

FASHION AS ARMOUR

REINTERPRETING PROTECTION THROUGH CULTURAL HERITAGE AND INNOVATION

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Abstract

This essay explores the evolving relationship between fashion, material culture, and digital technology through the conceptual and formal legacy of historical armour. Positioning clothing as a symbolic and communicative system, the study interprets armour as a paradigmatic object – simultaneously protective, aesthetic, and identity-forming. A critical historical and semiotic analysis of selected European armours from the Stibbert Museum in Florence investigates their material composition, craftsmanship, and cultural significance, identifying them as early examples of wearable design where function and ornament converge. This historical inquiry is complemented by an experimental application of 3D laser scanning on reflective metal surfaces, assessing the potential of digital technologies to document, preserve, and reinterpret heritage artefacts. These research phases inform a design-led practice that translates the symbolic and structural qualities of armour into a contemporary fashion collection. Employing advanced materials, modular construction, and digital fabrication, such as 3D modelling and printing, the garments propose an adaptive, emotionally responsive model of protection. This interdisciplinary investigation highlights fashion's potential to function as a dynamic interface between cultural heritage and technological innovation, positioning it as a medium for both continuity and transformation in the construction of identity.

Keywords: *Digital Heritage; 3D Printing; 3D Modelling; Digitalisation; 3DeVOK MT*

INTRODUCTION

Since its origins, clothing has served as far more than a simple covering for the body: it has fulfilled roles of protection, distinction, and communication, becoming a medium for individuals to express identity, assert presence, and tell their stories. Within this complex cultural and symbolic framework, armour occupies a pivotal position. Conceived initially as a defensive device, armour gradually evolved to encompass aesthetic, representational, and identity-related functions, anticipating many of the expressive roles now attributed to contemporary fashion (Di Carlo, 2022).

This research seeks to investigate and reinterpret the enduring relationship between armour and fashion, weaving together insights

from history, art, technology, and design. The study begins with a theoretical and visual in-depth analysis of the historical evolution of armour, highlighting its dual function as both utilitarian protection and ornamental display. Over the centuries, armour mirrored the fashion of its time, adapting its forms, silhouettes, materials, and embellishments to prevailing aesthetic codes (Kim et al., 2023). Beyond its defensive function, it became a symbol of status, power, and social belonging. The use of precious materials, refined craftsmanship, engravings, and gilding elevated armour to the realm of art, signifying the prestige and identity of the wearer (Thomas, Gamber & Schedelmann, 1965).

Exploring the relationship between fashion

and armour requires a critical examination of the foundational concepts involved – namely, functionality and aesthetics. In this context, we propose a deliberate reversal of the conventional hierarchy between these terms, adopting a holistic approach that considers the interplay between meaning and signifier (Barthes, 2006). Here, fashion is understood as meaning: the idea, concept, or mental representation attached to a material expression – what clothing communicates. In contrast, armour assumes the role of signifier: the tangible form through which meaning is articulated and projected into the world.

Fashion, ultimately, is a language – a system of signs through which individuals communicate with the world, their communities, and themselves. Within this dialogic process, aesthetic form and functional purpose merge, generating a conception of beauty inseparable from the object's role. Historically, armour was developed as a protective apparatus for warfare. However, over time, it evolved into a complex cultural artefact, enriched with symbolic and aesthetic value far beyond its original purpose.

The protective function of clothing – universal in scope and transcending cultural, temporal, and geographical boundaries – has always gone hand in hand with psychological and identity-driven dimensions. As Cabrices (2022) insightfully observes: “[...] we turn to our clothes, expecting them to solve our problems. We leave to the garments in our wardrobe the almighty job of answering our questions, making our lives and ourselves better, and standing up for our looks and beliefs”. Since its earliest incarnations, clothing has protected the human body from environmental threats. Initially purely functional, garments gradually took on symbolic, decorative, and social functions.

