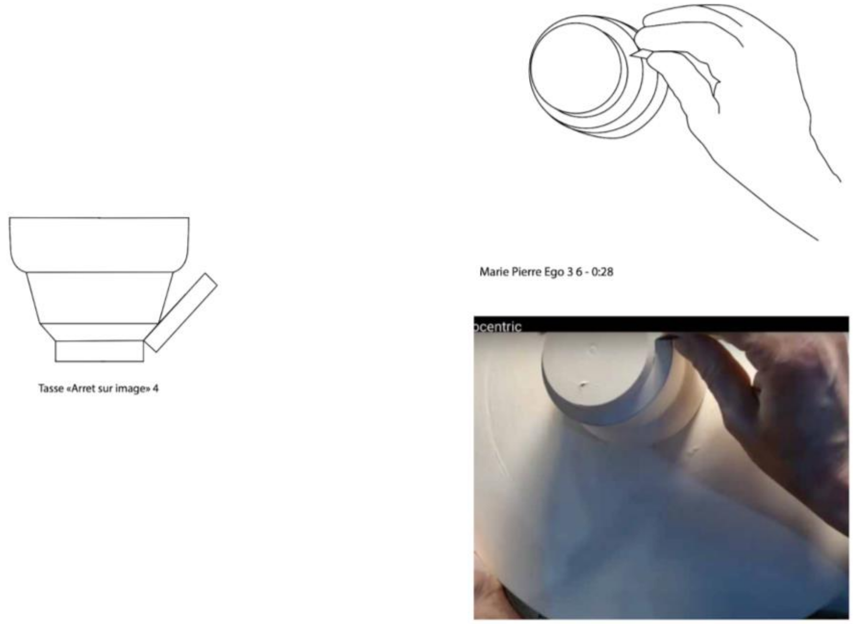

Figure 51. Anne Xiradakis, Freeze Frame Series (Arrêt sur Image) Cup # 4, developed from an original cup design by Gilles Bonnetat.

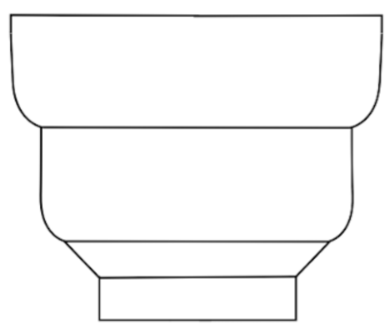

Figure 52. Anne Xiradakis, Freeze Frame Series (Arrêt sur Image) Cup # # 5, developed from an original cup design by Gilles Bonnetat.

Drawing Adjustments (M27-M28)

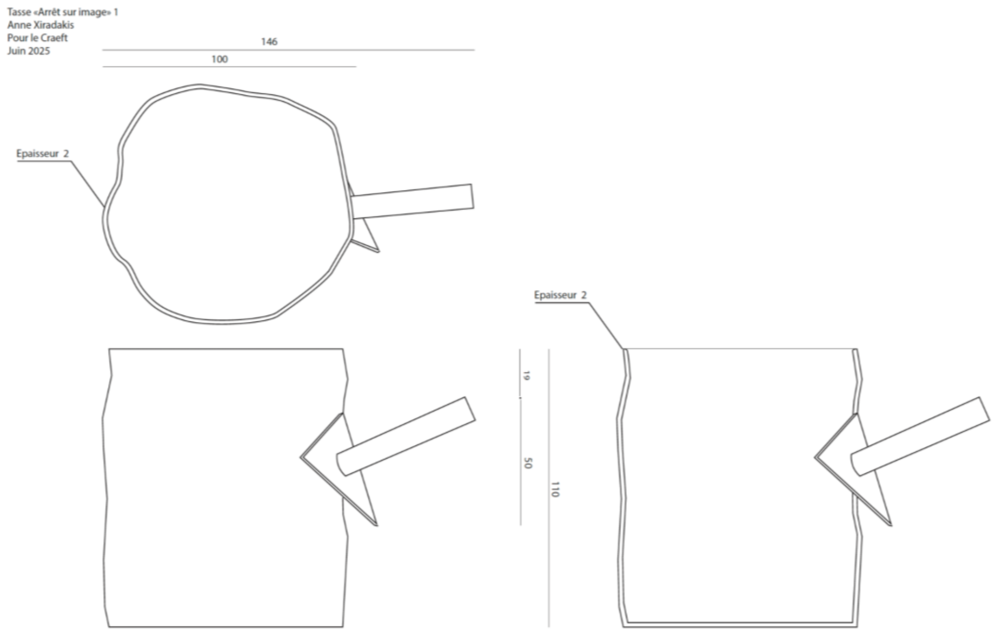

Figure 53. Anne Xiradakis, Freeze Frame Series (Arrêt sur Image) Cup # 1, developed from an original cup design by Gilles Bonnetat

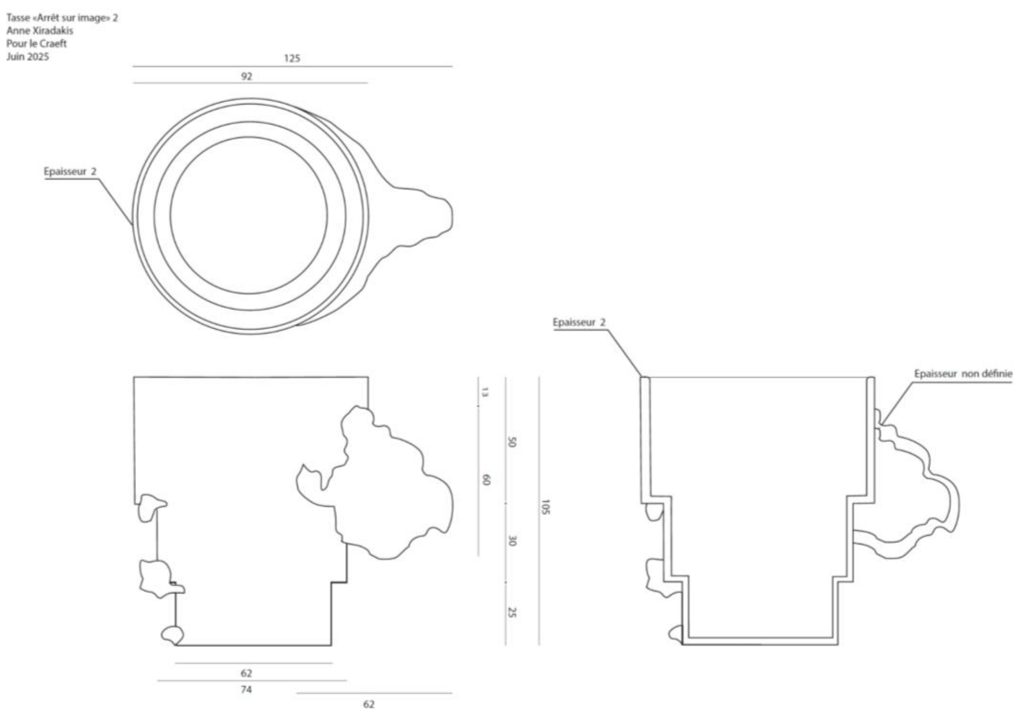

Figure 54. Anne Xiradakis, Freeze Frame Series (Arrêt sur Image) Cup # 2, developed from an original cup design

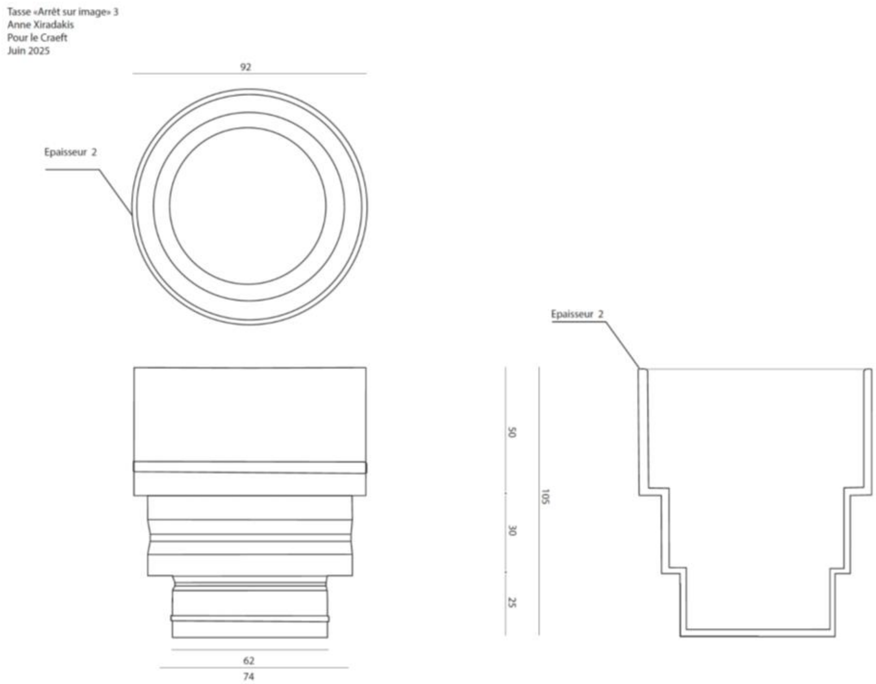

Figure 55. Anne Xiradakis, Freeze Frame Series (Arrêt sur Image) Cup # 3, developed from an original cup design

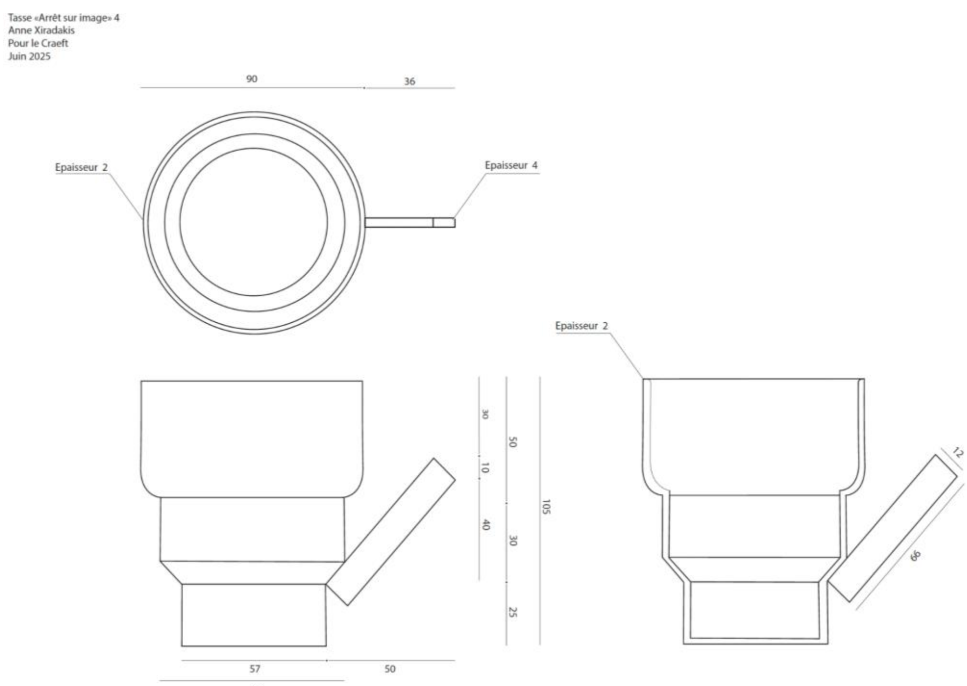

Figure 56. Anne Xiradakis, Freeze Frame Series (Arrêt sur Image) Cup # 4, developed from an original cup design

