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**USING 3D ANIMATION TO CAPTURE AND PRESERVE INTANGIBLE HERITAGE:  
INDUSTRIAL TEXTILE CRAFTS****Authors:** Professor Tom Fisher, Dr Nicola Donovan and Dr Julie Botticello

A commitment to Industrial heritage means valuing, understanding and preserving the material remains of industrial activity, from individual artefacts, to buildings, to landscapes. Such a commitment is reflected in UNESCO's inclusion of industrial locations as World Heritage Sites. The cultural significance of such sites, and the buildings and artefacts that they contain is clear, given their role in structuring the everyday lives of individuals, building communities and regional identities. The loss of industry or its transformation involves more than the loss of the symbolic fabric of communities that such material remains comprise. It also means the loss of the material, embodied, productive engagement of people with the processes that make up the industry.

Coming from the perspective of creative arts and design which are themselves founded on materially engaged practices, a team of researchers at Nottingham Trent University are finding new ways to engage with industrial heritage that focus on the relatively 'immaterial' components of industrial processes. These are the embodied skills that exist only in the relationship between people and things (tools, machines, materials), sites and environments and that make them productive workers.

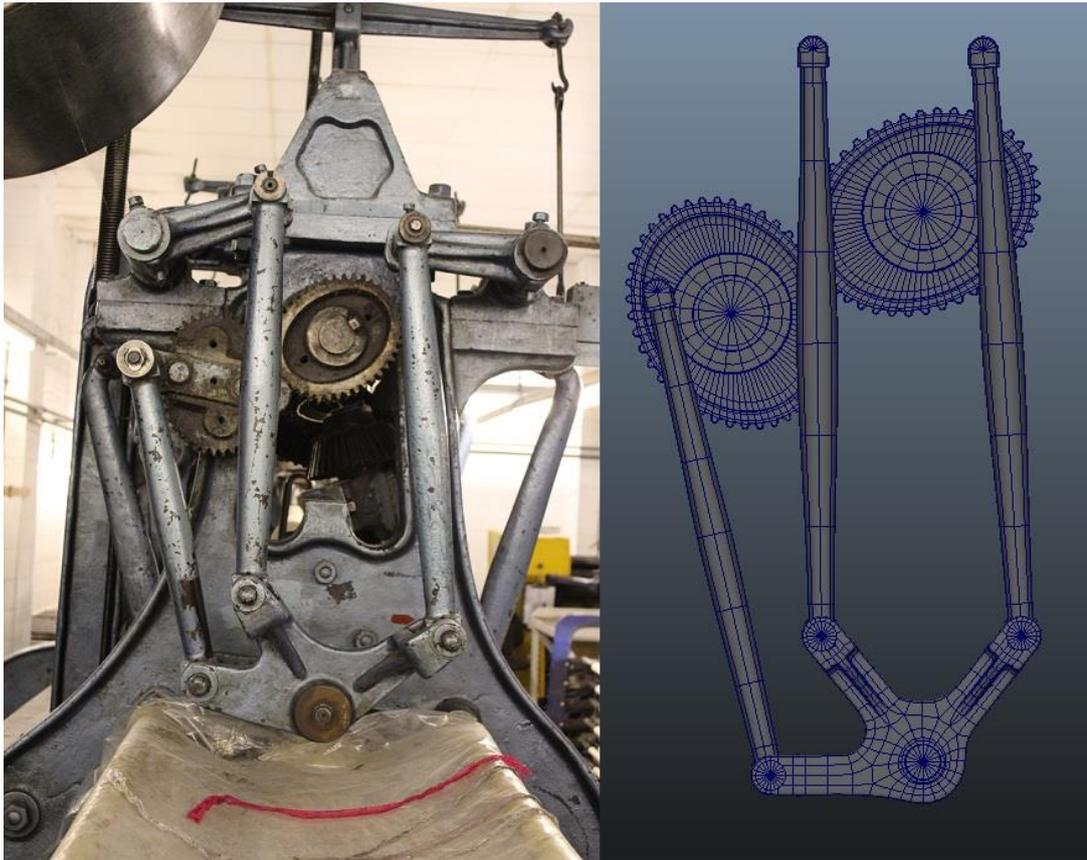


Figure 1: An end view of a lace machine and a 3D model of a lace machine mechanism

