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# Hand Knitting in a Digital Era

Josephine Steed

## Introduction

This chapter seeks to develop an argument for a more nuanced language in our critical understanding of the cultural and contextual significance of hand knitting within contemporary craft practice, towards developing a clearer articulation of the intrinsic complexities within this craft practice set against emergent digital contexts, technologies and new modes of collaborative socially engaged practices.

The physical activity of hand knitting is a relatively simple repetitive action that has often been described as requiring limited skill or ability. Knitting at its most basic can be described as the transformation of a linear thread into an interwoven layered construct, whether as a hand-knitted flat panelled jumper knitted on two pins or a complex multi panelled whole garment produced on a high-end computer controlled seamless 3D knitting machine. However, these basic actions and processes, the transformation of yarn into artefacts is not the whole story or the starting point of this chapter. Instead the author suggests deeper levels of complexity that are embedded within the hand knitting language informed by: haptic, temporal and cultural indices. There are greater levels of embodied tacit and experiential knowledge together with complex associations across culture[s] and customs that call for the development of a far more precise and appropriate language in contextualizing knitting against preconceptions of craft.

Through exploring a range of knitting practice together with new emergent designers working across conventional boundaries within knitting, this chapter challenges past perceptions by re-evaluating knitting as a unique skill and offers some thoughts on the process and knowledge embedded within knitting. The chapter attempts to develop a more meaningful language that clearly reflects and contextualizes the actual nature of knitting both practically and philosophically seen against a digital technological and social backdrop.

### **Knitting as a 'Living' Craft**

In Sabrina Gschwandtner's article '*Knitting is...*'<sup>1</sup>, the artist seeks to articulate the different characteristics of knitting when manifested within culture[s] as a language for participatory practice and community engagement. The article attempts to reposition knitting as a physical knowledge of culture where the knitted artefact is a living embodiment of human activity. This re-evaluation recognizes the innate complexities of knitting as a craft that is embedded in and reflective of wider cultural and social developments.<sup>2</sup>

We might look back to the lineage of knitting itself in order to start unpacking these predeterminations. As an ancient craft with its origins dating back to 1000 B.C. knitting originated from hand knotting or twisting of yarns using fingers.<sup>3</sup> The word 'knit' developed from the old English term '*cnyttan*, and the German '*knütten*' developed to knot. Hand-knitting rapidly advanced from fingers to hand tools known as pins into a skilled and complex craft where by the 5<sup>th</sup> century AD knitted objects such as socks are recorded combining fashioning, seaming and circular knitting together with patterning techniques simultaneously.<sup>4</sup> The deep associations and

connections we have with knitting may also be tracked in many common phrases having their origin or meaning, where 'knit' it is often predicated in pronouncing this sense of connectedness, for example, 'a close-knit family', 'a tightly knit community', 'knitted brows' and 'bones knitted together'. This common linguistic adoption and associations we have to 'knit' as a verb, reveal deep-rooted societal connections with the craft as an expression of wider culture associations.

For a wider renewal of hand knitting, we must perhaps look to the pre- and post-war periods of the 1930s and 40s where knitting was promoted as a patriotic and positive activity for those on the 'home front' as part of their contribution to the war effort. Post-war hand knitting became part of the 'make-do-and-mend' austerity campaign both in Britain and the United States where novel knitted artefacts were created as tangible expressions of very personalized creativity and innovation, both in deconstructing 'decoding' and redesigning old knitted goods, patterns and yarns to produce unique knitted objects which quite often suggested or explicitly embedded personal narratives into the very 'fabric' of the artefacts. Post-war industrialization and the commodification of knitted artefacts shifted knitting out of the home and onto the 'high-street' subverting or undermining the status of hand-knitting as a parochial craft, merely concerned with preserving the past. Innovation in knitting was now firmly associated with mechanized manufacture, where the language or individual maker's vocabulary became simplified and ultimately alienated through the commodification and industrialisation process itself.<sup>5</sup>