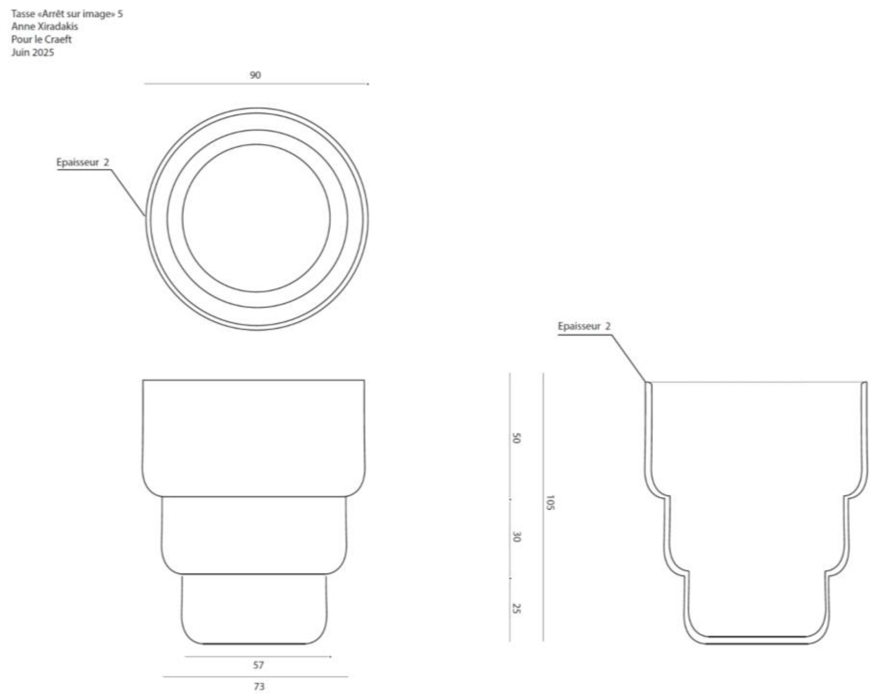

Figure 57. Anne Xiradakis, Freeze Frame Series (Arrêt sur Image) Cup # 5, developed from an original cup design

3D Modelling and Integration of Advanced Rendering Technologies (M29–M36)

In the final phase of the Freeze Frame (Arrêt sur Image) project, the five cup variations were translated into 3D models and rendered using advanced visualisation workflows. This work was carried out collaboratively between the designer and the Craeft technical partners to (i) validate the feasibility and coherence of the five variations as a single series, and (ii) provide a consistent visual reference for comparing formal features that directly “quote” the manufacturing process (tool fragments, grooves, and plaster accumulations).

The figure below presents one rendered view per cup (Cups #1–#5), based on the original cup design by Gilles Bonnetat and developed as part of Anne Xiradakis’ Freeze Frame series. Each rendering uses a consistent viewpoint and lighting setup to support side-by-side comparison across the series.

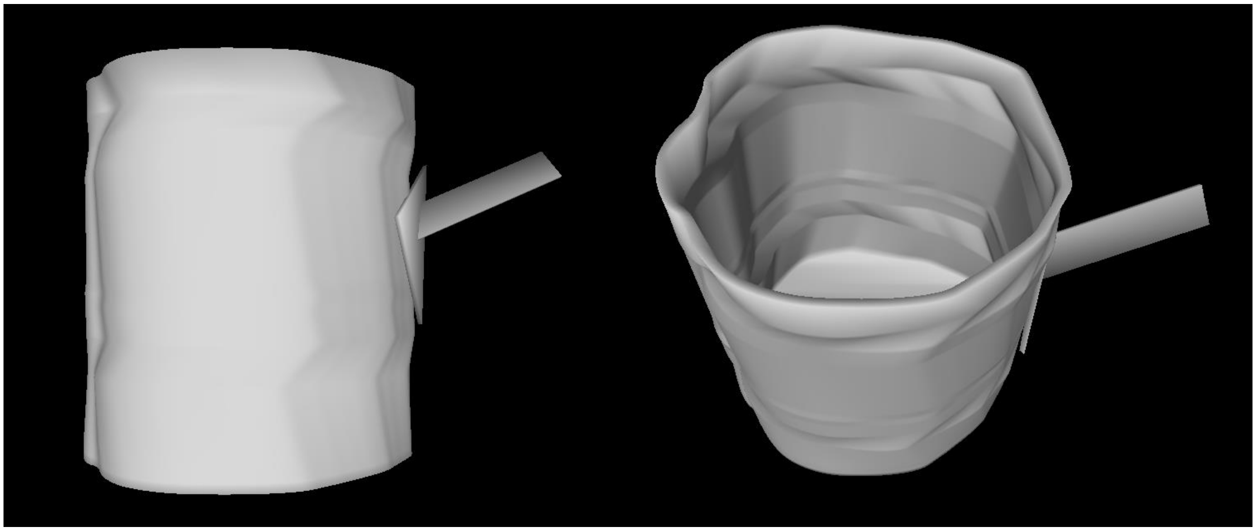

Figure 58. Anne Xiradakis, Freeze Frame (Arrêt sur Image) series — Cup #1 (rendering). Developed from an original cup design by Gilles Bonnetat. Rendering © FORTH.H

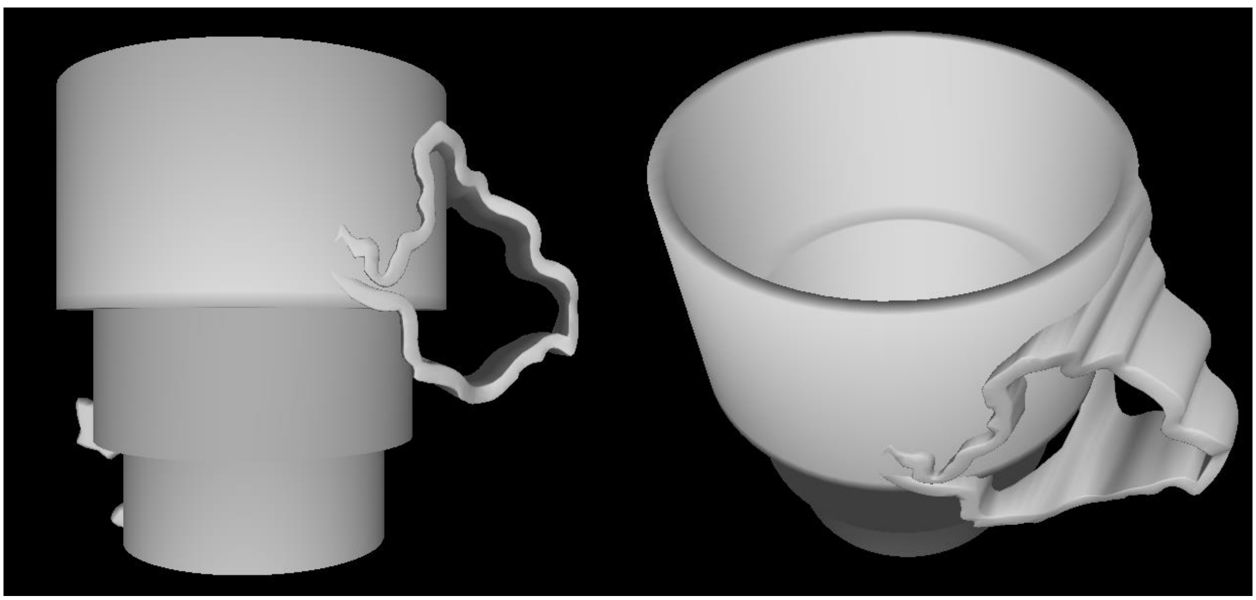

Figure 59. Anne Xiradakis, Freeze Frame (Arrêt sur Image) series — Cup #2 (rendering). Developed from an original cup design by Gilles Bonnetat. Rendering © FORTH.

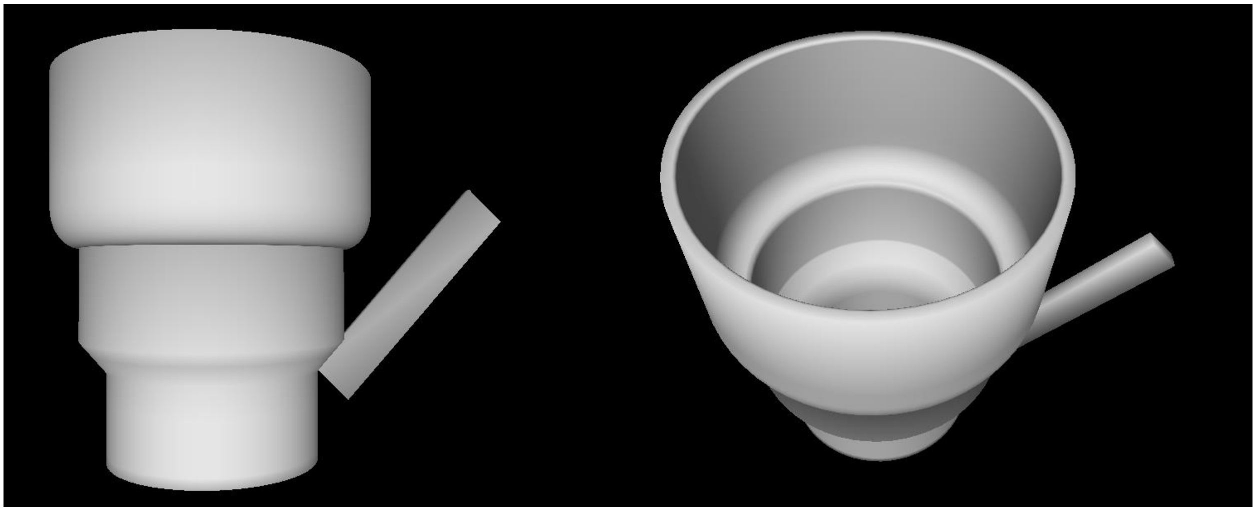

Figure 60. Freeze Frame (Arrêt sur Image) series — Cup #3 (rendering). Developed from an original cup design by Gilles Bonnetat. Rendering © FORTH.

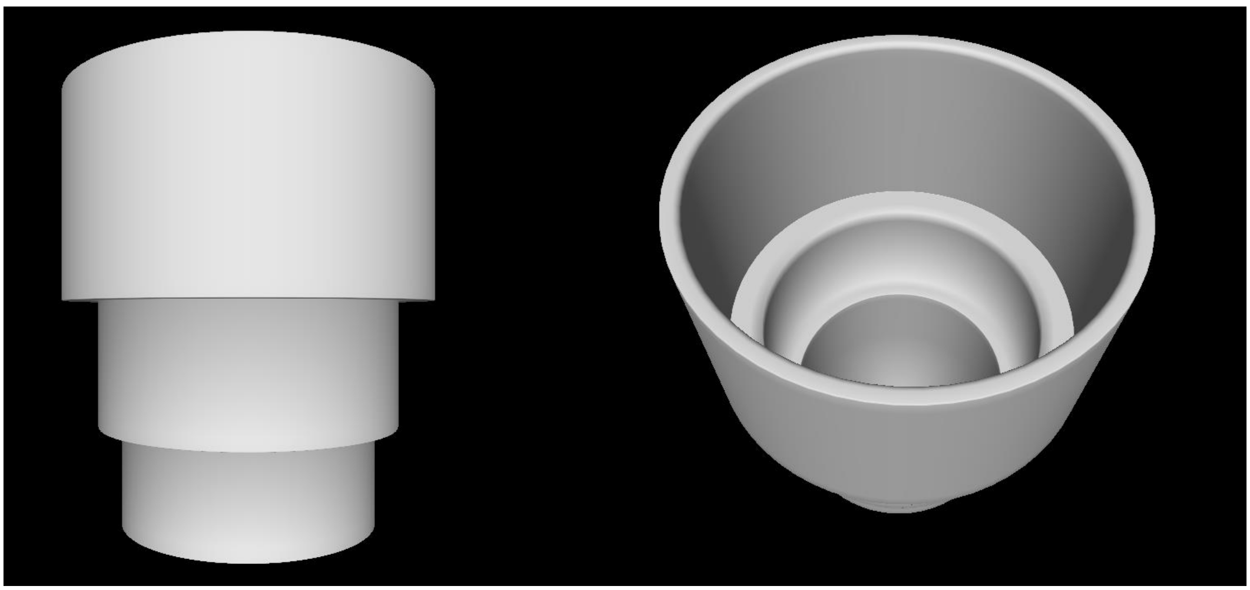

Figure 61. Anne Xiradakis, Freeze Frame (Arrêt sur Image) series — Cup #4 (rendering). Developed from an original cup design by Gilles Bonnetat. Rendering © FORTH.