The approach the team is taking starts from the premise that this relationship is a part of the Intangible Cultural Heritage that the UNESCO identifies in its 2003 'Convention for the Safeguarding of the Intangible Cultural Heritage'<sup>1</sup>. The convention sets out a list of guidelines, or rules that define Intangible Cultural Heritage, reinforcing its relevance to Indigenous heritage practices, such as those of Asia, Africa and South America. Laurajane Smith argues that heritage, whether tangible or intangible is 'the performance and negotiation of identity, values, and a sense of place' which means that in principle it is relevant to all people, whoever they are and wherever they might be (Smith 2008:292). Smith is challenging the 'othering' of Indigenous heritage practice, and in principal this allows any cultural heritage practice to be claimed as Intangible Cultural Heritage, including those that appear within the sphere of industry.

In developing the argument for industrial crafts to be taken as intangible cultural heritage, the team at Nottingham Trent University has embarked on a research programme that both contributes case studies to underpin the argument and promises some practical consequences for both heritage institutions and audiences. In 2013 a piece of research supported by the AHRC/ EPSRC *Science and Heritage* programme<sup>2</sup> focused on a Nottingham lace making factory (Fisher and Botticello 2016). A further piece of research based on a framework-knitting museum is currently in preparation.

<sup>1</sup> <http://www.unesco.org/culture/ich/en/convention>

<sup>2</sup> *Nottingham Lace: Capturing and Representing Knowledge in People, Machines and Documents*

The focus in both is on knowledge as intangible heritage. In the AHRC funded study, an interdisciplinary set of researchers combined oral histories, ethnographic research and 3D digital animation to register knowledge embodied in the workers and embedded in the machines and the factory's organisation and made manifest in their relationship. The relationships were uncovered through an ethnography and oral history interviews, accompanied by photography and video that demonstrated both the embodied skills involved and the knowledge embedded in the lace machines and the workers' relationship to them. It further uncovered differing practices among the workers, based on their original training, suggesting that intangible heritage and the knowledge of the workers, even within one small factory, is plural and is itself based on workers' own histories. Some of the intangible knowledges exposed throughout the project has, for the purposes of knowledge transfer and preservation, been made concrete, or accessible to others outside the factory, by being 'captured', at least in part (Haraway 1998), in these ways. As well as being an opportunity to engage deeply with the workers, the project made it possible for the team to go beyond static representations of the material artefacts in the factory by constructing a virtual model of the machine, which gives access to the physical process of machine lace-making in a new and powerful way. Thus, a process that appears obscure is made more understandable through these multiple forms of representation.

A short film summarising this work can be found here:

<https://www.youtube.com/watch?v=2mYtIPKmrwo>

Although the research team concluded their work at the site in 2013, the everyday cultural practices of the social actors in the lace factory continue, as do performances of intangible industrial cultural heritage. Following on from this work is a project currently in preparation that aims to secure skills that pre-date those of machine lace making, and which are their origin. These are the skills of operating a knitting frame, which are central to the operation and the sustainability of a working museum near Nottingham. Ruddington Framework Knitter's Museum (RFKM)<sup>3</sup> occupies the site of a former cottage industry complex of frame-shops, manager's and worker's cottages, outbuildings and a courtyard garden. Saved from destruction by the local community the site became Ruddington Framework Knitter's Museum in 1971 and since then it has aimed to preserve the material, or tangible aspects of framework knitting heritage as well as the intangible heritage inherent in the skills and knowledge required to operate the frame.