Armour has historically embodied a dual role: both protective device and communicative artefact (Krause, 2017). Beyond its capacity to shield the body from physical harm, armour has consistently conveyed symbolic meanings (Breiding, 2004). The materials selected, the craftsmanship employed, and the decorative intricacies of historical armour were strategically designed to generate psychological impact and visual authority (Breiding, 2023a; 2023b). The origins of protective wear can be traced to classical antiquity, notably within Greek and Roman civilisations. However, the conceptual impulse behind such artefacts – the human desire

to protect and fortify the body – predates recorded history and continues to shape clothing design in the Modern Age. These early forms evolved significantly during the Middle Ages, culminating in the 15th-century development of full plate armour, an intricate ensemble of articulated components designed not only for maximum defence but also as a display of artisanal and symbolic sophistication (V&A Museum of Art, 2023).

As military technology advanced and the practical utility of traditional armour diminished, its representational and ceremonial functions gained prominence. Armour increasingly came to symbolise personal prestige, institutional authority, and sociopolitical identity, foreshadowing the expressive and aesthetic roles of modern fashion. From the 14th century onward, European armour began to reflect, and at times influence, civilian fashion trends, incorporating the silhouettes, proportions, and decorative motifs of contemporary dress. These stylistic evolutions, much like modern fashion cycles, were visible, rapid, and culturally resonant.

The enduring significance of armour's aesthetic and conceptual legacy is evident in its continual reemergence within contemporary fashion (Rall, 2014). Modern designers reinterpret its forms, materials, and metaphoric aspects to engage with current themes of resilience, vulnerability, and transformation.

While recent studies in digital heritage and fashion archives primarily focus on digitising historical designs, garments, and armour for documentation, conservation, or virtual exhibition, such approaches often remain limited to communicational and marketing purposes (Vacca, 2024). This research advances the field by framing digital technologies as interpretive and creative tools within a design-led exploration. Instead of viewing digitisation as a final goal, the study uses 3D scanning, modelling, and additive manufacturing to transform historical armour into a modern, wearable artifact. In doing so, it connects heritage preservation with material experimentation, highlighting fashion design as a vital practice that generates new cultural meanings from historical sources.

FASHION AND ARMOUR: AN AESTHETIC AND FUNCTIONAL CONNECTION

While historical armour gradually evolved from a war apparatus to a symbol of authority and identity, contemporary fashion has inherited and reinterpreted its forms and meanings. In this context, modern clothing can be viewed as a conceptual evolution of armour: no longer solely focused on physical protection but also on identity, narrative, and emotional expression.

Seen through a contemporary lens, armour and fashion are both means of engaging with the world. Clothing covers the body, regulates exposure in accordance with social codes of propriety, offers environmental protection, and serves as a nonverbal communication tool. It attracts attention, builds identity, and reflects moods, values, and desires. In some cases, fashion even takes on controversial dimensions, especially regarding the environmental and ethical challenges facing the textile industry. Even garments derived from technical or protective contexts, such as military jackets, hazmat suits, and face masks, have been symbolically appropriated by fashion. Designers integrate these elements into their collections, transforming them into visual metaphors for resistance, crisis, and adaptation. Contemporary figures like Craig Green and Demna Gvasalia have explicitly drawn on protective forms and materials, suggesting that fashion can respond – sometimes critically – to the anxieties of our time.

In today's sociopolitical climate, fashion increasingly emerges as a new kind of armour not made of steel, but of textiles, signs, and symbolic structures. Clothing and accessories serve as tools of empowerment and self-expression, while also revealing the tensions between identity, conformity, and resistance. The relationship between fashion and armour is not only historical or formal; it is a living, dynamic language that reflects the emotional and cultural battles of each era. In the contemporary landscape, armour is reimagined: softened, internalised, and adapted to confront the conflicts, both visible and invisible, of our time.

The idea of clothing as armour – whether physical, psychological or identity-based protection – has been explored by numerous designers who reinterpret its forms, materials and meanings through collections that are often theatrical and scenographic. While some adopt rigorous, concept-driven approaches, others privilege their