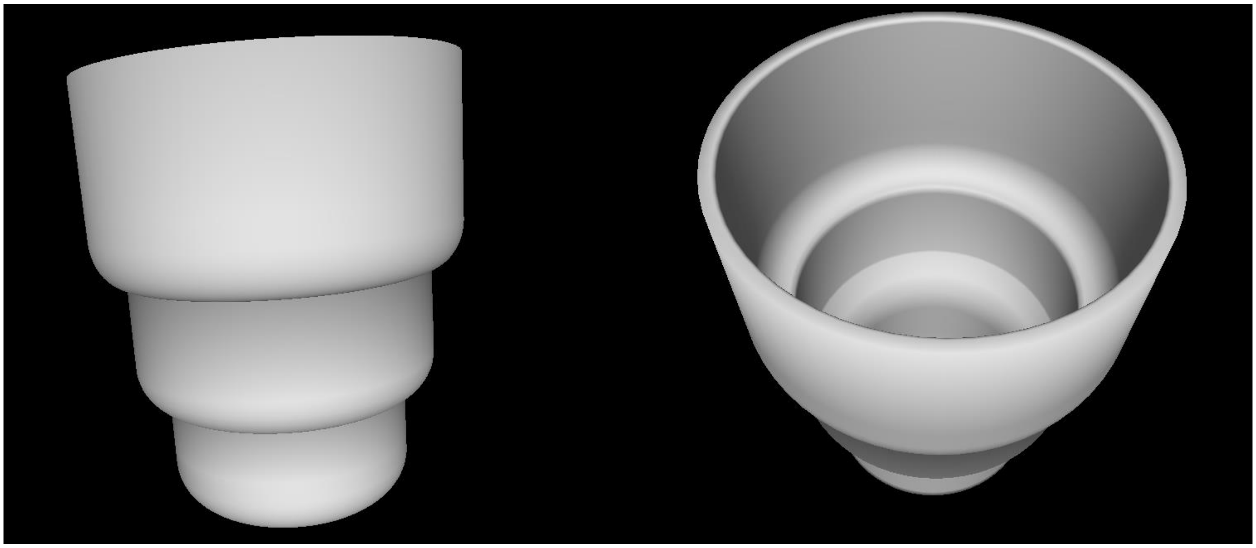

Figure 62. Anne Xiradakis, Freeze Frame (Arrêt sur Image) series — Cup #5 (rendering). Developed from an original cup design by Gilles Bonnetat. Rendering © FORTH.

Figures 60–64 provide representative frames from the animated renderings, one per cup, to ensure the document remains readable even without opening external links.

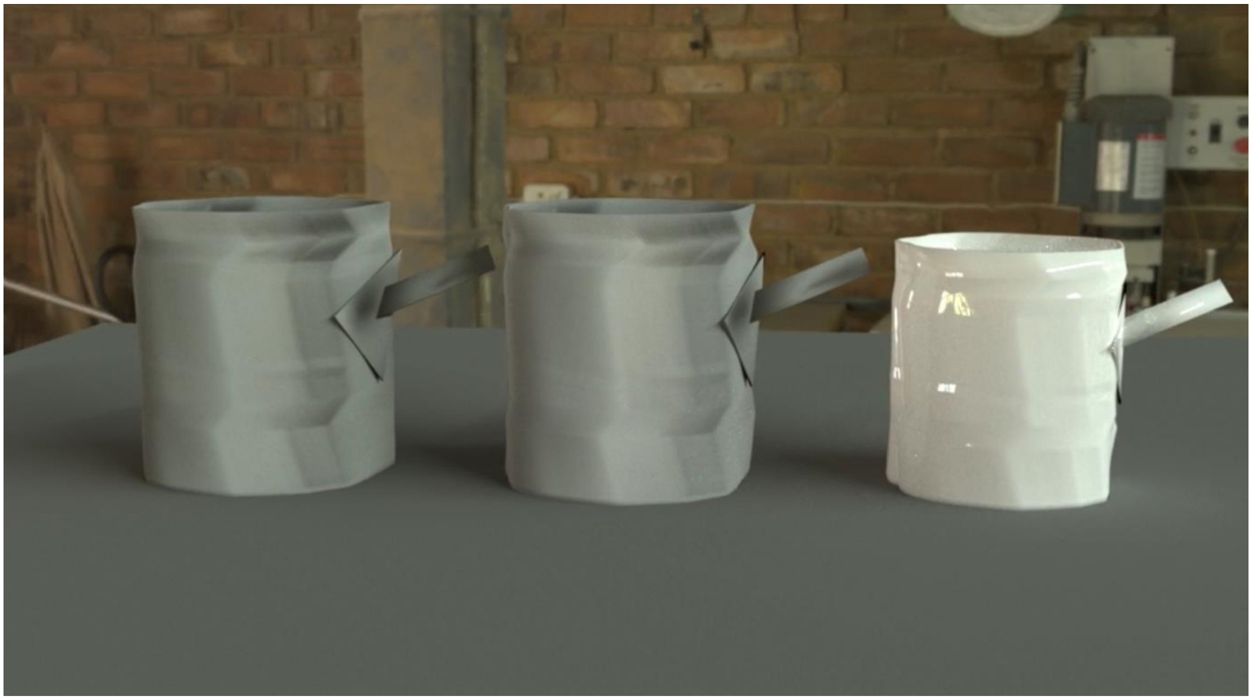

Figure 63. Anne Xiradakis, Freeze Frame (Arrêt sur Image) series — Cup #1 (still frame from animated rendering). Developed from an original cup design by Gilles Bonnetat. Rendering © FORTH. Video: https://youtu.be/Rty2M11qdd0

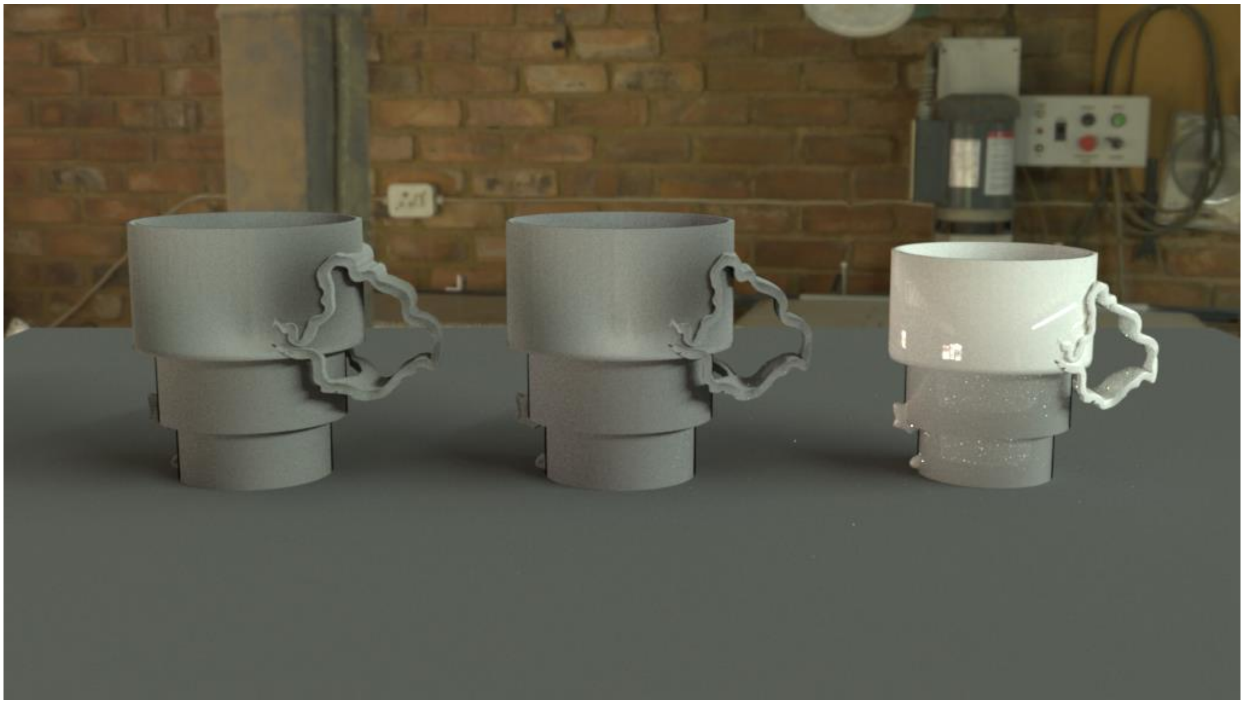

Figure 64. Anne Xiradakis, Freeze Frame (Arrêt sur Image) series — Cup #2 (still frame from animated rendering). Developed from an original cup design by Gilles Bonnetat. Rendering © FORTH.

Figure 65 shows the same model in studio illumination and imbued in the workshop ambient light as simulated by the HDRI asset.

Figure 65. Anne Xiradakis, Freeze Frame (Arrêt sur Image) series — Cup #3 (still frame from animated rendering). Developed from an original cup design by Gilles Bonnetat. Rendering © FORTH. Video: https://youtu.be/amlYxqYBFwA

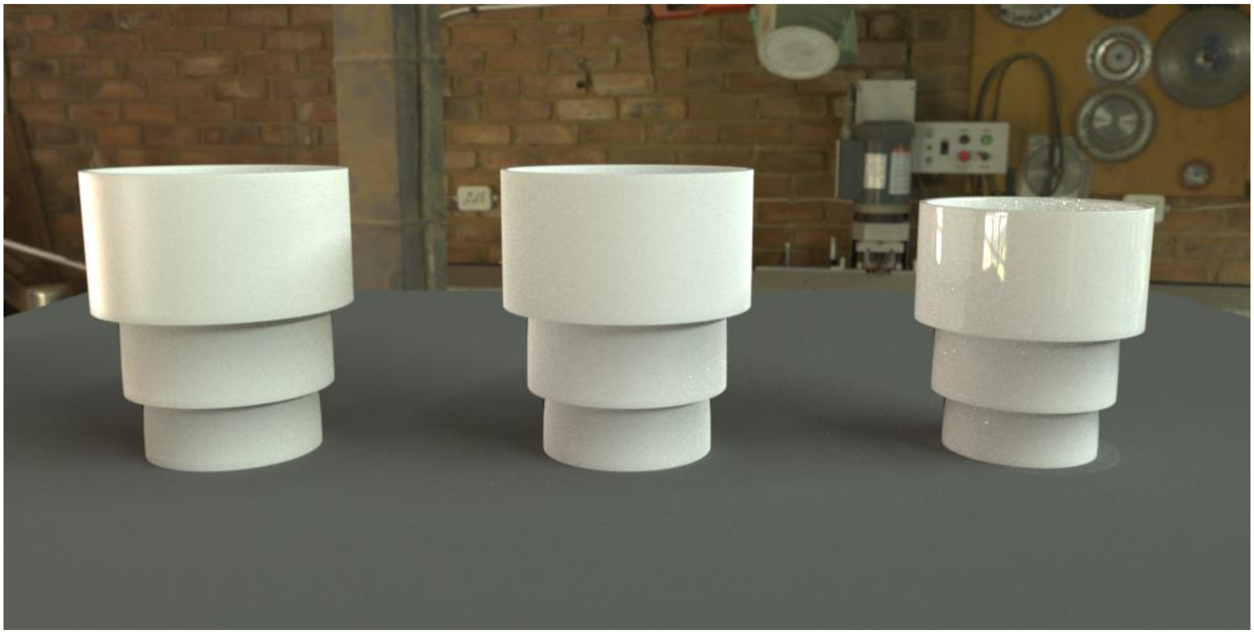

Figure 66. Anne Xiradakis, Freeze Frame (Arrêt sur Image) series — Cup #4 (still frame from animated rendering). Developed from an original cup design by Gilles Bonnetat. Rendering © FORTH. Video: https://youtu.be/M1ut9vQ3XRg

Figure 67. Anne Xiradakis, Freeze Frame (Arrêt sur Image) series — Cup #5 (still frame from animated rendering). Developed from an original cup design by Gilles Bonnetat. Rendering © FORTH. Video: https://youtu.be/ipUgEeU-Qyw

A video playlist with these and additional results is available at:
https://youtube.com/playlist?list=PLQZAktGyYNilgK29oFQmIvE-lWFhKzpVc&si=AM6Hr1i_klcoVYVf

7.1.6.5 Limoges Porcelain Design Pilot Assessment

At the end of January 2026, a closing interview for the Pilot Design was conducted with designer and design teacher Anne Xiradakis to evaluate her collaboration on the project. Following the methodological approach defined for the Pilot, the discussion focused on design processes and the place of the project in contemporary design practice; her way of thinking about the creation of objects and their modes of presentation; the evolving role of digital technologies in her practice; and finally, the place of gesture in her work as a designer, both in general and within the framework of the project developed for the Pilot.