As hand knitting inclined to the margins as a viable manufacturing process, it was its long history of connecting people with their environment that came to the fore: from material source to the maker's largely unwritten generational knowledge of patterns and techniques, in clearly locating the craft of knitting against distinct

communities and indigenous practices. The results of these knitted artefacts embodying more complex layers of narrative with hidden biographies and histories together with the 'taciturn' knowledge of the maker. This phenomenon is clearly evidenced within indigenous craft. For example, in Iceland's sub-Arctic climate, the natural characteristics of Icelandic wool (both insulating and water repellent), together with cultural pattern and garment construction work, visually and aesthetically differentiate the iconic Icelandic jumper. Likewise, in Shetland hand knitting still plays an important cultural and societal role where due to the Islands' geographical remoteness and links with European traders, the traditions and customs of knitting have adapted and been preserved and continue to make an important contribution to the Island's heritage where the living skills of knitting are still retained.<sup>6</sup> The cultural identity of this remote archipelago is firmly bound up with hand knitting production where it has been a prime creative and economic activity for around 5000 years.<sup>7</sup> Knitting practitioners in Shetland today, for example, Andrea Williamson seamlessly combines traditional materials and patterns and demonstrates a renewal of interest in indigenous knitting. Williamson explains: 'Traditional Shetland knitting which has absorbed influences from centuries of trade links with Europe and Scandinavia is a constant source of inspiration. Old notebooks of patterns collected by family members, and garments that have survived over generations...still vibrant and innovative, are a great reference...'.<sup>8</sup>



Fig. 1: Anchor and Crown tea cosy, © Williamson 2011, Photo: Williamson

Inspired by national events such as The Royal Wedding and the Tall Ships' arrival in Shetland, Williamson re-appropriates traditional anchor and crown Fairisle and lace patterns widely used in traditional Shetland knitting, giving new contemporary meaning to indigenous knitting. Further this notion of these craft skills being alive and connected can be seen in the designer-researcher Hazel White's work *Hamefarers' Kist* inspired by Shetland life. She uses knitting as an interactive tool for generating collective memories across generations by sharing online photo albums with people who do not routinely use computers. The small box containing knitted pincushions, each one with a different pattern, is associated with people, places or events. Using a 'knitted remote' the *Kist* is an intuitive way of accessing online content and speculates how objects like these might be usefully integrated into our lives. Knitting within this context is intended to engage users with technology in an accessible and unobtrusive way.



Fig. 2: *Hamefarers1*, © White, 2009, Photo: White

Hand knitting is experiencing a revival of interest that challenges many previous assumptions that it is more concerned with the preservation of the past rather than as a medium that can be forward thinking and progressive. New modes of practice such as seen in Amy Twigger Holroyd's work are emerging which find new meaning for knitting, in her case, re-knitting as a 'craft of use' tool for exploring the potential of knitting as a strategy for sustainability.<sup>9</sup> For Otto Von Busch, he alludes to this wider contextual premise as the 'Zen of knitting' being not merely a method of production but 'as a process of investigation and intervention' not unlike the game of chess.<sup>10</sup> Von Busch emphasizes that the whole entity of the human experience of knitting needs to be examined for future innovation rather than singular aspects such as process, tools and finished artefact. 'Crafts like knitting are not usually connected to the idea of progress, yet innovation is an inherent but often overlooked part of the practice', says von Busch.<sup>11</sup>