visual, narrative, or emotional impact. The motif of armour in contemporary fashion operates as a powerful visual and conceptual device, embodying themes of protection, identity, and transformation (Fig. 01). A paradigmatic figure in this discourse is Alexander McQueen (Guerisoli, 2024), whose designs integrate historical references with material innovation to reimagine armour through a dramatic couture lens. Notable examples include his SS2024 collection, where the traditional cuirass is reconstructed using non-traditional materials, plaster, leather, acrylic, and glass, signifying vulnerability and strength. Similarly, collections such as Joan (FW1998) and Eye (2000) articulate complex narratives through the fusion of military, religious, and cultural iconography. Alongside McQueen, Paco Rabanne emerges as a seminal figure in redefining femininity through metallic and synthetic constructions (Mariani, 2022). His 1966 collection, 12 Unwearable Dresses in Contemporary Materials, challenged fashion orthodoxy by assembling garments from metal and plastic, advocating for fashion as both modular and sculptural (Fabbri, 2021). This legacy continues under Julien Dossena, whose FW 2023-24 collection revives Rabanne's aesthetics through chainmail, bustiers, and metallic fringes. The symbolic function of armour extends across numerous fashion houses. Dolce & Gabbana, Balmain, and Saint Laurent have all reinterpreted chivalric and metallic motifs, often integrating historical references with opulence and modern tailoring (Trevisson Zardini, 2024). Saint Laurent's collaboration with Claude Lalanne, whose galvanised metal body moulds blurred the line between fashion and sculpture, remains particularly influential. Contemporary designers continue this dialogue with new materials and digital aesthetics. Nicolas Di Felice's minimalist chainmail for Jean Paul Gaultier and Demna Gvasalia's dystopian, game-based presentation for Balenciaga (FW2021-22) reflect evolving interpretations of armour in relation to futurism, sensuality, and spectacle. Likewise, designers such as Jonathan Anderson, Dries Van Noten, Simone Rocha, and Iris van Herpen (Smelik, 2018) explore armour's conceptual terrain through sculptural silhouettes and experimental fabrics, often emphasising the tension between fragility and strength.

One iconic manifestation of this thematic lineage is Issey Miyake's thermoformed acrylic bust, worn by Grace Jones in 1995 and now housed at