Gestures at the Core of Design Practice

Within her practice, gesture in its multiple dimensions occupies a central position. Although this focus initially developed intuitively, collaboration within the Pilot Design framework enabled its further articulation, highlighting a concern that consistently informs her work as a designer. The approach she has developed is characterised by a degree of intentional literalness, allowing for a more direct engagement with gesture as a vector of creation.

The designer establishes a parallel between the gestures involved in object-making and those associated with food preparation, both understood as forms of embodied knowledge. She describes a sustained interest in observing individuals at work, whether in processes of fabrication or culinary preparation. This sensitivity has been cultivated through attentive observation of situations of production and use, reinforcing an approach to design that considers gestures not only as operational actions but also as structuring elements of creative practice. Her encounter with the traditional Japanese tea ceremony is significant, as it brings together the acts of making and consuming within the same moment, establishing a dialogue between the person who prepares and leads the ceremony, the objects involved, and the participants. This situation introduces a dual dimension: the beverage is prepared in front of the participants, who are themselves observed as they drink it. In this way, the Japanese tea ceremony constitutes an important reference in the designer's reflection on gesture and the relationship to objects. The act of observing someone prepare tea creates a moment comparable to a form of meditation, placing the guest in a state of heightened attention. Within this ceremony, particular care is given to the selection of objects, which are chosen in relation to the specific context, including the season, the lunar cycle, and the guests. At a certain point in the ceremony, one object may be presented, its origin explained, and participants invited to observe and handle it attentively. This sequence fosters a strong relationship with objects and encourages a renewed mode of perception.

The pursuit of this awareness also extends to heritage objects. In one of the ceremonies in which the designer participated, organised in a museum, participants were invited to drink from bowls that were genuine heritage pieces dating from the 17th century. This experience made her aware of the responsibility involved in handling such objects and the heightened attention they require. This situation reinforced her interest in how objects can influence behaviour, encouraging more thoughtful gestures and a respectful attitude.

This perspective informs the designer's intention to create objects capable of generating a similar quality of attention. Increasing emphasis is placed on the role of detail, understood as a means of prompting users to engage more carefully with the object and to develop specific, lasting connections with it. Conceived within a sober formal language, such attention to detail supports an approach oriented toward durability. This reflection extends to an examination of how objects can induce gestures of use in a broad sense. For Xiradakis, object-based design involves understanding how form may influence handling, modes of use, and, more generally, the relationship established between object and user. Her research-driven approach seeks to open up the possibility of new gestures and patterns of interaction. More widely, this approach seeks to foster a lasting and intimate relationship between the user and the object, encouraging the development of forms of attachment. Based on a certain formal sobriety, the objects are designed to remain simple and discreet, so that their uses can unfold without being overdetermined by a design that is too distinctive, also with a view to sustainability.

Digital Technologies as Tools for Gesture Analysis

For the development of her proposal within the Pilot Design framework, digital technologies, particularly video, played a central role in analysing and understanding the gestures involved in the project. The raw footage recorded served as the main research material, allowing for frame-by-frame observation and detailed examination of each stage in the process of creating an operational sequence for the porcelain. For the designer, this was the first time she had based her work on the systematic study of production gestures to explore the forms of objects they could generate. Choosing key moments in the technical action and drawing a singular interaction that occurs between the gesture, the tool and the material in the midst of transformation allowed for a better understanding and awareness of it. Particular attention was given to selecting video frames that revealed a distinct visual quality, reflecting the designer's ongoing interest in utensils and tools as elements that actively shape fabrication gestures. This process also created an opportunity to establish a parallel between the object, its function, and the tool involved in its making.

The turning gestures were already familiar to the designer, having spent ten years working alongside a porcelain craftsman in Limoges and extensive time in his workshop. However, access to raw video recordings, combined with the ability to slow down the footage, isolate specific moments, and translate them into drawings, generated a different level of awareness. This process fostered sustained observation and aligned with her deliberately slow working methodology, enabling a more reflective and nuanced engagement with the gestures under study.

Closely linked to her design practice, although this time mobilising an intentionally literal approach, this method constituted a largely exploratory stage of work that served to examine how an object can reflect and communicate its manufacturing process. This approach resulted in the design of five objects, each designed to embody a key moment in a sequence of gestures involved in porcelain production.

Rethinking Interaction Through Open-Ended Object Design

In her practice, the designer explores the design of objects that remain intentionally open in terms of the modes of interaction they propose. Rather than prescribing a single, clearly defined function, the approach prioritises a notion of "use", broadly understood as the range of gestures and relationships that arise when a person interacts with an object. This perspective challenges the logic of traditional design, which often aims to determine and define the function of an object in advance. Instead, this perspective aims to encourage multiple forms of handling and interpretation that go beyond functionality to include how an object invites touch and guides gesture.

This aspect is partially present in the *Freeze Frame Series* (*Arrêt sur Image*), as the formal characteristics of the objects, and above all, the presence of handles, more clearly guide the possibilities for handling and grasping. The deployment of this design process has been developed as a first phase, the materiality of which is based on drawings and models without involving the creation of physical 3D models. However, some of the pieces, particularly those without handles, offer a greater palette of interpretative freedom and reflect a continuous reflection on the possibilities of gestural interaction. A key aspect of the design of this series has been the inclusion of details that naturally attract the hand, encouraging tactile curiosity even before the object is grasped. The resulting object is deliberately unusual, encouraging exploration and sensory engagement.

7.1.7 Conclusions and further reflection

The *Design Pilot* focused on Limoges porcelain, which provides a significant example of how gesture-oriented and research-driven design methodologies can contribute to renewing contemporary porcelain practices.

Anne Xiradakis' proposal demonstrates how careful analysis of manufacturing processes and their associated technical gestures can become a generative tool for the development of forms. By drawing directly on raw recordings of the plaster tournassage sequence, the perspective developed in the Freeze Frame series translates otherwise invisible technical actions into tangible design features, allowing objects to communicate aspects of their own manufacture. In doing so, the project reinforces the conceptual and sensory connection between the maker, the object, and the potential user, while highlighting the role of embodied knowledge in design processes.

The Pilot approach also underscores the relevance of digital technologies as analytical and projective tools. In addition to supporting the analysis of gestures through video, advanced 3D modelling and rendering techniques played a key role in the development and evaluation of the proposed objects. High-quality renderings made it possible to visualise subtle surface effects, tool marks and volumetric variations that refer directly to the production process. These technologies facilitated iterative refinement while maintaining consistency with the initial research intentions, providing a reliable means of evaluating formal hypotheses before prototyping. The integration of advanced rendering methods demonstrates how digital environments can expand design experimentation while maintaining a strong link to craft processes. The project's approach also contributes to rethinking interaction modalities through the design of open objects. By prioritising an expanded notion of “use” over a strictly predetermined function, the work encourages multiple modes of handling and interpretation, expanding the relational dimension of everyday objects.

More broadly, this use case seeks to highlight the importance of flexible production models that allow for variability, recognise the creative contribution of artisans, and challenge the standardisation often associated with industrial manufacturing. This perspective aligns with ecological concerns by promoting durability and adaptability, generating other forms of attachment to objects. It also reaffirms the value of interdisciplinary collaboration by bringing together designers, artisans, researchers, and technology partners within a shared experimental framework.

7.2 Case Study 2: CETEM / Design and 3D Printing - Furniture and Woodworking

7.2.1 Design Pilot Implementation

Preparatory Work and Objectives

The Design Pilot aims to explore how designers can leverage digital tools not only to innovate but also to maintain and reimagine the artisanal traditions they work with. It focuses on integrating digital technology into the interaction between design and craftsmanship.

The main objective of the Design Pilot regarding woodcarving at CETEM was to introduce not just FDM 3D printing technology into the wood carving process, but also CAD/CAE tools and even CNC machining, thereby linking the design phase with the execution of the carving itself. This initiative explores how digital tools can improve traditional processes and reduce the gap or barrier between a designer and a woodcarver, introducing the technique of additive manufacturing and applying it to the woodcarving process. Specifically, the pilot aimed to:

- Use the available technologies to help visualise the final result of a woodcarving piece before carving.
- Validate the design by examining a physical model or replica of the final product. This allows for modifications, and the carver to assess if the design is feasible or not.
- Reduce errors in proportion, scale or form when carving a specific design. Reduce failures and iterations.
- Introduce new techniques such as computer-aided-design (CAD), computer-aided-engineering (CAE), CNC machining, and additive manufacturing in traditional wood carving.
- Reduce the gap between the designer and the carver, helping the carver to visualise the proposed design.
- Allow the craftsman to work in a concrete and precise way, focused on a final design.

Methodology

The pilot has been structured in different phases or steps:

0. Preliminary phase. Interview with a professional designer.

During this first phase, a professional designer, Florian Moreno, was contacted to collaborate on this project pilot. An interview was conducted. The main goal of this interview was to find out what the issues or main problems related to the woodcarving process are, from a designer's point of view. The interview was carried out in CETEM facilities, and it addressed the following points:

- Project introduction and Design Pilot introduction.
- Florián's expertise in the furniture industry and specifically in woodcarving (projects, designs, collaborations…).
- Florian was shown different videos of the woodcarving process recorded in different phases of the project.
- Main problems related to woodcarving.
- Proposals for improvement.

As a result of the interview, Florian explained how difficult it is to integrate woodcarving in modern furniture design, and how he is trying to do it, integrating woodcarving not as a classic decoration, but as a structural and organic part of the product. He emphasises that many finishes can only be achieved by hand, which adds value but increases costs, hindering their adoption by companies and the current market.

The lack of generational succession is also highlighted as one of the greatest risks to the continuity of these techniques. It is noted that, although modelling and digital tools help, there is an "interpretive zone" that only the artisan can resolve, making complete standardisation difficult.

At this point, 3D printing arises as a resource for creating initial prototypes when working with organic or complex pieces. It serves to verify geometries, validate volumes, and detect incompatibilities before moving on to hand carving.

Figure 68. Interview with Florián Moreno, CETEM (2025) / CETEM.

Full interview available: https://youtu.be/o_i1HWa3LnM

7.2.2 Designer Presentation: Florián Moreno, Furniture Designer

CETEM has established strong connections with designers from the furniture industry. As part of its initiatives, a first exploratory interview is scheduled at the end of February with Florian Moreno, a designer specialising in various types of wooden furniture. This semi-structured interview will take place at CETEM's facilities and will cover topics such as the designer's life story, his personal definition of 'design' and the meaning of craftsmanship, his general working process, and his use of digital technologies to preserve and boost woodworking in current furniture designs.

Designer Professional Trajectory

Florian Moreno studied Industrial Design at the School of Applied Arts and Artistic Trades in Valencia. In 1985, he joined the Design Department at GRANFORT, which was the largest upholstery company in Spain at the time. In 1989, he established his own industrial design studio in Yecla, working as an independent designer for the furniture sector and various companies nationwide. Today, his work focuses on habitat-related projects, spanning both home and commercial installations.

Florian Moreno's Relationship with CETEM

Florian Moreno has maintained a long-standing relationship with the CETEM, actively contributing to its initiatives. He has been involved in the prestigious CETEM Design Award, Spain's longest-running annual furniture design competition, in which he first participated as a contestant and later became a jury member. Additionally, he has contributed as a lecturer in various design courses at CETEM, with a particular focus on the master's degree in design and industrial Organization for the Furniture and Wood Sector, where he shares his expertise with new generations of designers. His collaboration extends to some projects, reinforcing his commitment to innovation in the sector.

His Connection to the Yecla Furniture Industry

Moreno's career is deeply rooted in the furniture industry of Yecla. He started working with a local company but soon transitioned to freelancing, allowing him to collaborate with multiple companies in the sector, such as Sancal, Muebles Jose Rovira, Muebles Hernaval, Tapizados D´estilo, Sillas Agustin Diaz, Sillas Ebarol, Torneados Ortuño, among others. This decision enabled him to remain closely connected to the industry, playing a significant role in the evolution of furniture design by exploring new forms and materials. He has participated in different workshops/seminars organised in the framework of the Yecla Furniture Fair, as a close collaborator and expert designer. With over 30 years of experience, Florian Moreno continues to develop projects related to habitat design.