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<sup>3</sup> <http://www.frameworkknittersmuseum.org.uk>

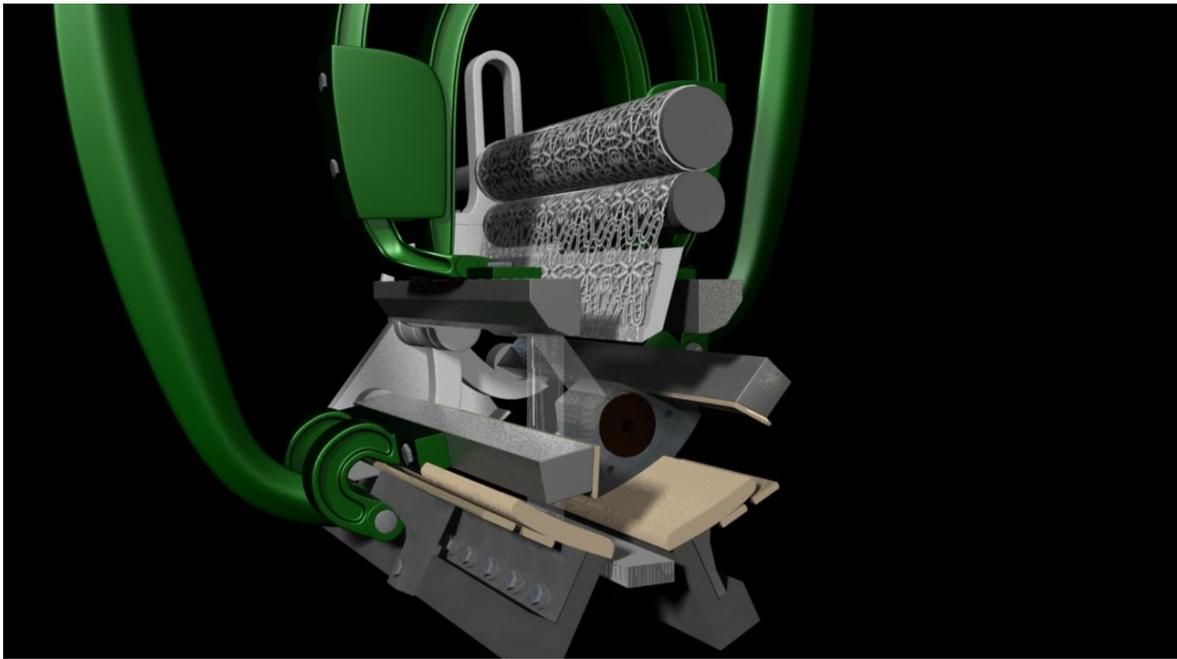


Figure 2: 3D model of the workings of a lace machine

The knitting frame is the origin of all the knitwear we now consume, including the ubiquitous jersey used in leisurewear and underwear and the lace that trims women's lingerie. Invented in 1589 by William Lee in Calverton near Nottingham (Felkin 1863 p.23ff), the knitting frame produced knitted cloth many times faster than hand knitting and made possible what is now a multi-billion dollar global industry. However, the dwindling number of people who know the framework knitting process means significant aspects of this intangible industrial heritage are at risk of complete loss. In partnership with Ruddington Framework Knitter's Museum, the researchers at Nottingham Trent University aim to protect and sustain this knowledge through the production and deployment of 3D digital animation that will be used both as a training tool for novice framework knitters, and as an interpretive vehicle to enhance visitor experience.

Framework knitting depends on an orchestration between cognitive and embodied knowledge, similar to that which is required for driving a car, and according to experienced operators interviewed by the team, many would-be knitters just 'don't get it', so there is an element of aptitude involved too. Among the problems novice operators face is their limited ability to constantly scan the machine's head, while making the correct sequence of physical actions required to power the machine and form the fabric. This difficulty in sequencing actions and monitoring results leads to dropped stitches and damaged needles. It is linked to their inadequate knowledge of the mechanism – the material artefact and its components – and the way to use it. The craft skill unfolds through repeated sequences of actions that must occur in the right order and with the right relationship to each other, with the right 'flow'. The novice's difficulties include comprehending this process intellectually as well as physically – they need to be able to 'feel' the machine and respond fluidly to it.



