**Title: An object-based research study of archive pieces incorporating digital technology**

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**Introduction**

The aim of this article is to demonstrate examples of knowledge exchange between the practices of pattern and garment technology and fashion curation involving garment technology students and museum curators. It examines how students can apply practical research techniques to explore the interface between the precise, time-consuming craftsmanship, which defines ‘couture’ fashion (Shaeffer, 2011, p.8) and contemporary digital technology processes. In this context, students also evaluate the level of accuracy which can be achieved when incorporating digital technology into the re-production of handcrafted couture garments.

Over the past two decades, two dimensional (2D) digital pattern technology, the process by which pattern designs are manipulated within a software programme, has become a fundamental part of the garment development process in the apparel industry. This is reflected in fashion technology education by an increased embedding of 2D digital pattern technology into course curriculums, largely supported by partnerships with leading industrial providers of the software. In a further development, the fashion industry has started to incorporate three dimensional (3D) digital technology into the product development process, using 3D digital sampling to reduce physical sampling. Innovative approaches from smaller, independent companies show garments animated on moving avatars. The capabilities of such software to accurately represent garment construction and fabric properties, both static and in motion, are not restricted to the commercial fashion industry; digital representations of garments have recently been incorporated into museum collections.

Many leading museums already have static digital images of items in their collections, thus making them available to view online; however, Clough (2013) proposes that it will soon be possible to remotely access three-dimensional digital image files of museum objects and considers that digital technology in a museum context ‘has to be focused on education and learning, some of which should be structured and purpose-driven, and some of which should be open-ended and curiosity driven’ (2013: 31). One important development in this context was seen in the exhibition *Charles James: Beyond Fashion* (James 2016) at the Metropolitan Museum of Art, New York in 2014. Traditional practices of static exhibits were combined with digital technology in 3D manipulation, x-ray and robotic formats, which enabled internal structures, individual pattern pieces and garment construction processes to be exhibited. This approach inspired an internationally acclaimed museum in London to invite a group of garment technology students from the London College of Fashion (LCF) to collaborate on a project that would incorporate digital technology into a forthcoming exhibition of a themed selection of garments from their archives.

The exhibition for which the work in this study was generated runs from spring 2017 until early 2018. For this reason, the museum and the designer have not been identified in this paper.

**Methodology**

The objective of the project was to study a selection of couture womenswear garments from the museum archive to create a duplicate, in cotton calico (or a more suitable comparable fabric) that was as accurate as possible to the original in terms of pattern design and construction. The originals are the work of one designer, spanning the era 1951-1967. Some of the styles were made to order after being selected from a seasonal collection, whilst others were directly commissioned by individual clients. Five students volunteered to join the project, recognising a rare and valuable opportunity to study these historic couture pieces alongside museum curators and thus to challenge their existing technical knowledge which, excepting one student, was situated in contemporary commercial pattern cutting and garment technology techniques. All the students had a good level of competency in digital pattern cutting. The duration of the project was 15 weeks and the students had access to the archives for one day per week at the museum site holding the archives. Here they conducted their research of the archive pieces, using a combination of object-based research and reverse-engineering processes.

The process required a thorough, analytical study of the cut and construction of the pieces to

produce the following:

* A specification drawing: This contains a diagrammatic line drawing of the piece and all the information required to make the garment.
* A manually drafted pattern: Using paper or calico, this is the set of individual pieces which were copied from the original garment.
* 2D digital patterns: The manually drafted pattern pieces input into a 2D digital pattern cutting software programme for further manipulation.
* Toile: Using the digital pattern, the piece was reproduced using calico, or other fabric where a close representation could not be achieved with calico.

Each student in this project was assigned one or two pieces, depending on its complexity, and was partnered with a museum curator who supported practical tasks such as turning over garments and supporting external layers whilst internal layers were examined. Chatterjee (2010: 179) discusses the importance of objects from museums in a pedagogical context for inspiring key transferable skills in higher education, such as discussion, group work and lateral thinking. The student/curator partnership enabled knowledge sharing from the curators on the provenance and social history surrounding the archive pieces, whilst the students identified techniques in pattern cutting and garment construction and defined these in technical terms to the curators. Chatterjee (2010: 180) describes how the study of objects supports the acquisition of subject-specific knowledge through observation and drawing of the piece. The garments in this study were photographed and sketched, detailed measurements were taken, careful tracing through tissue paper, where permitted, was conducted and construction methods were recorded. The methods conformed to the reverse engineering process used in the apparel industry, where an existing garment is analysed by tracing its component parts to extract a pattern (Bubonia, 2012: 205).The process continued in LCF’s sampling studios, where the measurements and tracings recorded during the archive study sessions were developed into a first-pattern draft. Often this first manual draft was incomplete as the student would discover that the detailed measurements could not be fully realised into an accurate pattern. As one student observed in their evaluation of the project:

…the measures seemed to make sense when standing next to the object, but once examined in isolation, there were discrepancies and inaccuracies that made the pattern work tricky.