Design Work Examples

Figure 69. Design Works Exemples / Florián Moreno

7.2.3 Woodcarver Presentation: Francisco Sánchez Carcelén

Francisco Sánchez was born in 1946 in La Alberca, a hamlet of the city of Murcia. He grew up in a large family with 12 siblings, under the influence of his father, a forest ranger. At the age of nine, his family relocated to Yecla.

In 1957, at just 11 and a half years old, Francisco left school and began working at the workshop of brothers Antonio and Pedro Ortega, known as Muebles Ortega. With no prior experience, he started as an apprentice and assistant, initially focusing on sanding wood carvings, a critical task at the time. Over time, he became familiar with the craft under the guidance of the renowned carver Pedro Ortega. By the age of 12, Francisco purchased his first carving tool, a gouge costing 17 pesetas (0,10€), thus beginning a lifelong collection of tools.

For 30 years, he worked at Muebles Ortega, located on Calle Esteban Díaz, mastering carving techniques and contributing to the creation of exquisitely decorated furniture. During these years, Francisco Sánchez participated in various carving competitions, notably at the Industrial Apprenticeship School in Murcia, where he was crowned provincial champion after crafting a detailed Fleur-de-Lis in just two intense days of work.

However, the economic crisis of the 1980s deeply impacted the furniture industry, prompting Francisco to take a new direction in his career.

In 1984, drawing on his extensive experience, he entered a competition organised by the Town Hall to teach a wood carving course. Alongside his mentor, Pedro Ortega, he taught a group of 12 students over five months. The following year, in 1985, he delivered another course, this time lasting seven months, organised by INEM (National Institute of Employment).

Simultaneously, Francisco Sánchez established himself as an independent artisan, crafting carved furniture for companies and private clients. He also received commissions from religious brotherhoods in Yecla, Jumilla, Cieza, and other towns. Among his most notable works are the processional float of "The Descent from the Cross" in Jumilla, the platform for the Christ of Medinaceli in Cieza, and his contribution to the float of the Virgin in Yecla. In 2014, he also worked on the creation of a church altarpiece in Cieza, showcasing his talent in large-scale projects.

After decades of dedication, Francisco retired at the age of 65, leaving behind a legacy of exceptional craftsmanship and a profound passion for the art of carving. He described his craft as far more than just a job:

"I was lucky, very lucky, to get started in carving. I didn’t know what it was at the time, but I liked it so much, so very much, that it became both my profession and my hobby."

7.2.4 Phases of Pilot Development

Phase 1. Digital 3D sketch using CAD software.

Florian Moreno was contacted again to propose and create a design for woodcarving. Florian was told to create a simple design of a woodcarving piece. First, he created a 2D (two-dimensional) sketch, using paper and pencil, and then this sketch was transferred into 3D design software. He created a product briefing (see Annex II). This design was validated by CETEM

Phase 2. 3D printing (FDM) the prototype.

Thanks to CAD software and technification of design, it was possible to quickly obtain the 3D model of the design, to prepare it and 3D print it.

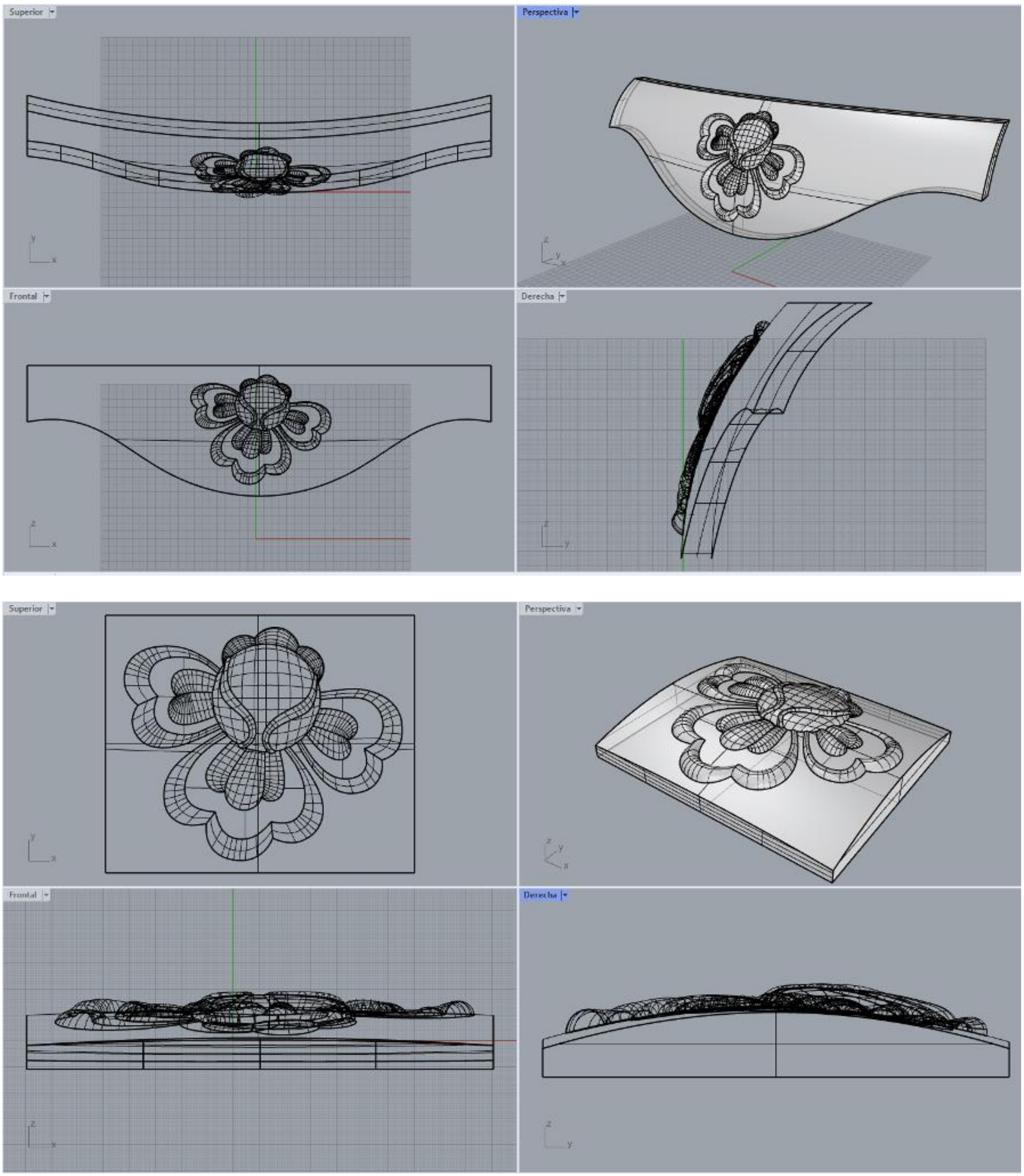

Figure 70. CAD model of the design of the woodcarving piece. Software: Rhinoceros. CETEM (2025) / CETEM

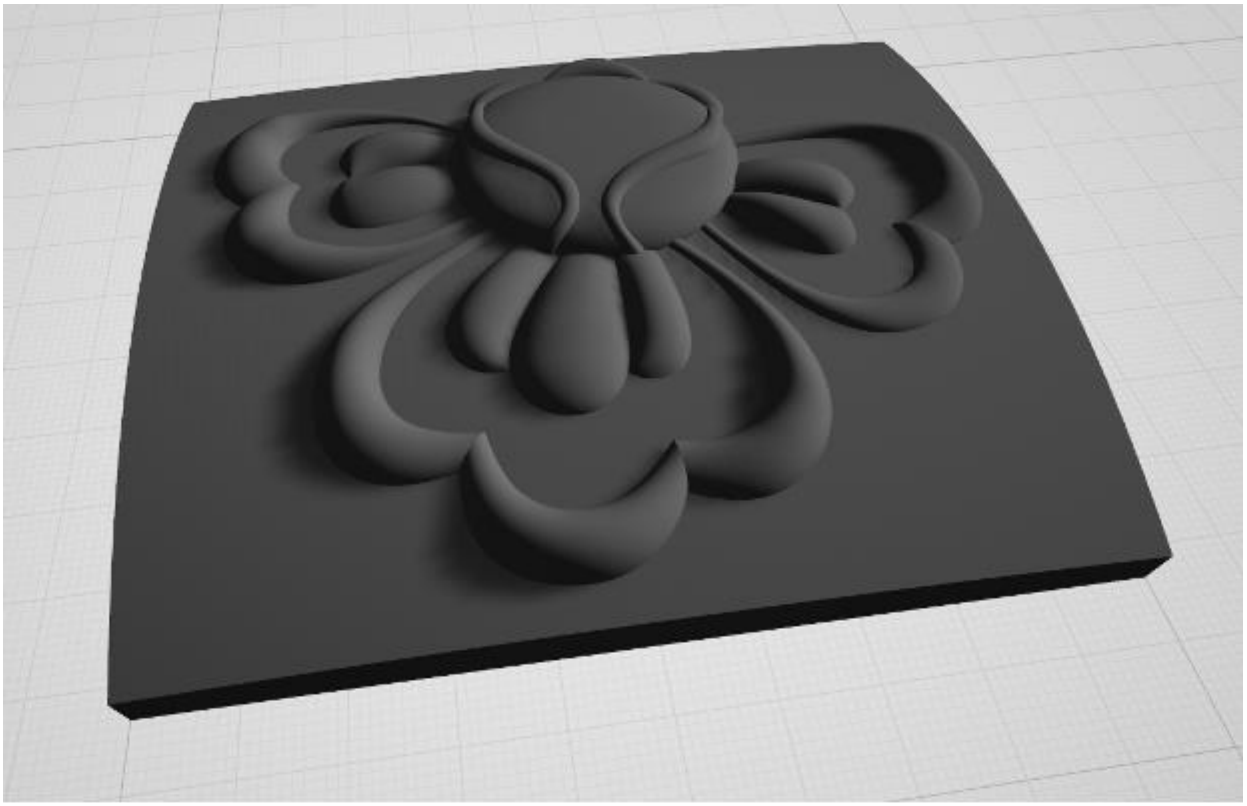

Figure 71. Rendered model of the woodcarving piece. CETEM (2025) / CETEM

Once ready, the CAD design must be exported as an STL file, compatible with the 3D printing software, also called a slicer. The appropriate parameters for the 3D-printed piece were chosen.

Additive manufacturing is not just a single technology. It encompasses many technologies: material extrusion (FFF or FDM), Photopolymerization in vat (SLA, CLIP, DLP), Powder layer fusion (SLS, MJF, DMLS), Material Jetting (MJ, DOD, NPJ), Binder Jetting (BJ), etc. Some have certain advantages, and others have different ones. For the chosen purpose, Fused Deposition Modelling (FDM) was the most appropriate technology to use. Because it is low cost, quick, allows for rapid iterations, a quality surface is enough, etc.

Since it is a piece just for show, and it does not need to withstand stresses or have extremely high resolution, cost and speed were prioritised over strength and appearance. This saved time and material costs.