The evolution of knitting as a 'living craft' then clearly does embrace new iterations as an integrated and embedded craft within contemporary design, technology, and fashion innovation and recognizes a need for more critical analysis of the aesthetic and contemporary cultural narrative elements associated with the products of this medium. This renewal of interest, in particular of knitting as social intervention or collaborative movement, has been played out particularly within Europe and North America with socially proactive knitting groups, for instance *Stitch 'n' Bitch*<sup>12</sup> or the politically motivated performance pieces of Liz Collins's *Knitting Nation*,<sup>13</sup> challenging our frames of reference.<sup>13</sup> New generations of knitters across different demographics, generations and types of practice, both amateur and professional, have emerged who are 'blogging', 'twittering', 'bombing' and 'guerrilla-ing' their knitting.<sup>14</sup> In *The Culture of Knitting*, Turney recognizes the need for greater understanding and more critical approaches in re-examining the value and impact of knitting on contemporary culture and society.<sup>15</sup> Set against our physical communities increased fragmentation into new cyber-space global villages, knitting has the potential to restore a sense of self and locality by better connecting people to places and history through both the haptic and temporal processes of making something by hand from start to finish.

### **Extending the Language of Knitting**

The physical process of knitting is 'easy'. It is essentially created using two sticks or pins based on two stitches. It is highly accessible, portable and simple which, may suggest that little skill or mental application is required.<sup>16</sup> However this assumption fails to recognize that the actual practice of knitting can also be complex, highly

skilled and difficult. In many respects, knitting is full of contradictions, cleverly disguising its true attributes and thus appearing harmless, nonthreatening and familiar. It is the 'softer' skills of knitting that enable the medium to address 'hard' issues in witty and creative ways. For example, Freddie Robins uses knitting to question issues related to domesticity, gender and the human condition.<sup>17</sup> Due to the strong cultural preconceptions associated with knitting her work disrupts the notion of craft being passive and benevolent.



Fig. 3: *Knitted Homes of Crime*, © Robins 2002, Photo: Douglas Atfield

In *Knitted Homes of Crimes*, Robins uses knitting as a medium to address crimes by women in a soft yet provocative manner.<sup>18</sup> Through knitting she disrupts our assumptions of the home as a place of safety and domesticity. Another piece by Robins, *How to make a piece of work when you are too tired to make decisions*, focuses on the process of making rather than the product as the main driver for her work. This relationship between the process and the product is central to understanding some of the key attributes of knitting. Each piece of knitting tells a story where the making process is an integral part of an experience, which often

results in unfinished pieces. Referred to as 'ephemeral joy',<sup>19</sup> this phenomenon is well known in knitting circles, where the pleasure experienced by the knitter during making, outweighs the need to produce a finished garment. Rachael Matthews, co-founder of a socially engaged network of knitters, refers to these as uFO's (un - Finished Objects) where uncompleted knitting projects lie dormant in homes representing hours of invested time and memories.<sup>20</sup> Matthew's *uFO Project Administration Service* rehomes these abandoned knitted enterprises by inviting participants to engage with their history and embedding them with new knitted narratives.

In another sphere literally, Daina Taimina, a mathematician at Cornell University and the author of *Crocheting Adventures with Hyperbolic Plane*, uses crochet to visually understand complex three-dimensional forms.<sup>21</sup> Taimina invents and utilizes 'hyperbolic crochet' to describe a space with a negative curvature that increases exponentially. With no formula available for this complex form, mathematicians were unable to physically visualize a hyperbolic curve and it was not until 1997 when Taimina made the first usable model of the curve using crochet that mathematicians were for the first time able to visualize this form. She further explains:

I have crocheted a number of these models and what I find so interesting is that when you make them you get a very concrete sense of the space expanding exponentially. The first rows take no time but the later rows can take literally hours, they have so many stitches. You get a visceral sense of what "hyperbolic" really means.<sup>22</sup>



Fig. 4: *Crocheted geometric manifold*, ©Taimina 2004, Photo: Taimina

The three examples here point to the diversity of the craft that explores and communicates a range of complex issues and contexts. In the case of Robins, the assumptions of knitting as 'soft' and non-threatening are manoeuvred away from the familiar safe territory of female domesticity towards a darker and more sinister perspective. Matthews explores the underlying process of knitting, reflecting on why we knit by inviting discussion based upon unfinished objects. In both cases, their knitting practices are focused on articulating human behaviour and exposing personal lives through knitting. In contrast to this, Taimina's 'hyberbolic crochet' uses soft craft skills to illustrate complex mathematical problems. Through using crocheted models in her teaching of complex geometry, she makes mathematics accessible and enables the boundaries of scientific and creative disciplines to converge.