The students recognised that reliance on their existing technical expertise to resolve the problem would have resulted in an inaccurate duplication. Therefore, it was necessary to revisit the archives to re-examine the garments alongside all the documented details and the pattern draft. Through this experience, the students learned to apply Mida and Kim’s ‘Slow Approach to Seeing’ method of research by ‘…working thoughtfully and methodically through the evidence at hand…’ (2015:33). To document these skills, the students edited a version of the authors’ ‘Checklist for Observation’ (2015: 216).

The students followed a range of approaches to develop a pattern for their assigned garment:

* Draping on a stand***:*** Draping calico directly on to a stand to create pattern pieces, working alongside the reference garment placed on a second stand. Measurements were cross-referenced and corrected on the resulting calico pattern pieces.
* Tracing and draping sections: With the reference garment laid flat on a table, lightweight strands of weights were used to anchor calico and tissue paper onto sections of the garment. These sections were traced with a pencil using minimal pressure, or wrapped within the pattern material to re-create pleats and twists.
* Direct tracing:It was possible to directly trace around the perimeter of the more 2-dimensional styles. Areas that did not lie flat were padded with tissue paper and traced as a 3-dimensional shape.
* Half-scale: The students were advised by the curators that this method, using half-scale rulers and graph paper, is often used at the museum when drafting patterns for publication. One student drafted her pattern in half-scale, input the pattern into the computer and digitally scaled the pieces to full size.

After checking the drafts of the manual patterns against the original garments for general accuracy, these drafts were input into Gerber Pattern Design software for further manipulation and the creation of a 2D digital pattern from which to make the toile. The software was used to combine any part-pattern pieces which had been drafted as sections due to their large size, and any irregular lines and curves which were the outcome of tracing the patterns, rather than part of the original design, were smoothed and neatened. Finally, the patterns were notched, labelled and seam allowances applied, then exported and used to make the toiles. The patterns at this stage were of particular interest to the curators, who typically work with completed garments. In pattern format, they were presented with representations of the component parts of the garments.

**Discussion**

The main challenge for the students was to ‘read’ the archive pieces without being biased by their existing technical knowledge, which for most of them was centred in contemporary pattern and garment technology which uses different techniques to those applied to historical couture. They respected the archive pieces to be the work of an acclaimed couturier and of great value, and with due reverence they followed guidance from the curators on appropriate handling of the pieces. This object-based research approach was further supported by the opportunity to immerse themselves in the environment in which these pieces are held. Collaboration with the curators during these sessions fostered an increased appreciation of object analysis as a research process as, through observation and discussion, the students learned new knowledge about the pieces which enabled them to expand their existing technical experience.

Following a ‘Slow Approach to Seeing’ approach (Mida and Kim, 2015:40) the students adopted a thorough and methodical analysis of the archived garments; observing styling and construction details and documenting these through photographs, sketches, diagrams and measurements on to their checklists. Although assigned individual pieces, they sometimes worked in pairs to develop detailed measuring and tracing systems according to the style of each garment. Their existing technical knowledge demands a similar level of accuracy, but the necessary careful and respectful handling of the garments, taking care not to mark with pencil or pins, was a new experience.

This analysis resulted in a documented account of every accessible detail of the pieces. The students then evaluated this information to distinguish between original and modified features. They discussed and agreed that any specific construction techniques that could be clearly identified as an alteration or a repair would not be incorporated into the reproduction. For example, it was agreed that a horizontal dart across the lining of a skirt had been added after completion to prevent the lining from becoming visible below the hem of the garment; also, there was clear evidence of a repair to the underarm area of a dress. Once these features had been identified and categorised, other features, which were more recognisable as authentic to the original construction, were discussed. Typically, the archive pieces had areas of wide seam allowances for joining individual pattern pieces together, whereas contemporary garments, particularly those that are mass-produced, have narrower seams, usually for economical purposes as less fabric is used.

