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PLEASE SCROLL DOWN FOR TEXT.

# **The Role of the Textile Materials Library: Providing Access to Multimodal Knowledge in Design Research**

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## **Abstract**

This paper considers the role of the textile materials library as an effective research tool through its provision of tactile, visual samples, technical data and project application information. The abundance of new materials and the increasing complexity of materials and processes that are used by designers requires a comprehensive rethink of the traditional 'samples in a box' approach. The physical handling of fabrics samples allows for a haptic learning tool to isolate and combine the senses in information gathering. Written data in the form of books, papers, and specification sheets can communicate information about the composition, origin, designer/manufacturer, production process, visual reference and applications very effectively. The research described in the paper includes consultation with industry and academia, along with a review of four contemporary textile material libraries to explore the formats that future textile libraries may best take. In considering a future textile library, the authors also examine answers to the question: as the number of textiles available continues to expand, how can physical material, image and text-based library techniques best be combined with the web and digital information to make it possible for colleges, public institutions and companies to keep a textile library resource up to date?

## **Keywords**

Textile design; materials library; design research; haptics; multimodal knowledge

## **Introduction**

The number of new developments in textiles and the availability of increasingly detailed and complex data and fabric samples has led the authors to undertake a reassessment of the nature, role, usage and format of the textile material library. Although the research

literature on textile libraries is sparse, there is a body of research into relevant attributes of these libraries and the paper discusses these. Examples of attributes include: haptics, human engagement, and the nature of libraries.

In considering the role of the textile library, this paper looks specifically at the material library as a research tool. The textile library typically achieves this through its provision of hands on and visual samples, as well as information on technical data, end use and certification. Hands-on samples and text or web-based libraries have much to offer and there is much to be gained by this combination of haptic and digital knowledge formats.

The multisensory experience is a feature in the understanding of materials in industry, museum curation and research locations. The textile industry uses samples alongside specification data. Museums typically combine written data in the form of catalogues and exhibition text with examples of textiles. In a more advanced experiential format, the Exploratorium in San Francisco's Tactile Dome sees visitors moving through a blacked out space using touch alone to heighten their experience by excluding others (Oppenheimer, 1972). This haptic approach is also supported by Jones (Jones, 2005), who notes the benefits of the haptic experience in acquiring tacit knowledge:

'Teachers often talk about the advantages of hands-on experiences in learning, yet the underlying mechanisms for hands-on experiences have not been fully researched. One aspect of haptic experience is active manipulation (as opposed to passive touch) that adds the elements of choice, control, and conscious movement that makes learning tasks more engaging and motivating to students.'

The importance of text and images for library documentation is clear if we consider the nature of textiles that are highly technical, advanced or smart (i.e.: responsive or interactive). In many of these cases, a physical sample alone does not reveal the complex nature of the textile: technological material advances emerging from research laboratories can be invisible to the eye. An example is with nanotechnology, in which materials and coatings are manipulated at a molecular level. The current early usage of nanotechnology for textiles is primarily as applied coatings to fabrics that are invisible to the eye. The growing significance of such developments for textiles is highlighted by the institute of nanotechnology (NANO, 2010):

‘As nanotechnology techniques and applications become more sophisticated, we are likely to see a whole new variety of textiles with integrated electronics, special self-cleaning abilities, resistance to fire, protection from ultraviolet light, and a range of other features. There is currently a huge amount of research and development being conducted across the globe from universities to global corporations to design and create the next generation textiles. Venture Development Corporation (VDC) estimates that consumption in the smart and interactive textiles market is today worth about US\$720 million.’

In the future it is anticipated that nanotechnology will be used to create and replicate whole new textile structures. For this reason it is the subject of much speculation and hypothesis, and can relate to advanced processes in addition to actual product, as described by Forrest (Forrest, 1995):

‘One envisioned result of the technology is a portable manufacturing system able to build a wide range of useful products to atomic specification, including a copy of itself. A system capable of building a copy of itself to atomic specification—as well as a wide range of other products from clothing to food to computers—would have important economic consequences.’

A textile library allows for knowledge to be acquired through multimodal learning and this draws on the dual coding principle where information is gathered and retained more effectively when accompanied by a visual image (Paivio, 1971). In dual coding verbal, or logogens and non-verbal, or imagens, units are used to provide alternative representation. The latter contains data that viewers can use to generate mental images and associations. The layering and connecting of these processes by the library user greatly extends their comprehension of the materials and their ability to utilize the information more effectively. One note of caution on the types of information and relationship between them is highlighted in the redundancy principle which ‘suggests that redundant material interferes with rather than facilitates learning....occurs when the same information is presented in multiple forms or is unnecessarily elaborated’ (Sweller, 2001).