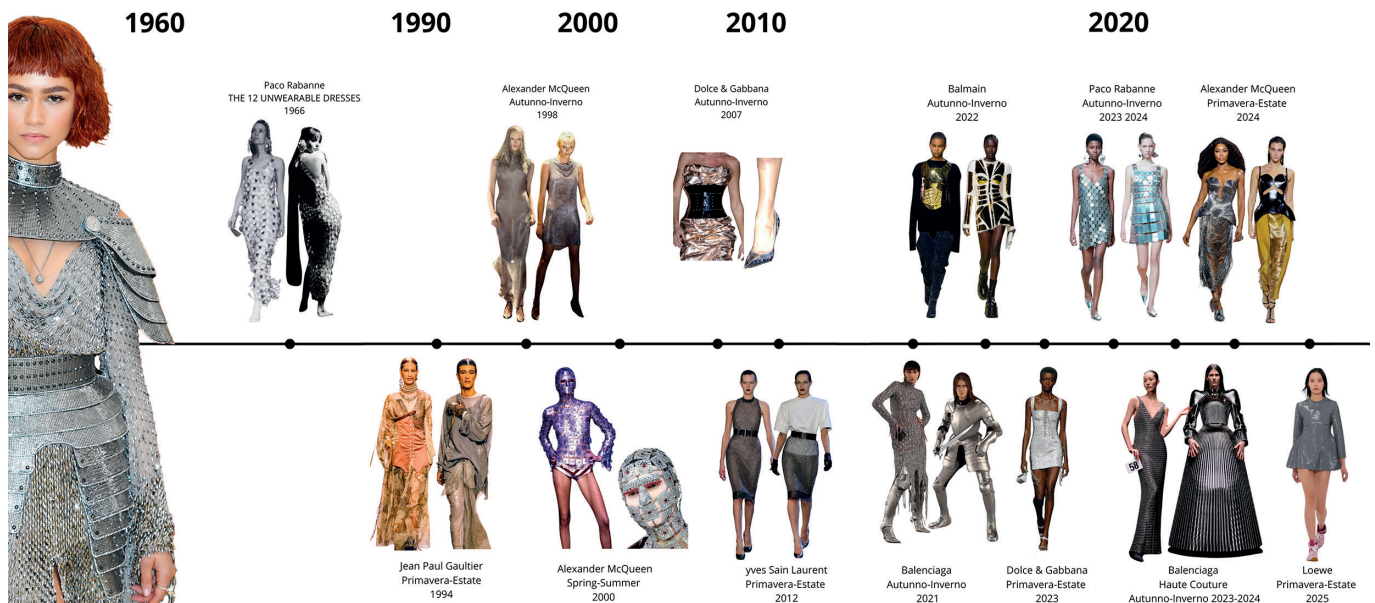


Fig. 01

armour-inspired design (Villanova, 2023). The increasing popularity of medieval and chivalric aesthetics beyond the runway has fostered dynamic interactions among fashion, visual culture, and contemporary media. Fantasy representations serve as powerful cultural vehicles that reframe the iconography of armour, blending historical influences with a spectacular, hyper-stylised modern aesthetic.

In essence, the resurgence of armour in contemporary fashion reflects a cultural moment in which clothing is invested with intense symbolic value. No longer relegated to ornamentation or seduction, garments act as devices for psychosocial protection and identity expression. Armour, in this context, becomes an evolving aesthetic code through which individuals and communities renegotiate their relationship with the body, power, and vulnerability. As fashion incorporates and reinterprets this imagery, it continues to function not only as a mirror of the times but as a language of resistance, transformation, and survival.

DIGITALISATION AND 3D MODELLING

This study forms part of the outcomes of the thematic seminar Heritage and Innovation, conducted within the framework of the bachelor's degree programme in Textile and Fashion Design at the Department of Architecture (DIDA), University of Florence. At the core of the research is a case study of the Stibbert Museum in Florence, which houses one of the most extensive and visually compelling collections of European armour worldwide (Becattini, 2010). The museum is currently engaged in a digitisation project to produce high-resolution digital surveys of both its architectural spaces and individual artefacts (Cottini et al., 2025). In contemporary design and heritage studies, digital surveying techniques have become indispensable tools for acquiring and processing complex geometries, enabling the creation of high-fidelity three-dimensional models applicable across a wide range of disciplines, including morphological analysis, cultural heritage conservation, industrial design, and creative prototyping. Among the most widely adopted technologies are digital photogrammetry

and 3D scanning, using either structured light or laser-based systems. Although both methods enable non-invasive data acquisition, they differ in their operating principles, levels of accuracy, processing workflows, and ideal contexts of use.

Within this context, the research investigates how historical and artistic cultural heritage can serve not only as a source of creative inspiration but also as a direct component of the contemporary design process through the application of advanced digitisation technologies (Schactler, 2022). The study examines selected artefacts to analyse the structural complexity and symbolic significance of historical armours, considering their lasting impact on contemporary visual and material culture.

Furthermore, the project is aligned with the broader convergence of fashion and digital fabrication. Recent developments in the fashion industry – such as 3D scanning, modelling, and additive manufacturing – demonstrate how heritage references can be reinterpreted through technological innovation. A notable example is Balenciaga's iconic armour dress from the Haute Couture FW2023-24 collection, fabricated using galvanised resin and polished chrome printing. Inspired by historical armour and recently exhibited at the Louvre, the piece exemplifies how fashion design can intersect with both historical reference and digital experimentation.

The scope of three-dimensional digitisation today extends far beyond documentation or preservation (Parrinello & Dell'Amico, 2019). These technologies are now central to interactive museology, virtual reality experiences, digital fashion, and experimental design. Within this framework, the present research explores the integrated use of photogrammetry and 3D scanning to digitise historical armour, to reinterpret its forms in the context of contemporary fashion design. The aim is to establish a multidisciplinary dialogue between technology, history, and creative practice, in which historical memory serves as a catalyst for innovation.

The initial phase of the research involved an in-depth analysis of the materials conserved at the Stibbert Museum, intending to establish a conceptual and formal framework for the development of a fashion collection. The investigation aimed to identify visual, structural, and decorative elements that could inform the design of nine original outfits, drawing inspiration from historical references in terms of silhouette, ornamentation,

and construction techniques. Attention was devoted to the suits of armour displayed in the Sala della Cavalcata (Boccia & Probst, 2004), whose scenographic arrangement and typological variety offered a rich source of morphological and symbolic motifs for reinterpretation within a contemporary fashion context.