 At this point the students’ reverential approach to the luxury status of the pieces evolved into a far more critical analysis, as the construction of the couture pieces continued to be reviewed through the lens of contemporary garment technology processes. They remained appreciative of examples of highly skilled finishes such as narrow seam bindings and weighted hemlines, but were more critical when considering other details. They suggested that the wider seam allowances were wasteful and bulky in areas where they were not substantially wide enough to provide desired weight to the garment or to provide an opportunity to alter the fit subsequently. It was also observed on some of the pieces that the edge of the seam allowances and facings, although over-sewn with neat hand stitching, were fraying. The students recognised that, although this appeared on the inside of the garment, the finish would not pass contemporary quality control standards of garment manufacture. Elsewhere, excess fabric in a feature on the neckline of a dress was simply tucked over to the inside of the garment; students observed that the excess fabric would need to be reduced and neatened to present a higher standard of finish according to contemporary construction techniques.

When manipulating the digital versions of the patterns, some of the students encountered challenges to their established experience of using digital pattern technology. As had been identified, many of the pattern pieces had large or small seam allowances, which were unfamiliar to the students, who were used to working within contemporary commercial parameters. One student had difficulty retaining the finished shape of pattern pieces, which had seam allowances of 4cm, and had been manipulated manually during the construction of the original garment. Some seam allowances were graduated, for example around a tightly curved armhole, or were cut in a repeated curve formation along a seam. These processes cannot be achieved digitally using a standard function for applying seams. The students had not anticipated such limitations in translating traditional techniques into a contemporary format designed for efficiency and consistency. In considering the time remaining on the project, the students decided to adjust the amount of seam allowance to one that was readily recognised by the software. This deviated in accuracy from the original patterns but enabled digital patterns to be completed and used to make toiles. Versions of digital patterns were also successfully 3D animated by an Audio-Visual provider for inclusion in the exhibition.

**Conclusion**

Object analysis can focus on the exploration of the properties of an existing object to understand the construction and composition of the piece. Undertaken as part of a group, the research is further informed through discussion to facilitate peer learning and knowledge sharing (Chatterjee, 2010: 180). In the context of this project, one student reflected:

[…]this collaboration with team members who shared our interest in the clothes, but who looked at them from a different perspective, was extremely insightful. I discovered that the history of the objects we analysed was as interesting as the shape and construction process of the pieces, and the research into the provenance of museum objects means I now look at exhibitions with a fresh perspective.

Advancing the views of Chatterjee, reproduction enables deeper understanding of the elements of the object as the component parts are recreated for reconstruction (Minkin and Dawson: 2014); this can continue the practice of knowledge exchange and include collaboration in the endeavour to create an accurate reproduction.

As the garments studied in this project were ‘finished’ pieces, a reverse-engineering study allowed the construction process to be broken down into individual steps and for the pattern pieces to be extracted from the original garments. Through this process, students observed unfamiliar cutting and construction techniques which challenged their existing skills and in turn empowered them to critically analyse established, valued and revered couture techniques. When translating the patterns into a digital pattern format, it was necessary to develop compromises, due to limitations with standard digital pattern cutting function. These were considered and evaluated to be such that the aims of the project were met while the integrity of the archive pieces was retained. Therefore, whilst the digitisation of the patterns did not advance these skills during the project, the students realised that it would be necessary to experiment with using the software in a less prescribed way to realise the outcomes more accurately, or to explore alternative software with more manipulative possibilities.

The transfer of knowledge during this project enabled the students to transition from a position of inexperience when first engaging with the archives and the curators to one of recognised expertise based on the input of their construction and digital technical skills. The presentation of the digitally produced pattern pieces was of particular interest and excitement to the museum curators who, being used to studying finished garments, were introduced to the scale of individual pattern pieces and the number of pieces contained within each garment. The accuracy of the toiles was noted and commended by the curatorial team at the museum;

Your presentations [..] were fascinating and the quality of your toiles amazing […] it’s added incredibly useful information to our knowledge of our …garments.

The project demonstrates how an interdisciplinary object-based approach, sharing the contextual knowledge of curators and the understanding of 2D and 3D patterns and construction of garment technologists, provided a deeper understanding of the archived pieces. The project demonstrates how 2D and 3D digital technology, utilised by technologists and curators, can be used by museums to exhibit archived garments in a way to enable an additional level of discussion and understanding for the audience. The digital replica will demonstrate cut and construction in both the deconstructed and re-constructed form to facilitate more critical observation than can be obtained by the static garment alone.

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