Another aspect is the historical and contextual nature of a library itself. In his introduction to Treasures of the Library (Trinity College Library), Fox states that the library must perform two important functions. The first is to develop the institution and the second to ensure that once established, the collection should continue to grow (Fox, 1986).

Libraries are dynamic and can have their 'golden period' through times of launch, better funding, inspirational management, etc., but can also have fallow periods. New textiles are being developed very quickly and the constant introduction of new materials encourages a 'living laboratory' approach to library management, in which materials may be tried out with users, or made available for experimentation and projects. Some may also be withdrawn as manufacturers upgrade their products to new ranges.

The value afforded in bringing together a physical library of fabric samples with a digital database that includes multimedia components is of clear benefit for a comprehensive understanding of contemporary textiles, particularly those with a significant technical aspect.

Following a review of existing textile libraries, this paper looks at how a future textile library should be positioned – considering how physical material, image and text-based library techniques can best be combined with the web and digital information makes it possible for colleges, public institutions and companies to keep a textile library resource up to date economically.

## **Research Approach**

The research framework used by the authors had three stages. Firstly, a literature review of library attributes, multimodal knowledge in design research, and new directions for textiles. Secondly, case studies of significant textile materials libraries. And thirdly, using the first two stages in combination with personal experience and peer discussion to consider the requirements for a future textile library.

The authors undertook an examination of case studies to explore the critical duality and epistemology of user 'knowledge by acquaintance' and 'knowledge by description' (Russell, 1918) for a textile library. Within the textile library formats, acquaintance is very much through the haptic element, and description through written information; images,

digital interaction and film media are able to occupy either territory. The authors considered the effectiveness of the libraries' structures, users, and the user experience.

Four textile materials libraries were reviewed by the authors: three were commercial and one was at an academic institution. These were selected to explore and discuss the range of approaches and the rationale behind them. Issues such as commercial versus academic, the user needs, aims and objectives, geographical location all factor in the nature of each library in the case studies. The libraries are: Material ConneXion in New York; Materia in The Netherlands; Materials Library in London; TechnoTextiles at the University of Technology Sydney (UTS).

A period of critical reflection on these case studies, personal experience, and international peer discussion was used to inform the authors consideration of a future textile library and to ask the epistemological questions such as: what is the library's knowledge? How is the knowledge acquired? How do users then know what they know?

## **Case Studies**

Through the examination of four case studies, the challenges of providing multimodal information were explored, noting that the written text retains its strength in communicating data that cannot be seen or felt accurately by handling the textile – for example: provenance; textile composition; production methods; environmental and ethical criteria are provided by text. The difficulties inherent in an over-reliance on the internet are highlighted, where accuracy is questionable and verification necessary, although smart data links such as RSS (Rich Site Summary) feeds are very useful in allowing users to receive regular updates on new web content for specific sites. And in printed books, such as Technotextiles 2, the problem is keeping up with the pace of textile development. In the revised text Braddock Clarke explains how the intervening seven years have seen a profound change as many of the materials originally included were at prototype or research stage but have subsequently been developed to full production (Braddock Clarke, 2005).

While each library employs a multisensory experience, they do so in very different ways and to different effects. These case studies are covered below.

## **Case Study 1: Material ConneXion**

Material ConneXion ( <http://www.materialconnexion.com/> ) is the best known commercial materials library with a head office in New York and smaller libraries in Milan, Cologne, Bangkok and Daegu. While the library collects a wide range of materials, textiles feature strongly. It is the brainchild of George M. Beylerian and is designed for “.. busy design professionals and companies seeking to better their products could benefit from learning about the latest material innovations”. It began modestly but has expanded in structure and scope to meet the needs of its users.

### **Structure:**

The library began with a physical office and database where visitors joining the library for a fee could log in remotely or on site. Staff and consultants around the world researched and gathered information and materials, with material manufacturers invited to submit samples and data to the library. Each month these materials are put before a panel of experts with selected materials included in the library. This was and remains an important part of the process to maintain a high standard and wide range of materials. The library also provides a consulting service for users, a quarterly publication and a series of books with worldwide distribution. The remote user access to the materials database has now been extended so that lectures in the form of webinars (web-based seminar) are now routinely delivered.

### **User:**

The library set out to attract professional users and they remain in the majority. The reason is twofold. First, they are most able to afford the annual fee and secondly, they are of greatest interest to the designers and manufacturers donating information and data to the library. The library has now added a different business and access model for researchers in education, one that allows multiple and remote access to the library.