Figure 3: Bobbin threading at Cluny lace in 2013

The research team therefore propose to use 3D animation to clearly show the relationship between the knitting frame's mechanism and the experienced operator's physical actions. We aim to do this by combining the animation with visualisation of how the knitter uses their eyesight to attend to the process, based on information generated through eye tracking technology. Although a 3D animation is a depiction, a representation of the human/machine relationship in the framework knitting process rather than an immersive experience, the team anticipates that enhanced learning and capability will arise from the addition of 3D animation to the existing, traditional training practices. Far from being a series of static, illustrative diagrams the 3D animation can depict the rhythmic 'dance' of the operator and machine in harmony, which through haptic perception (Freedberg & Gallese 2007, Fauconnier & Turner 2003) helps novice operators, and other audiences, to form a 'sympathetic corporeality', to feel the actions that they see, and consequently more deeply understand the process.

Because building a pool of new framework knitting operators is vital to the viability of RFKM as a working 'live' museum and consequently to the continuation of this

intangible industrial heritage, the research team will work with Nottingham Trent University undergraduates as trainees and research participants. Their involvement will make it possible to validate the enhanced learning material, testing its effectiveness before it is used to augment the training of volunteers at RFKM. In anticipation of enthusiasm for framework knitting, its heritage and the creative potential and entrepreneurial possibilities that it offers, four of the research participants will receive training as trainers. This will mean that the enhanced training materials will ensure a multiplier, or ripple effect that helps pass on framework knitting skills, thereby sustaining this important aspect of industrial textile heritage for future generations.



Figure 4: Bobbin winding at Cluny lace in 2013

Recruiting undergraduate trainees, who are young adults, will also help to address the gap in visitor audiences created by the reluctance of 16-24 year olds to engage with museums (Jensen 2001). Through involvement with a heritage environment that is creative and genuinely interactive, the trainees have an opportunity to experience heritage as a concept and entity that is relevant to them. In addition to courting the interest of young adults via innovative training methods, the museum will also make use of the 3D animation of the frame in the context of display, interpretation and visitor engagement. RFKM has awards for its innovative and creative approach to interpretive display and its engagement of younger, school age audiences. The research team are confident that 3D animation, which explains the framework knitting process in graphic, three dimensional, narrated detail will engage adult audiences.

To display the 3D animation effectively, RFKM and the research team are exploring using 'Magic Mirrors'. These devices, which appear as a wall mounted reflective glass surface, become active when passing visitors activate a sensor. Once activated the surface can incorporate the reflected image of the viewer into a moving image, a 3D animation in this case, thus creating a somewhat a participatory experience. Located within the displays at RFKM, where the original cottages are presented using theatrical set-dressing techniques as versions of what they might well have been in the 19c, Magic

Mirrors, with their incorporation of the visitor's reflection may provide a powerful way to present the 3D animation to young, and also not so young adults.

Smith (2008) argues that heritage is constantly created through discourse and that hegemonic approaches to heritage heavily influence what is valued and how it is valued. For example, recent urban regeneration of cities in the UK and USA has used industrial heritage in highly selective and affective ways to market romantic versions of the broken and discarded past for contemporary consumption (Collins 2016). In contrast, the work of the team at Nottingham Trent University seeks to recognise what is intangible yet vital to negotiating identity, valuing the relatively small-scale narratives that accrue round industrial crafts. The introduction of relatively new technologies into this enterprise gives it an inflection that can open up what were once referred to as 'mysteries', and which will remain mysterious as long as they remain closed from view.

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