Further to this and perhaps more importantly, knitting has become a powerful tool for politically and socially engaged practitioners where it is at the forefront of forging new meaning for craft practice. In her collaborative performance work *Knitting Nation: Knitting During Wartime*, American artist and designer Liz Collins, facilitates large groups of knitters to produce knitted banners and garments that

contend with issues of nationalism, globalism and community.<sup>23</sup> In addition, politically active knitting groups such as Knitta, a Houston-based group of amateur knitters who began the 'knit graffiti' movement in 2005, posit knitting as an illegal activity.<sup>24</sup> Ranging in age from 23 to 71, these 'guerilla' knitters anonymously 'tag' street lamps, public and private property and bring new meaning by juxtaposing craft, graffiti and vandalism. Thus, they re-appropriate activity normally associated with male-dominated media. As the artist statement for the group explains further: 'We prove that disobedience can be beautiful and that knitting can be outlaw'.<sup>25</sup>

However, philosopher Michel Foucault challenges this perspective of knowledge, by advocating an 'insurrection of subjugated knowledges' that revalues indigenous and naïve knowledge in order to develop a better and more meaningful language appropriate for the real world.<sup>26</sup> Foucault's comments are focused upon here to illustrate that knowledge is primarily driven by our own human activity and social organization. Therefore the knowledge of knitting as an indigenous craft is by its nature inherently complex and multi-layered mirroring the desires and needs of society at any given time. In *Abstracting Craft: The Practiced Digital Hand*, Malcolm McCullough argues for the acceptance of digital technology into the craftsman's toolbox and questions why these new manifestations should be excluded from the presence of the craftsman's 'hand' in these digital artefacts.<sup>27</sup> Linguistically, the term 'craft' has been applied to any number of activities that are personal and require some mastery. Whereas the advancement of 3D printing and other rapid prototyping technologies are now able to separate digital craft practices from industrial design by producing 'individually prepared' objects, digital craft may need to become more 'haptic', or manipulated by the different aspects of touch, in order to be considered craft.

## **A Social Medium through New Technology**

The Web 2.0 and social networking have produced completely new modes of engagement and levels of collaboration. The egalitarian nature of the web has created platforms, which are no longer limited by geographic or culturally fixed practices. This has transformed our understanding of networked interactions where online sites and services are no longer about passive audiences but building proactive communities of collaborators where DIY (do-it-yourself) online communities drive a new form of creative practice through sharing experiences via websites and blogs. Online knitting communities are driven by amateurs and consist of hobbyists and enthusiasts who evaluate and learn from one another to bring new methods of interaction across different areas of society where free access to information and resources are blurring previous boundaries. This new wave of practitioners, the 'amateur expert'<sup>28</sup> brings new meaning to knitting, which is not motivated by commercial practice, and suggests alternative aims based on personal satisfaction, community values and the intrinsic gratification experienced in the act of 'making'. The widespread use of the Internet has introduced new tools for knitting where practitioners simultaneously use mouse and needle, knitting and blogging, to develop new knitting communities that operate both locally and globally. This phenomenon is manifested in a project instigated through Ravelry, a social network for knitters that demonstrates the power of Internet craft communities to foster new types of collaborative practice.<sup>29</sup> Called *The Queen Susan Shawl* project, members recently recreated a 'lost' knitting pattern. Through distributing the only existing record of The Queen Susan Shawl, a photograph available on the Shetland Museum