The intention at the outset was that users would access information about materials and



then contact the manufacturers direct to place orders (G. Baylerian, personal communication, September 19th, 2002). The concern of some companies was that their close competitors were also members and viewing exactly the same materials. This resulted in the use of the library by these companies predominantly for styling, trend and inspirational purposes (Anon. Reebok employee, March 7<sup>th</sup>, 2003). The consulting services offered by the library allows for a 'bespoke' research service that is tailored to the needs of the particular client and exclusive to them.

### **User Experience:**

The user experience is multimodal, in some instances by choice and in others (where dictated by geography) by necessity. Of Material ConneXion's distinguished client list, less than half are based in New York city, necessitating the need for remote access in addition to the physical library. The library must decide whether they will try to provide an online version of what is available on site, or to provide a different type of user experience. Moving images of material samples cannot directly replicate the sensory experience of handling, but what the online webcast can do is create a more interactive environment although it does have to be treated in a different way to live a lectures or seminar with wider implications for live presentations: "Video and live performances differ, not unlike spoken and written language. The video is on your permanent record, the lecture is here only for today. Might we see lecturing styles change to look better on the video, possibly to the detriment of the live performance?" (Wolff, 2011).

### **Case Study 2: Materia**

Materia (<http://www.materia.nl/> ) describes itself as "an organization of, for and by architects". Based in The Netherlands, the commercial materials library collects, records, analyses and disseminates information about materials for architecture, interiors and design. Each month a jury selects twenty new materials for its collection. It was set up by architect Els Zijlstra who is also the Creative Director. The library includes a wide range of materials with textiles and hybrid materials featuring strongly. The fact that it started with an architecture bias has given the collection a distinctive identity.

**Structure:**

The Inspiration Centre is the hub of the organization where its materials collection is stored and can be handled by visitors. The library also offers consultancy, newsletters, publications and presentations as well as having an online presence. The web site offers its material database free of charge to its 60,000 registered users worldwide. The library and online presence is supplemented with an annual Material Xperience themed exhibition and keynote lecture series with expected visitor numbers of 9,500 (E. Zijlstra personal communication, February 10<sup>th</sup>, 2011).

**User:**

Architects, interior designers and other design professionals are the primary users of the Materia Materials Library. They acknowledge the need to provide useful information to researchers in these areas in order to continue to update their collection. Manufacturers supplying samples and data are provided with statistics on the visitor profile and numbers to their material page. The themed Material Xperience allows the manufacturers and researchers in architecture and design to meet. This is especially important for the area of technical textiles where many of the materials are made to order according to the user's technical and aesthetic specification. In this instance, it can be said that both the manufacturer supplying the materials and the architect/design professional are both users.

**User Experience:**

The haptic experience for the user is given less emphasis than the optic in the form of the online written database and accompanying images. The difference afforded by haptic versus optic perception is that "While touch yields knowledge about impenetrability and depth, the eye rapidly yields a sense of extension, through height and width" (Hubert, 2011). For the online user, the image quality is extremely high to provide not just aesthetic qualities but also technical data that is reinforced by the reading of the accompanying specification text or caption. Barthes disputes the notion of a civilisation of image and believes it more accurate to refer to a civilisation of the written

word. His reasoning for this is that speech and the written word are in fact a civilisation of writing, which in the form of the caption can be present in the image (Barthes, 1986).

### **Case Study 3: The Materials Library**

The Materials Library (<http://www.materialslibrary.org.uk/> ) houses several thousand material specimens that include textiles as a resource, laboratory, studio and experiment area. It is based at Kings College London and is in the process of relocating to Somerset House where it will be incorporated into the Institute of Making. It was established and is run by a multidisciplinary group of three people: Martin Conreen, Zoe Laughlin and Mark Miodownik. Their backgrounds are in sculpture, materials and art/design, engineering and material science. The member organization engages in both “scientific research and artistic practices that explore the senso-aesthetics of materials”.

#### **Structure:**

The Materials Library is physically located in the heart of London as well as having an online presence. Interaction, collaboration, projects and workshops are largely dependent on live contact with results further disseminated online. It is geographically close to other organizations that it works with such as the Tate Modern and Victoria and Albert Museum. The approach to the materials themselves goes beyond the provision of visual, tactile (“senso-aesthetics”), composition and performance, and is driven by an innate curiosity as to how each material works and can be manipulated. The broadening of the area to the retitled Institute of Making reflects this philosophy.