The Stibbert Museum represents a paradigmatic case of 19th- and early 20th-century historical collecting, shaped by the intellectual and cultural milieu of its founder. By the late 1850s, Stibbert had begun acquiring objects through European markets, particularly in London, with the explicit aim of establishing a public museum. This vision was realised in the architectural transformation of his Florentine villa into a museum complex, featuring purpose-built galleries. Central to the collection is the European Armoury¹, which comprises over 8,500 artefacts dating from the late 15th to early 19th centuries, arranged in display environments inspired by dynastic armouries of Central Europe. The Sala della Cavalcata exemplifies a museographic *mise-en-scène* in which mounted mannequins evoke the performative and symbolic dimensions of chivalric warfare. By the time of his death, Stibbert had assembled approximately 12,000 items, including around 1,400 Islamic and a comparable number of Japanese artefacts. However, the enduring value of his legacy lies not merely in the scale of the collection but in his conception of a comparative, cross-cultural museum. His curatorial vision – anchored in both scholarly ambition and museographic innovation – established a framework for interpreting the material culture of warfare as a dialogue among aesthetic, technological, and historical traditions. Today, the Stibbert Museum stands as a foundational reference point for the study of arms and armour, historical museology, and the transformation of private collections into public cultural heritage.

Following the identification of key formal and decorative elements for the collection's development, a photogrammetric survey campaign was undertaken using Structure-from-Motion (SfM) techniques. Data acquisition was conducted both from the ground and via a telescopic pole, to digitise selected armours and generate high-resolution 3D models for subsequent processing

1 While the collection's nucleus remains European, Stibbert's interests later expanded to include Islamic and Japanese martial cultures.

and during the documentation process, primarily due to the complex geometry of the artefacts, the highly reflective nature of metallic surfaces, and the constraints imposed by the museum's exhibition layout. To address these limitations and improve data fidelity, an experimental test was conducted using a next-generation laser scanner on a metal helmet borrowed from a theatre costume workshop. This preliminary test allowed for a comparative evaluation of scanning technologies and informed the methodological refinement of future digitisation strategies.

The survey was conducted using an instrument 3DeVOK MT² on a reflective metal helmet, assessing the potential of 3D digital surveying for capturing the intricate, shiny surfaces typical of armour (Fig. 02). The focus was on digitising a highly polished helmet to evaluate the feasibility of integrating this device into a digital workflow for non-invasive surveying of historical artefacts. The 3DeVOK MT is a high-performance

scanning system that combines three advanced light sources: 34 blue laser lines, 22 infrared laser lines, and a wide-area IR speckle pattern. This hybrid configuration allows for scanning in multiple modes, enhancing precision and adaptability across a range of operational conditions. One of the device's most valuable features is its ability to scan without markers, a critical advantage when working with fragile or delicate surfaces. Additionally, it employs hybrid alignment algorithms that maintain high accuracy even with low-feature or straight-forward geometries. Crucially, the device proved capable of scanning reflective and dark surfaces without the use of matting sprays and demonstrated full operability even in low-light conditions or outdoor settings. These features were fundamental in confirming the scanner's suitability for non-invasive documentation of historical metal objects, which typically present technical challenges due to their glossy finishes and complex geometries. This preliminary experimentation confirmed the efficacy and reliability of the 3DeVOK MT system for capturing the detailed morphology of historical armour. The resulting data not only supports digital conservation and archiving but also enables new

² Key technical specifications: resolution: up to 0.05 mm; accuracy: up to 0.04 mm; acquisition speed: 4.5 million points per second; scanning area: up to 1100 × 1000 mm; working distance: up to 1500 mm.