Photographic Archive, knitters from across the world worked continuously in their different time zones to create a chart of the original design and produce a pattern that could be downloaded free of charge from Ravelry. As a member, blog posting clearly surmises the project thus: 'Think of it - a piece knitted before the turn of the last century, designed by a close group of family/friends living in an isolated area, preserved in a photograph, being recreated by a far-flung band brought together by technology and a love of this craft.'<sup>30</sup>

In his book *Making is Connecting*, David Gauntlett discusses the power of the Internet to drive a new direction for craft.<sup>31</sup> Seemingly contrary to values of hand-making, knitters across the globe have embraced the web as a medium to inspire, encourage and collaborate with an intensity and pace not previously possible. We tend to view the final artefact as the only true expression of knitting where innovation lies within the final object. However, as Otto Von Busch points out there is another layer of mathematical innovation, which he refers to as 'micro-interventions', which can provide another perspective on our understanding of knitting.<sup>32</sup> At this micro level where a continuous thread or yarn is repeatedly looped and reconnected to itself the craft has analogies to software protocols where a multitude of iterations are made possible. This mathematical coding of knitting, similar to weaving, is inextricably linked to technology where the coding embedded within knitting patterns can be easily translated into the 0 and 1 binary code within computer circuitry.<sup>33</sup> Technology has for a long time been a major driver within knitting innovation where the development of three-dimensional knitting machines in the mid 1990s in particular signified a paradigm shift in seamless knitwear manufacture.<sup>34</sup> Referred to as 'New Craft',<sup>35</sup> emergent digital interfaces for knitting provide an alternative craft practice which challenge established skills of hand-making. New technological

capabilities require a different set of design skills that go beyond merely production to 'machine-thinking',<sup>36</sup> making possible new types of design practice. New modes of knitting innovation are taking place. For example, the ideas and techniques employed by designer Rudiger Schlömer where he attempts to re-appropriate knitting technologies as well as their production methods to use them as tools with which to 'hack'. As Schlömer explains: 'The parallel to pixel graphics is probably one of the first things you notice when you look at knitting patterns, yes. And using patterns you're really counting the whole time. Knitting is a really repetitive movement—it's a loop out of a loop out of a loop; over, under, out of, into. It's very algorithmic, like analog programming.'<sup>37</sup>

New flexible manufacturing technologies for instance three-dimensional scanning and printing are set to further revolutionize traditional methods of production, and have major implications for knitting in the future.<sup>38</sup> Initially developed for the car and medical industries, users of the technology have started to research into softer products such as textiles. The Dutch company Freedom of Creation<sup>39</sup> investigates the making of 'immediate products' to create rapid prototyped stretch products that mimic the inherent characteristics of knitting. The company have high ambitions where they state: 'Our Goal is to replace traditional knitting.'<sup>40</sup>

Technology also drives other types of innovation, namely a shift in focus from product towards experience. Japanese fashion designer Issey Miyake provides an example of innovation in this area through his A-POC (A Piece of Cloth) collection. A-POC utilizes knitting technology to produce knitted tubular fabric with integrated garment shapes that can be modified by the wearer to create customized body pieces. Developed in the late 1990s, this collection transformed the retail experience for their customer. Through creating a retail laboratory environment, Miyake engaged

the wearer as co-designer whereby their input became part of the design process. Similarly, the Considerate Design research project 'Knit to Fit', a collaboration between London College of Fashion, Open University and Cambridge University's Engineering Design Centre, explored the personalised fashion experience within the context of seamless garment knitting.<sup>41</sup> This project addressed the use of three-dimensional body scan data for the extraction of precise body measurements and translation into two-dimensional computer-aided design systems integrated with industrial knitting machines. Its final aim was the direct three-dimensional production of seam free knitwear with enhanced fit and customization for user requirements.