#### **User:**

The users of The Materials Library are very broad, as their activities are directed to art and design audiences as well as to scientists, students and schoolchildren. Events in the form of workshops and lectures show a desire to encourage a deeper more sensory and intimate level of engagement with what are often highly scientific materials and processes. Titles for events run by the library include for example, ‘The Materials Science of Pleasure’ (2007),

## **User Experience:**

Although the library has a physical and online location, much of its public engagement is outside of the conventional library setting. One example is the 'Essence of Fluorescence' exhibit, which is a "cabinet of curiosities" exploring the nature of fluorescent and phosphorescent materials. It was shown at the Hayward Gallery, London to accompany a major retrospective exhibition of artist Dan Flavin's work that focuses on fluorescent light. Visitors were not allowed to touch the artist's sculpture but the cabinet allowed them to handle and experience the material, affording visitors a chance both to understand the technology and appreciate at a deeper level the visual and tactile aesthetics of both artwork and the material itself. Reviewing the exhibition, art critic Adrian Searle notes how "...the reflected light gets soft and scented" (Searle, 2006) in Flavin's work. This affords the material a synaesthetic affect where one sensory and/or cognitive perceptions trigger a second sensory and/or cognitive perception.

## **Case Study 4: The TechnoTextiles Library**

The TechnoTextiles Library is at the University of Technology Sydney (UTS). This is an experimental resource specifically aimed at tertiary researchers through user generated content.. It was set up by one of the paper's authors (O'Mahony) and is based on her own textile library built up over a period of fifteen years while she worked as a consultant in London. There are around one thousand advanced textiles in the library. The aim of the library is to provide first clients, and subsequently students, with materials that they could handle and gain a better understanding of weight, tactility, drape and visual characteristics. Specification sheets on the materials and other literature is available in the library with an online wiki site restricted to recording exhibitions and other events held at the library.

## **Structure:**

The TechnoTextile Library (<http://technotextilelibrary.wikispaces.com/>) is designed to encourage an interactive experience for students alongside the collation and assessment of data on the materials. A database is located on site with discussion currently under way as to whether to make this available online. One concern is that

it might discourage students from coming to the library to handle the actual materials if they feel they can get the data online. A rotating exhibition schedule is curated and includes both professional and student work to reflect some of the most innovative developments in advanced textiles. Where manufacturers are showing work they are invited to give a lecture or run a one-day seminar. The emphasis is on multi-disciplinary practice so that fabrics in the collection are used in applications such as medicine, clothing, architecture, sports and product design.

### **User:**

The users are from within the university and include staff, research and undergraduate students. Much of the use is project driven and for Fashion and Textile students it forms part of a course module in Year Three. Here the students use it as part of their lecture series on fibre, fabric and coating technologies in design before going on to set up their own materials database that inputs to the textile library. PhD and Design Masters students are based in the library using it as the centre for their own research.

### **User Experience:**

The multimodal approach allows users to experience the textiles at a number of levels, from a basic introduction to more in-depth self-directed research. Smart and responsive materials can be demonstrated and discussed and experience first hand, for instance the lightness of metal fabrics and the fact that banana fibres do not smell of the fruit. These facts can be communicated verbally or in writing but it is in experiencing them that engagement grows exponentially.

### **Discussion**

The users of the libraries differ greatly and the case studies have been specifically chosen to reflect this and allow for discussion on the differing challenges this brings. The term 'researcher' covers undergraduate and postgraduate students as well as professional designers, engineers, manufacturers, authors and the textile manufacturers themselves. Each of these researchers will have different demands and expectations

of the library. The user can be geographically remote from the library, which raises issues relating to the acquisition of tacit knowledge. In addition, the library must also have value for those who contribute to it. Unlike conventional book libraries, the material library does rely on the knowledge and generosity of those who produce the fabric to provide much of the content. While books and journals undergo an independent review and editing process, much of the information received from designers and manufacturers has not been verified in this way unless it has been issued with specific certification. The consequence of this is that it then falls to the librarian to perform the additional role of editor in the textile library.

All of these libraries are 'tethered' in the real world to a physical location, or to several locations for franchised libraries. They all make use of the web to complement the physicality, but not to replace it. This digital-physical relationship is, in the view of the authors, a pivot point with respect to examining the desirable attributes of future textile libraries.

### **Towards a future library**

The case studies collectively provide an insight into how current practice tackles the options available when creating a textile library. The authors extended the knowledge of 'best practice' into a consideration as to how a future library might be. This returned the research to the question: as the number of textiles available continues to expand, how can physical material, image and text-based library techniques best be combined with the web and digital information to make it possible for colleges, public institutions and companies to keep a textile library resource up to date, economically?