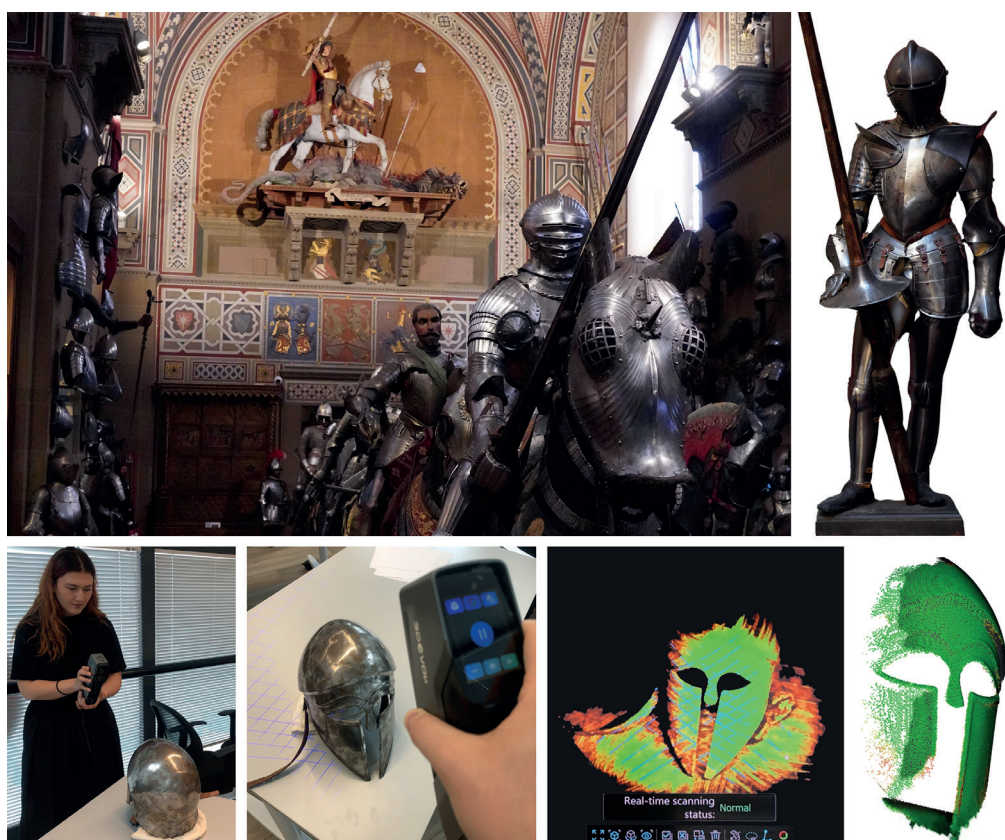


Fig. 02

approaches to design-driven reinterpretation, in which historical artefacts serve as direct inputs to the creative development of contemporary fashion and conceptual garments.

This study adopts a hybrid epistemological framework that combines historical and semiotic analysis with practice-led design research. Knowledge is generated not only through critical interpretation of archival and museological sources but also through material experimentation and prototyping. Within this framework, design is understood as a form of inquiry, in which the act of making becomes a means of reflection, allowing theoretical insights and technical processes to inform one another in an iterative, integrated manner.

3D PRINTING AND COLLECTION DEVELOPMENT

The project entailed the design and development of nine original garments, each conceptually and formally inspired by a specific suit of armour housed in the Stibbert Museum (Fig. 03). The creative process was articulated through the production of flat sketches, technical construction

drawings, and the prototyping of a top garment as a tangible outcome of the research. A key focus of the project was the experimental integration of historical heritage and technological innovation. This was exemplified by the development of a digitally modelled shoulder pad through reverse engineering (Vandi, Bertola & Suh 2024), derived from photogrammetric survey data and reinterpreted through advanced 3D modelling techniques. The resulting component functions as both a structural and symbolic element (Almond, 2019) within the collection, embodying a synthesis of artisanal tradition and computational design. Through this approach, the project highlights the potential of digital technologies to reactivate and recontextualise cultural heritage within contemporary fashion practice.

The development of a shoulder pad inspired by historical armour preserved at the Stibbert Museum represents a crucial stage in integrating digital design processes into the construction of a contemporary fashion collection. Central to this phase was the creation of a three-dimensional digital model, designed to be materialised through 3D printing. The process began with the



Fig. 03

acquisition of the original artefact using photogrammetric techniques, resulting in a dense point cloud and a high-resolution mesh. This data was subsequently imported into Rhinoceros 3D, optimisation for additive manufacturing. However, several critical challenges emerged \ a modelling environment chosen for its support of NURBS surfaces and its precision in managing complex geometries, particularly in the context of additive manufacturing.