When using rapid technological innovations such as three-dimensional knitting and printing, a new approach to design practice is required to facilitate a sustainable future for knitting relevant to the demands of increasingly complex twenty first Century technology and customer experience. As Suzanne Lee surmises in her book *Fashioning the Future: Tomorrow's Wardrobe*: 'Technology is nothing without craft.'<sup>42</sup>

This acknowledgement of the importance of craft is further expressed through the Emotional Wardrobe research project at the Central Saint Martins College of Art and Design.<sup>43</sup> The project focused on how fashion as an emotional and expressive medium can impact on the development of digital systems for clothing. The research discussed a number of issues concerning the future of design where in the face of so much technological complexity an understanding of a designer's core skills is paramount when working within transdisciplinary environments.

## **Conclusion**

The perception of knitting as a mere 'pastime', fails to recognize that it is unique in its simultaneous creation of surface, structure and form where unlike two-dimensional problem-solving, knitting explores the whole design problem and results in completed products from raw materials. This method of making uses code reading, together with additive and deductive techniques, and demonstrates that knitting is a holistic design approach. As a hybrid craft, the skills of knitting occupy the space between disciplines that embrace both craft and industry and that have, over time developed through hand-skills, then mechanical operation and more recently through electronic and digital technologies. In addition to this, knitting is a craft, which is firmly rooted within society where it has always been a method for expressing oral history, facilitating community engagement and expressing deep personal attachments.

A new role for knitting has emerged in recent years across an increasingly diverse range of creative practices, demonstrating the intrinsic value of knitting within new contexts, which challenge definitions and the language of this craft practice. Hand knitting can offer another type of perspective on problem solving that, due to its inherent qualities as an accessible media, enables complex themes to be explored by both experts and amateurs alike. It is in fact these qualities of inclusivity and accessibility together with inherent participatory and collaborative values, which suggest that knitting skills and knowledge has more to offer than previously thought. Further, the ability of knitting to transform from raw material to three-dimensional forms suggests much closer synergies between knitting and complex emergent technologies, such as three-dimensional printing, than perhaps previously considered.

The design and technology relationship is becoming ever more complex. Different approaches to design are therefore necessary with particular emphasis placed on interactions involving process, experience and meaning embodied within the knitted artefact. As contemporary practice becomes progressively more sophisticated new models are required, experts from across the sciences and design disciplines need to be brought together to explore new territories. Further research is now required to examine the broader knowledge base of knitting to reveal the potential benefits of knitting methodologies, which can be applied within different scenarios. In short, we need to find out if knitting can be developed into a more nuanced language that can add new value to complex design problems.

## Notes

1 Sabrina Gschwandtner, '*Knitting is...*', *The Journal of Modern Craft* 1:2 (July 2008), pp. 271–8. Sabrina Gschwandtner is a New York-based artist who works with a range of photographic and textile media. Her artwork has been exhibited at various international museums and galleries, including the Museum of Arts and Design, New York and the Fleming Museum. Sees <<http://sabinag.com>> [Accessed 25 May 2015].

2 Sandy Black, *Knitwear in Fashion* (London: Thames & Hudson, 2002), p. 6;

Joanne Turney, *The Culture of Knitting* (Oxford: Berg, 2009), p. 4.

3 James Norbury, *The Penguin Knitting Book* (London: Penguin Books, 1957), p. 15.

4 David J. Spencer, *Knitting Technology: A Comprehensive Handbook and Practical Guide to Modern Day Principles and Practices* (Oxford: Pergamon Press, 1989), p6.

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5 Claudia Eckert, Martin Stacey and Christopher Earl, References to Past Designs, in John S. Gero and Nathalie Bonnardel (eds) *Studying Designers '05* (Sydney, Australia: Key Centre of Design Computing and Cognition, 2005), pp. 3–21.

<[http://oro.open.ac.uk/7412/1/past\\_designs\\_from\\_SD05\\_PROCEEDINGS-2.pdf](http://oro.open.ac.uk/7412/1/past_designs_from_SD05_PROCEEDINGS-2.pdf)>

[Accessed 25 May 2015].

6 Shetland Government, *On the Cusp... Shetland's Cultural Strategy, A Vision for Cultural Life in Shetland 2009–2013*, n.d.