The result is shown in the following picture:

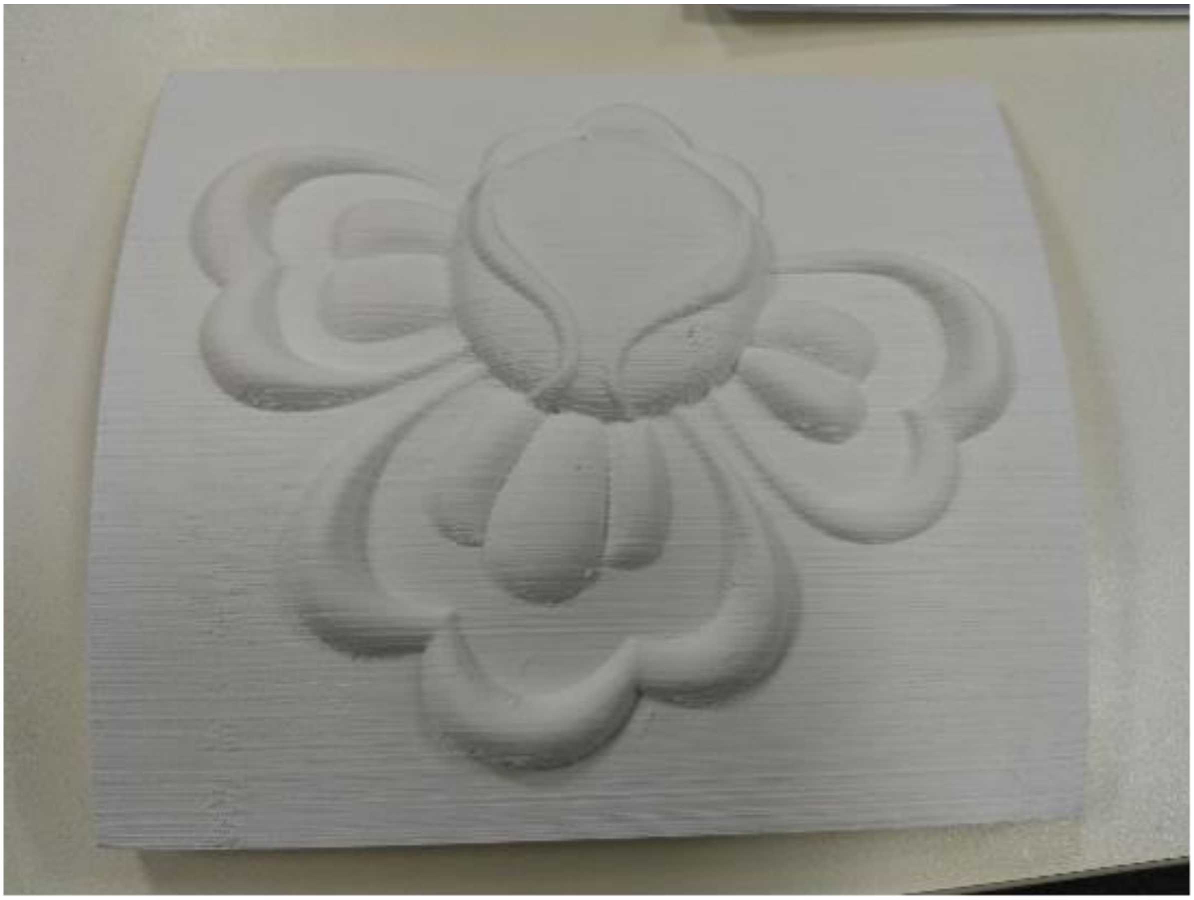

Figure 72. 3D printed model of the woodcarving piece. CETEM (2025) / CETEM

Phase 3. Validation and adjustments by the woodcarver.

Once the piece was printed, the CETEM team met with the woodcarver to begin planning the reproduction. As in other phases of the project, Francisco Sánchez, a renowned woodcarver, was involved (see Annex III).

Francisco had no objections to the proposed design, but he did specify that the base wood for carving should be curved, as the designer had intended.

So, a second technology was introduced, thanks to which the base piece could be prepared, from which the carver could begin to work on this specific design. This is numerical control or CNC machining. In this technology, a robot with a milling bit is used to remove material from a base piece, in this case, the piece of wood provided by the carver.

Figure 73. Anthropomorphic robot used as a CNC machine for preparing and curving the wood piece, CETEM (2025) / CETEM

An engineer must program this robot so that, through different passes, it gradually removes material until the desired shape is achieved.

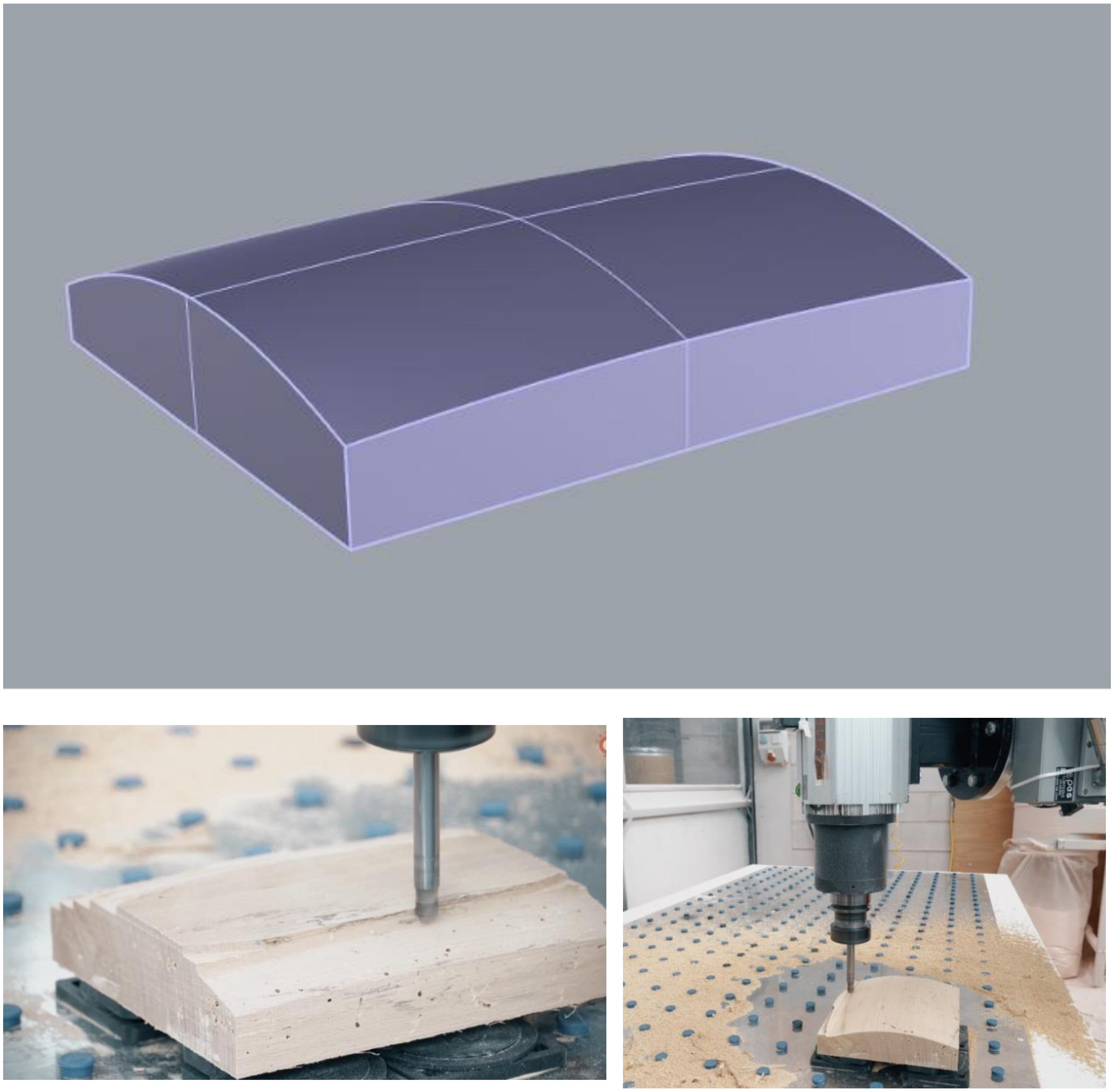

Figure 74. CAD model of the wood piece. The CNC robot is working. CETEM (2025) / CETEM

<u>Phase 4. Woodcarving.</u>

The next step in the design pilot was the actual carving. In Francisco's workshop, the CETEM team, the piece's designer, Florian, and Francisco himself gathered to observe the carver at work. The designer, Florian, discussed his project and design in detail with the woodcarver, Francisco, and they both discussed details about the carving to be done.

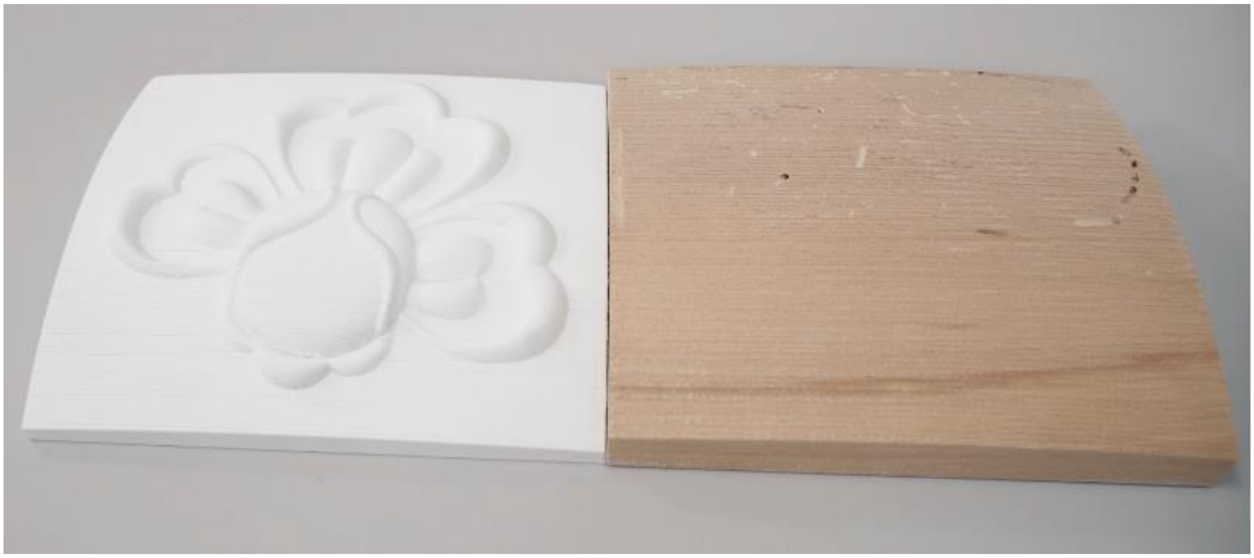

Figure 75. Comparison between the printed model and the prepared wood for woodcarving. CETEM (2025) / CETEM

Then, the carving process by Francisco began:

4.1 Securing the starting wooden material to the workbench. Of the possible methods for securing the wood to the workbench, Francisco chose to use other pieces of wood to block the movement of the wood being carved. He nailed these pieces of wood to his workbench.

Figure 76. Woodcarver Francisco Sánchez is preparing, securing and fixing the wood piece. CETEM (2025) / CETEM.

4.2 Drawing and tracing of the design on the wood. Transfer the design to the prepared wood piece. Thanks to the fact that the whole process began in a technological and digital way, with a 3D design by CAD, it was very easy to obtain and print the profile or contour to be transferred to the wood. Francisco used tracing paper and a pencil to transfer the design to the wood. He also marked the depth to which he should carve, and for this, he used the 3D printed piece.

Figure 77. Woodcarver Francisco Sánchez transfers patterns from paper to the wooden piece / CETEM.

4.3 Wood carving process. Francisco began carving the wood, which was already secured and marked. He kept the 3D printed piece in front of him on the workbench as a reference at all times.

Figure 78. Woodcarver Francisco Sánchez during the carving process / CETEM.

Florian, the designer, was very attentive to the whole process, but at no point did he have to correct the carver or give him instructions or comment on anything. The final result can be seen below. As it is possible to see, it is very faithful to the original design and identical to the 3D printed part.

Figure 79. Comparison between the final wood-carved piece and the 3D printed piece. CETEM (2025) / CETEM

Video of the process available: https://youtu.be/enNICcQFBLg

Phase 5. Process evaluation.

In this final phase, a joint evaluation was conducted between the designer, the woodcarver, and CETEM staff to assess the actual usefulness of integrating 3D printing into the woodcarving process. Key questions included:

- Does the final carved piece accurately reflect the original digital design?
- Did the woodcarver find that using the 3D-printed prototype facilitated the work in terms of understanding volume, visual references, or technical execution?
- Was the designer able to materialise their vision more accurately thanks to the physical prototype?

This evaluation was qualitative and based on conversations held in the workshop itself, after the carving process. It helped identify both the benefits and limitations of the pilot project.

7.2.5 Design Pilot Timeline

CETEM planned to complete the entire activity within one year. The process began with initial contact with Florian, the industrial furniture designer. An interview with him was then arranged, during which various ideas emerged for the pilot project, exploring how new technologies could be integrated into a traditional and artisanal process like wood carving.