The reinterpretation of the shoulder element aimed to preserve the proportions and curvature of the original armour piece while translating it into a contemporary design language. The morphological analysis of the reference object informed the generation of construction lines, initially traced as 2D curves in orthogonal projections. These profiles served as the foundation for building continuous 3D surfaces, resulting in a structurally coherent solid capable of expressing the formal identity of the historical source.

Throughout the modelling process, special attention was paid to surface cleanliness, edge continuity, and volume optimisation to ensure a closed geometry suitable for 3D printing. Care was devoted to the distribution of material thicknesses and the orientation of surfaces to guarantee both structural integrity and printability, while optimising the aesthetic and tactile qualities of the final object with respect to the chosen printing material. The resulting shoulder pad retains a strong symbolic and visual connection to the museum piece while establishing itself as an original design object that bridges historical memory and contemporary innovation.

Upon completion of the digital modelling, the file was exported as an STL file, compatible with slicing software for additive manufacturing. The 3D-printed model was subsequently integrated into a bespoke garment, entirely handmade using traditional tailoring techniques. This juxtaposition between textile craftsmanship and digital precision gave rise to a hybrid object, capable of weaving together two distant domains: that of manual tradition and that of technological experimentation.

The shoulder pad, in this context, is not conceived as a mere decorative element, but as an active structural component of the garment – a conceptual hinge between body, memory, and design. Its placement on the garment is both functional and symbolic: it serves as a form of visible protection, a contemporary reinterpretation

of armour that does not conceal but rather exposes and emphasises. The hosting garment was designed with an ergonomic interface that supports the printed element while maintaining the perceptible contrast between the fabric's softness and the rigidity of the 3D component. This formal and material dissonance becomes a central expressive device of the project. Within the overall collection, the shoulder pad has been designed as a modular, scalable element, adaptable to different outfits. The digital model can be replicated, modified, or personalised, promoting a design approach based on functional modularity and transformable aesthetics, aligned with the principles of a versatile and dynamic wardrobe.

DISCUSSION

For professional practice, the research outlines a transferable methodology applicable to fashion design, costume design, and fashion technology contexts, particularly in collaboration with museums and cultural institutions. The use of digitised heritage artefacts as direct inputs for design development opens new possibilities for sustainable innovation, modularity, and personalisation. Moreover, the integration of digital fabrication into traditional garment construction suggests alternative modes of production and storytelling, in which historical memory becomes an active component of contemporary fashion narratives.

From a didactic perspective, the proposed workflow offers a replicable model for teaching fashion design as a research-driven practice (Fig. 04). By integrating historical analysis, digital surveying, computational modelling, and prototyping, the project demonstrates how cultural heritage can be actively engaged within design education. This approach encourages students to critically reinterpret archival materials rather than passively reference them, fostering an understanding of fashion as a site where theory, technology, and embodied experimentation converge.

CONCLUSIONS

This research has examined the enduring dialogue between fashion, material culture, and digital innovation through the conceptual and structural lens of historical armour. Drawing from a critical semiotic analysis of selected European armours housed in the Stibbert Museum, the study has highlighted the historical convergence of function and ornament – of protection and self-representation – as a foundational aspect of wearable design.