<[http://www.shetland.gov.uk/community\\_planning\\_dev/documents/CulturalStrategyDigital.pdf](http://www.shetland.gov.uk/community_planning_dev/documents/CulturalStrategyDigital.pdf)> [Accessed 25 May 2015].

7 Linda G. Fryer, *Knitting By the Fireside and on the Hillside: A History of the Shetland Hand Knitting Industry c. 1600–1950* (Lerwick: The Shetland Times, 1995).

8 Andrea Williamson, see

<<http://www.andreawilliamson.co.uk/images/gallery/about.swf>> [Accessed 4 June 2015].

9 Amy Twigger Holroyd is a designer, maker and researcher. Her knitwear label *Keep & Share* explores the relationship between fashion, making, design and sustainability. See <<http://www.keepandshare.co.uk>> accessed [25th May, 2015].

10 Otto von Busch, 'Zen and the Abstract Machine of Knitting', *Textile: The Journal of Cloth and Culture* 11:1 (March 2013), pp. 6–19. Otto von Busch is a researcher at Business and Design Lab, School of Design and Craft, University of Gothenburg and at Parsons The New School of Design, New York. His research topics include socially engaged craft and DIY culture, fashion and social innovation.

11 Von Busch, 'Zen and the Abstract Machine of Knitting', p 7.

12 Stitch 'n' Bitch is an international social knitting network. Set up by Debbie Stoller in 1999, in New York, the network has been at the forefront of inspiring a new

generation of knitters who are politically and socially active. See

<[www.stitchnbitch.org](http://www.stitchnbitch.org)> [Accessed 25 May 2015].

13 American artist and designer Liz Collins has created a series of multi-media, site-specific installations and performance projects called *KNITTING NATION* as a response to working in the textiles and fashion industries, and has staged several exciting, large-scale events involving a small army of uniformed knitters and manually operated knitting machines. See <[www.lizcollins.com/projects/knitting-nation](http://www.lizcollins.com/projects/knitting-nation)> [Accessed 25 May 2015].

14 Yarn bombing and guerrilla knitting are types of graffiti that use knitting or crochet rather than paint or chalk.

15 Turney, *The Culture of Knitting*, p2-5.

16 Gschwandtner, 'Knitting is ...'.

17 Freddie Robins, see <[www.freddierobins.com](http://www.freddierobins.com)> [Accessed 25 May 2015].

18 Turney, p112.

19 TECH-knitter, 'Two bits of knitting theory: the "work-to-glory" ratio and "product plus-process"', *TECH-knitter* (9 November 2009).

<<http://techknitting.blogspot.com/2009/11/two-bits-of-knitting-theory-work-to.html>>

[Accessed 4 June 2015].

20 Textile artist Rachael Matthews is the co-founder of the Cast Off knitting club – a democratic and proactive knitting club.

See <http://prickyourfinger.blogspot.co.uk/2009/04/ufo-project-administration-service.html> [Accessed 25 May 2015]. and <[www.castoff.info](http://www.castoff.info)> [Accessed 25 May 2015].

21 Daina Taimina, *Crocheting Adventures with Hyperbolic Planes* (Wellesley, MA: A K Peters, 2009).

22 Margaret Wertheim, David Henderson and Daina Taimina, 'Crocheting The Hyperbolic Plane: An Interview with David Henderson and Daina Taimina', *Cabinet* 16 (Winter 2004/05). <<http://www.cabinetmagazine.org/issues/16/crocheting.php>> [Accessed 25 May 2015].

23 David Revere McFadden, Jennifer Scanlan, Jennifer Steifle Edwards, Corporeal Constructions, Liz Collins In *Radical Lace & Subversive Knitting* (New York: Museum of Arts & Design, 2007) p22-25.

24 Knitta is a group of artists who began the 'knit graffiti' movement in Houston, Texas, in 2005. See <<http://knitta.com>> [Accessed 25 May 2015].