Among the ideas that emerged, the most suitable was to use 3D printing in the carving process, as previously described. To this end, after some time, CETEM again enlisted Florian's support, and he created a carving design for a bathroom cabinet.

Therefore, Florian provided CETEM with the 3D model, which, once validated, was printed at CETEM's facilities.

Simultaneously, Francisco, the woodcarver, was contacted and provided instructions and adjustments for the wood to be used. Once everything was ready, the carving process was carried out at Francisco's workshop. Finally, a comprehensive evaluation of the entire process was conducted.

Design pilot	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Preliminary phase. Interview with a professional designer.												
Phase 1. Digital 3D sketch using CAD software.												
Phase 2. 3D printing (FDM) the prototype.												
Phase 3. Validation and adjustments by the woodcarver.												
Phase 4. Wood carving												
Phase 5. Process evaluation												

Figure 80. Design Pilot Timeline CETEM

7.2.6 Tools and Materials

The following section describes and details all the tools and materials used during this pilot.

CNC Robot

CNC (Computer Numerical Control) machining is an automated subtractive manufacturing process that uses a computer to control machine tools (milling machines, lathes, etc.) that remove material from a raw block to create highly precise and complex parts, guided by a code (G-code) generated from a digital design (CAD). It is fundamental in modern industry due to its accuracy, repeatability, and efficiency, enabling the production of unique or serial parts with perfect finishes and very tight tolerances.

CETEM has a KUKA KRC140COM 6-Axis® Robotic Machining and Milling System. This CNC (Computer Numerical Control) technology uses material removal milling to obtain prototypes, masters, and moulds in different materials, including polyurethanes (PUR), fiberboards (MDF), wood, cork (PES), machinable plates (PU), etc.

Figure 81. A KUKA anthropomorphic robot used as a CNC machine. CETEM (2025) / CETEM

How does it work? A digital 3D model of the part is created using CAD (Computer-Aided Design) software. CAM (Computer-Aided Manufacturing) software translates the CAD model into G-code, which are the instructions for the machine (movements, speeds, etc.). The CNC machine holds the raw material (metal, plastic, wood), and the operator loads the program. The machine executes the program, moving cutting tools with high precision to remove material, creating the desired shape. Auxiliary processes (finishing) are applied to meet the final specifications.

3D Printer

CETEM has the DISCOVERY 3D PRINTER® Additive Manufacturing System. This is FDM (Fusion Deposition Modelling) technology for obtaining preliminary prototypes in plastic material (mainly ABS/PLA) for large-scale functional testing.

Figure 82. 3D printed used for creating the plastic prototype of the woodcarved piece. CETEM (2025) / CETEM

FDM (Fused Deposition Modelling) 3D printing is an additive manufacturing technology that builds objects by depositing layers of molten thermoplastic material. It works by drawing a plastic filament through a heated nozzle that moves along the X, Y, and Z axes, building the part layer by layer. It is a popular technology due to its accessibility and low cost, and is used for both prototyping and professional-level manufacturing.

How does it work? A spool of thermoplastic filament is fed into the printer. The filament is heated until it melts and is extruded through a heated nozzle. The extrusion head deposits the molten plastic onto a build platform, creating the object layer by layer. The coordinated movements of the print head and the build platform construct the three-dimensional part. Support structures are used for any overhanging parts, which are removed after printing.

Woodcarving tools

Hand tools for wood carving come in a wide variety of shapes and sizes, and choosing the right one for each operation is complicated and challenging. Francisco, the woodcarver, has approximately one hundred different gouges and chisels in his wood workshop.

Francisco has a particular way of working. All his tools are neatly arranged on his workbench. Before starting each job, he analyses the piece or carving task and carefully selects the gouges and chisels he plans to use, keeping them within easy reach. He may then use a few more or fewer tools.

For the part chosen in this design pilot, he selected approximately 30 different tools and finally used 25.

Figure 83. Woodcarving tools. CETEM (2025) / CETEM

In addition, it should be noted that mallets were also used for the stronger striking of the tools, as well as bench clamping tools, or wood brushes.

PLA

Fused deposition modelling (FDM) 3D printers build parts by melting and extruding a thermoplastic filament that an extruder deposits layer by layer in the printing area.

PLA is a material for the FDM (also known as FFF) 3D printing technology. The advantage of this material is that it can be used in 3D printers easily, which allows a high quality of printing even in tricky details and an excellent lamination of the printed object. PLA filament is made of natural ingredients and is easily biodegradable by composting. It complies with the requirements for food contact.

3D printing with PLA is simpler and easier than with ABS. The print bed doesn't need to be heated, although it's recommended to keep it at approximately 40-50°C to prevent any warping. The extruder temperature should be between 190 and 210°C, depending on the colour and the 3D printer used. The temperature of the printing area should be controlled and free of drafts.

Figure 84. PLA material (filament) is used for creating the 3D prototype. CETEM (2025) / CETEM

Its material properties are provided in the following tables.

Physical properties	Typical Value	Test Method	Test Condition
Material density	1,24 g/cm³	ASTM D792	
Melt flow index	6 g/10 min	ASTM D1238	210 °C, 2,16 kg

Mechanical properties	Typical Value	Test Method	Test Condition
Tensile strength	60 MPa	ASTM D882	at yield
Tensile strength	53 MPa	ASTM D882	at break

Elongation at break	6 %	ASTM D882	
Tensile modulus	3600 MPa	ASTM D882	
Flexural strength	83 MPa	ASTM D790	
Flexural modulus	3800 MPa	ASTM D790	
Izod impact strength	16 J/m	ASTM D256	23 °C, notched

Printing properties	**Recommended**	**Notes**
Print temperature	190–210 °C	Recommended settings! It may differ according to the printer and the object.
Hot pad	50–60 °C	Try your own settings before printing.
Bed adhesive	Magigoo	

Wood

The wood most commonly used in Francisco's workshop is limewood. This wood is highly regarded for its ease of carving. It weighs about half a kilogram per cubic decimetre. It has a yellowish colour and a tight grain, with a subtle texture. It is one of the most suitable woods for carving, as it is firm but not very hard. Woodworm can attack this type of wood.

Figure 85. Limewood sample.

There are many species of lime tree found around the world, but the European lime and the American lime are particularly noteworthy. The common lime, or Tilia platyphyllos, is a very common tree species in the forests of Europe, especially in central and southern regions, and extends into parts of western Asia.

It is a soft wood, making it very easy to carve. Its light colour facilitates treatment and pigmentation with wax, varnishes, dyes, etc. It dries quickly, although it can warp, but the finish is usually excellent.

Figure 86. Stacked limewood boards / CETEM

Limewood is highly valued, especially by sculpture carvers, as it is easy and pleasant to work with, but precisely for this reason, beginners also use it: it allows for easy nailing, screwing, and glueing.

The characteristics of limewood make it the perfect solution for all kinds of carvings and sculptures. Furthermore, it accepts dyes and paints.

Linden wood has a straight grain and an exceptionally fine texture. These characteristics make this type of wood perfect for carving and turning. Kitchen utensils, among other tools, are commonly made from linden wood.

7.2.7 Design Proposal

Figure 87. Rendered model of the proposed woodcarving piece/design. / Florián Moreno - CETEM

Figure 88. Rendered model of the proposed woodcarving piece for bathroom furniture. / Florián Moreno - CETEM

7.2.8 Evaluation

The evaluation phase aimed to assess the effectiveness, relevance, and limitations of integrating digital design tools and 3D printing into the traditional woodcarving process. The focus was placed on understanding whether the pilot achieved its intended objectives, particularly in terms of improving communication between designer and artisan, reducing uncertainty during execution, and preserving the added value of handcrafted work.

Given the exploratory and demonstrative nature of the Design Pilot, the evaluation was primarily qualitative and process-oriented, rather than quantitative. It relied on direct observation, expert judgment, and reflective discussion among the key actors involved.

7.2.8.1 Evaluation methodology

The evaluation methodology was designed to capture experiential, technical, and collaborative aspects of the pilot. It was structured around three complementary components: stakeholder-based qualitative assessment, process observation, and outcome comparison.

a) Stakeholder-based qualitative assessment

A joint evaluation session was conducted involving:

- the designer (Florian Moreno),
- the woodcarver (Francisco Sánchez),
- CETEM technical staff.

This session took place in the workshop after the completion of the carving process. Semi-structured conversations were used to gather feedback, guided by a common set of evaluation questions focused on:

- the clarity and usefulness of the 3D-printed prototype as a communication tool;
- The perceived impact of digital tools on decision-making during carving.
- the level of fidelity between the original digital design, the 3D-printed prototype, and the final carved piece;
- perceived advantages and drawbacks of the hybrid digital–craft workflow.

Rather than using formal questionnaires, the evaluation prioritised open discussion to allow each participant to reflect on their experience from their professional perspective.

b) Process observation

Throughout the pilot, CETEM staff documented key moments of the process, including:

- the designer's transition from 2D sketch to 3D CAD model;
- The preparation and use of the 3D-printed prototype during carving.
- The interaction between the designer and woodcarver during the execution phase.

Special attention was paid to how often clarifications were needed, whether misunderstandings arose, and how decisions were made when transitioning from digital reference to manual execution. This observational input provided contextual evidence to support or nuance the qualitative feedback.

c) Outcome comparison

The final carved piece was visually and dimensionally compared with:

- the original CAD model,
- the 3D-printed prototype.

This comparison focused on proportions, volumes, overall geometry, and key design features, rather than on micro-level surface details that are inherently subject to artisanal interpretation. The degree of correspondence between these three artefacts served as an indirect indicator of the effectiveness of the digital tools in guiding the craft process.

7.2.8.2 Evaluation results

The evaluation showed a high level of consistency between the digital design, the 3D-printed prototype, and the final carved piece. All participants agreed that the carved object accurately reflected the original design intent, particularly in terms of volume, proportions, and overall form.

From the woodcarver's perspective, the 3D-printed prototype was considered a highly valuable reference tool. Having a physical model available throughout the carving process facilitated:

- A clearer understanding of complex volumes.
- More precise control over depth and curvature;
- Increased confidence in execution, especially in early stages.

The designer highlighted that the prototype reduced the need for verbal explanations or corrective interventions during carving. Once the process started, no significant design adjustments were required, indicating that the design had been effectively validated before manual execution.

CETEM staff observed that the integration of CNC machining for preparing the curved wooden base further reduced uncertainty and physical effort in the initial carving stages, allowing the artisan to focus on refined, value-adding work rather than on rough shaping.

At the same time, the evaluation confirmed certain limitations. Some aesthetic decisions and surface nuances could not be fully predefined digitally and were resolved through the artisan's expertise during carving. This reinforced the notion of an "interpretive zone", although minor, where craftsmanship remains essential and irreplaceable.

Overall, the evaluation confirms that the pilot successfully met its objectives, demonstrating that digital tools can enhance, rather than constrain, traditional woodcarving when used as supportive and communicative instruments rather than prescriptive ones.

7.2.8.3 Final Assessment Interview with the Designer

In December 2025, a final evaluation interview was conducted online with Florián Moreno and the CNAM and CETEM teams. At the conclusion of the Pilot, the interview focused on the designer's overall assessment of the process, the role of digital technologies in bridging design and craft practices, and his experience collaborating with traditional woodcarvers within the framework established by CETEM.

He believes that digital technologies are fully integrated into the designer's practice, shaping the process from initial quick sketches to CAD and 3D modelling. These tools function not only as design instruments but also as a shared language that enables interoperability between software platforms and direct integration with manufacturing systems such as CNC and five-axis machining. As a result, production is now structured around digital models rather than hand-drawn plans. The experience further underscores the value of 3D-printed prototypes as mediation tools in collaboration with artisans: by providing a clear volumetric reference, they reduce ambiguity, accelerate decision-making, and limit revisions, favouring an optimised progression from digital design to physical prototype and ultimately to execution in wood by the carver.

The designer described the collaboration with Francisco, the woodcarver, as a process grounded in mutual teaching and learning. He noted that this exchange enabled him to acquire new knowledge while underscoring the importance of the relational dimension of the process.

The conversation also generated broader reflections on the evolving relationship between craft and industry in the region, the history of this dialogue within the regional furniture sector, and the ongoing process of shaping professional identity in the field of industrial design.