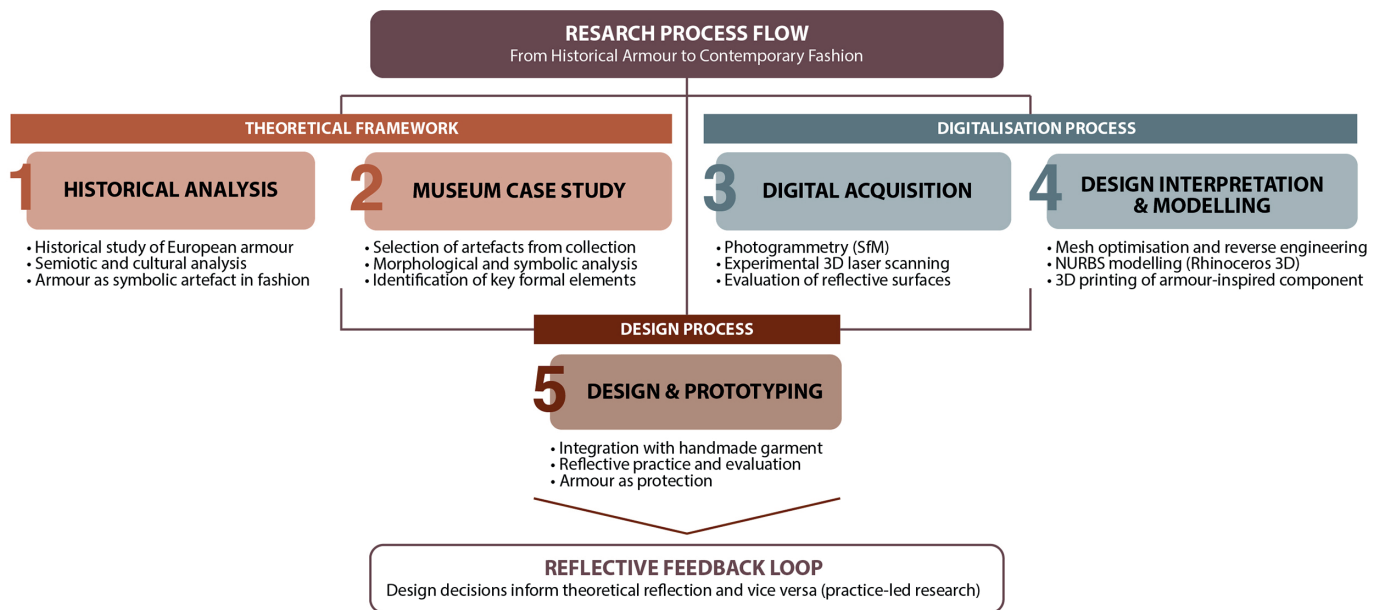


Fig. 04

By engaging with these artefacts not solely as relics of the past but as active cultural texts, the project reconceptualises armour as a powerful precursor to the communicative systems of contemporary fashion.

Through advanced digitisation techniques, the research has further explored how heritage objects can be reinterpreted within design-led practices. These technologies enable a material and symbolic translation of historical data into new formal expressions that engage the body and its identity in ways that transcend temporal boundaries. The resulting fashion collection, centred on the notion of “inner armour”, situates garments as adaptive, emotionally attuned interfaces – offering not static protection, but flexible responses to the psychological and social conditions of contemporary life.

By reversing the traditional hierarchy between form and function, the project proposes a new methodology in which historical signifiers such as armour serve not only as aesthetic references but also as structural and conceptual anchors for future-forward design. Fashion, in this framework, emerges as a language that is both reflective

and projective: capable of preserving memory while enabling transformation. The shoulder pad prototype – designed through a synthesis of digital craftsmanship and traditional tailoring – exemplifies this hybrid approach, serving as a visible hinge between past and present, body and object, technology and emotion.

Ultimately, this interdisciplinary investigation highlights fashion’s ability to serve as a cultural interface: simultaneously protective, expressive, and transformative. By reclaiming the visual and symbolic codes of armour, the project emphasises the importance of historical design practices in shaping new narratives of identity, resilience, and embodied meaning in the digital age.

Future research could expand the methodology through broader collaborations with museums, the exploration of additional armour typologies, or the integration of immersive technologies. Further investigations might also address the application of this framework within industrial production contexts, examining how digitally reinterpreted heritage can inform sustainable and adaptive fashion systems at scale.

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CAPTIONS

[Fig. 01] Timeline illustrating the main influences of armour on contemporary fashion. Elaborated by the authors.

[Fig. 02] Above: the Sala della Cavalcata at Stibbert Museum and the selected armour with the shoulder pad. Below: digitalisation process of a metal helmet using the 3DeVOK MT 3D scanning device. Elaborated by the authors.

[Fig. 03] Above: the nine outfits of the collection, inspired by historical armours from the Stibbert Museum. Below: development of the 3D model of the shoulder pad and the corresponding 3D-printed prototype. Elaborated by the authors. On the right: Flagship piece of the collection, designed and created by Giulia Gattuso. Elaborated by the authors.

[Fig. 04] Research process flow illustrating the hybrid methodology adopted in this study, integrating historical and semiotic analysis, digital heritage acquisition, design interpretation, and practice-led prototyping. Elaborated by the authors.

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