25 Sabrina Gschwandtner, *KnitKnit: Profiles + Projects from Knitting's New Wave* (New York: Stewart, Tabori & Chang, 2007), p. 92.

26 Michel Foucault, *Power/Knowledge: Selected Interviews and Other Writings, 1972–1977* (New York: Pantheon Books, 1980), p. 81.

27 Malcolm McCullough, *Abstracting Craft: The Practiced Digital Hand* (Cambridge MA: MIT Press, 1998).

28 Stacey Kuznetsov and Eric Paulos, 'Rise of the Expert Amateur: DIY Projects, Communities, and Cultures', in *Proceedings of the Sixth Nordic Conference on Human-Computer Interaction* (New York: ACM, 2010), pp. 295–304, <<http://www.staceyk.org/hci/KuznetsovDIY.pdf>> [Accessed 25 May 2015].

29 Ravelry is a free social networking website, beta-launched in May 2007. It functions as an organizational tool for a variety of fibre arts including knitting, crocheting, spinning and weaving. As of 28<sup>th</sup> February 2014, Ravelry had four million members worldwide. See <[www.ravelry.com](http://www.ravelry.com)> [Accessed 25 May 2015].

- 30 <http://www.ravelry.com/patterns/library/the-queen-susan-shawl>. For pattern created and blogger's quote see: <http://fleeglesblog.blogspot.com/2009/11/queen-susan-shawl.html> > [Accessed 25 May 2015].
- 31 David Gauntlett, *Making is Connecting: The Social Meaning of Creativity, from DIY and Knitting to Youtube and Web 2.0* (Cambridge, UK: Polity Press, 2011).
- 32 Von Busch, 'Zen and the Abstract Machine of Knitting', p. 8.
- 33 Sabine Seymour, *Fashionable Technology: The Intersection of Design, Fashion, Science, and Technology* (Vienna: SpringerWienNewYork, 2009), p. 15.
- 34 Kate Sayer, Jacquie Wilson and Simon Challis, 'Seamless Knitwear – The Design Skills Gap', *The Design Journal* 9:2 (July 2006), pp. 39–51.
- 35 Robyn Healy, *The Endless Garment: The New Craft of Machine Knitting*, (Melbourne: RMIT Gallery, 2010), p5.
- 36 Healy, *The Endless Garment*, p5.
- 37 From 'Words of Wool', Nick Currie interview with Rudiger Schlömer, American Institute of Graphic Arts, May 13, 2008 see <<http://www.aiga.org/words-of-wool-an-interview-with-rudiger-schlomer>> [Accessed 25 May 2015].
- 38 Jan Brand, *Beyond Green: Sustainability & Fashion*, Arnhem: Artez Press, 2008.
- 39 Freedom of Creation, see <[www.freedomofcreation.com](http://www.freedomofcreation.com)> [Accessed 25 May 2015].
- 40 Jan Brand, *Beyond Green*, p. 86.
- 41 The Considerate Design Project is research collaboration between London College of Fashion, The Open University and The Engineering Design Centre at Cambridge University funded by the research councils AHRC and EPSRC. See <<http://www.consideratedesign.com/projects/knit-for-fit>> [Accessed 25 May 2015].

42 Suzanne Lee, *Fashioning the Future: Tomorrow's Wardrobe* (London: Thames and Hudson, 2007), p. 18.

43 The Emotional Wardrobe (EW) was Phase 1 of Designing for the 21<sup>st</sup> Century Research Cluster supported by the UK's Engineering and Physical Sciences Research Council (EPSRC) and Arts & Humanities Research Council (AHRC). See <[http://www.design21.dundee.ac.uk/Phase1/21Clusters/Emotional\\_Wardrobe.htm](http://www.design21.dundee.ac.uk/Phase1/21Clusters/Emotional_Wardrobe.htm)> [Accessed 25 May 2015].

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