Generally, the interview highlights a central tension between craft, embodied in woodcarving, and industry, associated with furniture production. The designer formulates a guiding question: how can carving be integrated into “catalogue-worthy” furniture that can be reproduced and marketed at an industrial scale, rather than confined to unique pieces or one-off commissions? In his view, carving, as conventionally understood, is increasingly relegated to niche projects such as hotel furnishings, singular pieces, or short production runs, rather than incorporated into standardised manufacturing circuits. Within this framework, price emerges as a decisive variable. The designer emphasises that the inclusion of traditionally carved decorative elements substantially increases production costs, contributing to the positioning of such furniture as an “elitist” product, accessible only to a limited clientele. He also underscores the determining role of the economic dimension, closely tied to orders, sales, and market dynamics. While these factors often remain implicit in more theoretical discussions, they are fundamental to his professional practice. His relationship with the region’s tradition of ornamental woodcarving, historically associated with traditional furniture and religious sculpture, is marked by a degree of ambivalence. Ornament occupies a secondary and conditional position in his practice; describing himself as “more rational,” he prioritises function over form and approaches decorative elements with caution, incorporating them only when they remain compatible with technical, economic, and market constraints. In contrast, ornamentation retains a more stable role in upholstered furniture and is more structurally integrated into this type of industrial production.

One issue that emerges from the interview is the progressive disappearance of woodcarvers in the region. The designer notes that 20 to 30 years ago, carvers were still linked to the furniture industry and local companies, whereas today they have almost entirely disappeared. This concern surfaces again in discussions about the possibilities of reintroducing traditional carving techniques into furniture designed for industrial-scale production: even if carved elements were included, there would be virtually no specialists available to produce them. In this context, the designer suggests that initiatives aimed at documenting and preserving traditional carving practices, including those seeking to promote dialogue with digital technologies, might be arriving a little too late, as very few carvers remain in the area.

In his regular professional practice, the designer rarely works directly with artisans beyond occasional collaborations or commissions. His collaboration with CETEM as part of the Design Pilot, therefore, marked a significant opportunity to engage so closely with an artisan woodcarver. He nevertheless emphasises that upholstered furniture production, an area in which he has extensive professional experience, continues to retain a strong artisanal dimension. Except for mechanised fabric cutting, sewing and upholstering are still carried out by hand. The designer frequently collaborates with upholsterers, whom he regards as artisans, and stresses that the technique “requires very skilled hands.” In his view, “craftsmanship involves forms of human intervention that are essential to the completion of the furniture piece”. He also highlights the particularly artisanal character of furniture produced using the *capitoné* technique. However, he notes that the people who make capitoné, who work in companies, do not call themselves artisans, but upholsterers.

In the same vein, he also refers to the production of "organic" wooden furniture, whose finishes are shaped by hand using gouges. He points out that workers employed by companies who demonstrate considerable skill with these tools do not identify as artisans, nor do they regard their work as part of craftsmanship. The designer distinguishes between traditional ornamental carving, characterised by floral or geometric motifs and decorative reliefs, and manual finishing work on wooden furniture with organic forms, which includes sanding, adjusting, retouching, and refining surface transitions. In his view, hand finishing represents a more viable pathway for reintegrating artisanal techniques, understood as forms of skilled manual labour, into contemporary industrial processes, where they function as a qualitative enhancement rather than a purely decorative intervention. The conversation engages with conventional representations of craftsmanship as a profession associated with small workshops, limited output, and non-mechanised production. These assumptions contrast with the reality of production practices, where the boundaries between crafts and industrial production are often intertwined and less clearly defined.

7.2.9 Conclusions and discussion

The design pilot successfully demonstrated that integrating 3D printing and digital design tools into the traditional woodcarving process can significantly improve communication and collaboration between designers and artisans. The use of a 3D-printed prototype proved especially valuable, as it allowed both the designer and the woodcarver to share a clear, tangible reference to the intended final piece. This reduced ambiguity, facilitated the understanding of complex volumes, and minimised errors or misinterpretations during carving.

The pilot also showed that combining CAD modelling, FDM 3D printing, and CNC machining creates a more efficient workflow in which the carver can begin working from a prepared and precisely shaped wooden base. This hybrid approach preserves the artisan's interpretative role while enhancing accuracy and reducing unnecessary iterations.

Both the designer and the carver agreed that the final carved piece was highly faithful to the original digital design, validating the usefulness of integrating digital tools into traditional craftsmanship. At the same time, the pilot highlighted the limits of digitalisation: certain aesthetic details and decisions remain inherently tied to the artisan's expertise, forming an "interpretive zone" that cannot be fully standardised.

Overall, the pilot confirms that digital and craft practices can coexist effectively, providing added value without replacing artisanal knowledge. This mixed workflow supports the preservation of traditional skills while opening new possibilities for innovation within contemporary furniture design.

Video of the conversation with final considerations between the carver and the designer: https://youtu.be/7qbgr0xqfQ0

7.2.10 Exploitation and future actions

The outcomes of the design pilot demonstrate a clear opportunity to exploit the integration of **digital fabrication tools (CAD, 3D printing, CNC machining)** with **traditional woodcarving** to support innovation, knowledge transfer, and future training activities. The pilot validated that using 3D-printed prototypes significantly improves communication between designers and artisans, enables early detection of design issues, and reduces errors during carving. This creates a strong foundation for several avenues of exploitation.

First, the workflow tested in the pilot, combining digital sketching, additive manufacturing, and handcrafted carving, provides a **replicable methodology** that can be transferred to companies in the furniture sector, especially those seeking to introduce artisanal value into contemporary products. The successful collaboration between the designer and the woodcarver illustrates the potential of hybrid processes to reduce uncertainty and improve accuracy in complex or organic designs, offering companies a competitive advantage by merging efficiency with craftsmanship.

Second, the materials generated during the pilot (CAD files, 3D-printed prototypes, process documentation and technical insights) can be used as **training resources** for both novice and professional designers and craftspeople. The pilot highlights key teaching opportunities, such as understanding the "interpretive zone" of the artisan, improving designers' ability to anticipate carving constraints, and demonstrating how 3D-printed models serve as reliable physical guides during manual carving.

Third, the pilot opens the door to future **industrial and educational collaborations**. Potential next steps include:

- developing new design exercises where students or designers create pieces that will then be validated through combined CNC pre-shaping and hand carving;
- producing a series of case studies showing how digital tools can support the preservation of traditional craft skills;
- exploring new product typologies that merge handmade carving with industrial processes, particularly for limited editions or high-value furniture.

Finally, future actions should focus on **extending the methodology** to other craft domains studied within CRAEFT, evaluating how 3D printing and CAD modelling can enhance communication, precision, and skill transfer across different traditions. Additional research could assess how parametric design or alternative additive manufacturing technologies may support new design languages while respecting the artisan's interpretative role during the final crafting stages.

Overall, the pilot establishes a practical, scalable approach that connects digital innovation with traditional woodcarving and sets the foundation for continued exploitation, training development, and future experimental pilots within the broader CRAEFT framework.

8. Conclusion and Outlook

The Design Pilot demonstrates how the intersection of design and present-day technologies can reshape the conditions under which artisanal traditions are transmitted, interpreted, and transformed. By bringing heritage crafts into dialogue with contemporary design practices and digital toolchains, the Pilot has explored innovation potentials across domains ranging from tapestry and porcelain to glass and furniture-making. Each Representative Craft Instance (RCI) operates within its own cultural, material, and technical ecosystem, making diversity not a peripheral aspect of the Pilot, but one of its defining research conditions.

8.1 Challenges in the Diversity of Design Contexts

A primary challenge lies in the heterogeneity of the contexts in which design is embedded. Each RCI is shaped by distinct cultural histories, material constraints, institutional frameworks, and economic realities. In some cases, traditions are tightly bound to local materials and situated techniques; in others, the priority is the safeguarding of endangered practices or the reactivation of fragmented know-how. Integrating digital tools across such contexts requires careful calibration so that technological mediation supports regional identities and craft-specific forms of expertise.

A second challenge concerns the plurality of what “design” means across RCIs. Design may be understood as functional problem-solving, as artistic or symbolic articulation of identity, or as an industrial logic oriented toward scalability and market demands. These divergent design cultures complicate the development of shared methodologies because tools and workflows cannot be assumed to have the same relevance, legitimacy, or purpose everywhere. Developing a common framework, therefore, requires an inclusive approach that recognises different design regimes and builds interoperability between them.

Finally, scalability introduces a structural tension. Digital methods (e.g., algorithmic design, augmented reality, rapid prototyping) can support customisation and replication, yet they may also encourage formal standardisation if applied without critical attention to locality, variability, and tacit judgement. The challenge is to enable adaptation to contemporary conditions while maintaining the craft’s specificity, its material character, its embodied intelligence, and its cultural resonance.

8.2 Opportunities in Contextual Diversity

The same diversity that generates complexity also creates strong opportunities for innovation and cross-learning. By working through multiple RCIs, the Pilot shows how practices can inform each other through analogies and transfers: the precision and sequencing of glassmaking can inspire approaches to digital fabrication; the narrative and image logic of tapestry can open perspectives for interactive or spatial media; the constraints of ceramic or wood workflows can sharpen methods for prototyping, validation, and iteration. Such cross-pollination strengthens the Pilot’s capacity to function as a shared research space rather than a set of isolated experiments.

Moreover, the Pilot demonstrates that combining craft knowledge and digital tools can support sustainability, cultural preservation, and community engagement, especially when technologies are used to document processes, preserve endangered techniques, and create new contexts of relevance for traditional know-how. In this sense, digital innovation becomes a means to sustain continuity through transformation, rather than a break from tradition.

8.3 Outlook: Expanding Horizons

The Design Pilot provides a roadmap for future work at the intersection of craft, design, and technology. Its next phase should deepen exchanges among RCIs, encouraging collaborative formats that connect disciplines and territories while remaining attentive to local constraints. Expanding into additional materials, contexts, and technological approaches will further test the Pilot's adaptability and reveal new forms of innovation.

Engaging broader audiences, through exhibitions, interactive museum experiences, educational programmes, and digital platforms, can also extend the Pilot's impact by making its results accessible and by strengthening public understanding of how tradition and technology can co-produce contemporary cultural value. Future development will depend on maintaining methodological flexibility, supporting local agency, and ensuring that innovation does not come at the cost of cultural diversity.

8.4 Final Remarks

This Design Pilot confirms that the relationship between craft and design is not a new concern, but one that is being reconfigured today through digital infrastructures and contemporary design practices. Historically, design has repeatedly acted as an intermediary discipline: it translates workshop knowledge into projects, negotiates between inherited gestures and evolving tools, and frames how material cultures enter new social, economic, and symbolic contexts. The Pilot extends this lineage by treating digital transformation not as a technological upgrade, but as a methodological question: how design can operate responsibly and effectively when it is simultaneously grounded in heritage knowledge and mediated by computational tools.

A central finding is that "balance" between tradition and innovation is not a stable endpoint, but an outcome of situated design decisions. Technologies become relevant when they function as mediators, supporting interpretation, reducing uncertainty, enabling experimentation, and expanding the range of possible forms and experiences, without displacing the embodied, sensory, and cultural intelligence of making. This is why the Pilot foregrounds the project as the operational unit of collaboration: the project is where intention is negotiated, prototypes are tested, constraints are made explicit, and knowledge is transmitted across roles and disciplines.

The Pilot also shows that transferability should be understood as methodological portability, not the replication of a universal workflow. What can travel across RCIs is a set of repeatable phases and questions: how a brief is framed relative to a craft's constraints; how tools are selected to serve translation rather than spectacle; how workshops are structured to combine exploratory experimentation with validation; and how results are documented so that they can be taught, critiqued, and adapted. In this sense, the Pilot's contribution is as much epistemic and organisational as it is technical: it offers a way to scale learning and collaboration while preserving the specificity of each territory and practice.

Under this framing, the Design Pilot is not primarily a programme for modernising crafts. It is a platform for investigating contemporary design itself, how it can create forms, experiences, and meanings that remain situated culturally, materially, and territorially, while building methods robust enough to be shared across diverse contexts. Its final proposition is therefore design-centric: innovation is successful not only when it produces new artefacts, but when it strengthens the conditions for transmission, expands the design space without homogenising it, and sustains the plurality of craft cultures as active contributors to future design futures.

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