A hint at a possible direction for digitized textile libraries is given by Dillon, Moody, Bartlett, Scully, Morgan and James (Dillion, et al, 2001), in their investigation of the Logitech Wingman mouse with FEELit® technology, in which a Feedback Mouse allows you "feel" items shown on the screen as the cursor moves over them, who have explored:

"The interactive possibilities of fabrics within a virtual environment using a simple haptic device, a commercially viable computer [with].. the facility to set up some simple

mechanical variables to represent some of the more obvious tactile impressions in fabrics, e.g. denim for its overall roughness, and corduroy for its repetitive bumps.”

Although the Wingman Mouse is impressive, it is limited to a 1-dimensional tactile experience. This is mitigated to an extent by the possible integration with a 3D computer model, but the full range of tacit knowledge transfer is restricted.

In considering a future textile library, the authors returned again to the epistemological questions: what is the library’s knowledge? How is the knowledge acquired? How do users then know what they know? The authors considered that existing libraries and websites were already effective at communicating explicit knowledge: facts, figures and examples of use. Tacit knowledge also resides within physical samples that impact on all human senses – for a remote web library this is a substantial technical hurdle. But also challengingly, tacit knowledge resides among users’ experiences and expertise as well as in the library that is browsed. So the acquisition and sharing of knowledge between users becomes critical. In a remote context, the web is well suited to fostering communities where this can happen by using social networking, blog or wiki systems to set up dialogue, narrative, rhetoric, etc. This works better in many cases, or at least more continuously, than a physical context where users are less likely to ‘bump’ into each other except during organised events. Critical to the users knowing what they know is the use of feedback to test, challenge and reinforce their knowledge. Feedback may be by posting up their thoughts, or ideally through a dialogue with others to assist in self-awareness of new knowledge. There are already some specialist web-orientated libraries that are useful, such as Earth Pledge consulting’s embryonic sustainable library ( [www.earthpledge.org](http://www.earthpledge.org) ).

Bearing in mind the epistemology, to address both tacit and explicit knowledge transfer in the context of digital-physical hybridization of content, and on the basis of web-access, the authors of this paper consider the following attributes to be essential in the future: remote material ‘presence’; user contribution, authorship and editing; a knowledge pool or creative commons; and facilitation of project collaborations. These are outlined below.

### **Remote material ‘presence’**

The ability for users to fully explore physical materials without being present. It raises intriguing questions such as how users can 'file share' a physical object, and whether there is potential in combining with local rapid prototyping such as offered by Freedom of Creation ([www.freedomofcreation.com](http://www.freedomofcreation.com)) to 'magic up' the material, or to make use of virtual reality other advanced technological means of engaging with the senses.

### **User contribution, authorship and editing**

The ability of users to contribute, edit and shape the library. Adding their projects, editing entries, personal and project experience. Effectively a Wiki, blog or social network type approach.

### **Knowledge pool or creative commons**

Tapscott and Williams (Tapscott & Williams, 2010) see the wiki and open source software models as being the future in this area. They argue that this can work even in a commercial context, citing MIT's free availability of all course documentation online and IBM's open source project, where most information is free and some can be traded for other knowledge.

### **Facilitation of project collaborations**

Project collaboration is an excellent way of facilitating tacit and explicit knowledge exchanges. Web tools are making this possible now on a remote basis, and even involving very large numbers of contributors. Examples include IBM's Smarter Cities Program ([www.ibm.com/smarterplanet/us/en/smarter\\_cities/cities/index.html](http://www.ibm.com/smarterplanet/us/en/smarter_cities/cities/index.html)) and car design by local-motors ([www.local-motors.com](http://www.local-motors.com)).

The net effect of these additions is to steer a future library in the direction of remote, large scale collaborative working for research and applied projects. It offers the possibility of pooling knowledge across multiple locations with a creative commons (flexible copyright model where some elements are shared and others restricted).



## Conclusion

Experimental/hands on multimodal information approaches already exist that allow textile materials libraries to be comprehensive and accurate resources for researchers to draw upon. Innovative physical design and remote digital websites further enhance such libraries.

A multimodal library will offer the qualitative advantages of 'crosstalk' when the user is engaged with the content. In other words, the user's cognition will be complex when several sources of information are present. For example, tactility is not purely restricted to the haptic and it can be induced in a synaesthetic way, or otherwise achieve a cognitive understanding. For example, with painting; in his book "The senses of touch", Paterson (Patterson, 2007) refers to Bernhard Berenson's Florentine Painters of the Renaissance of 1896:

"The essential in the art of painting.. is somehow to stimulate our consciousness of tactile values, so that the picture shall have at least as much power as the object represented, to appeal to our tactile imagination."

Through reflection on their research, the authors' criteria for a future textile library emerged from seeking to answer epistemological questions, leading to the authors' derivation of the essential attributes that have been described in this paper for a future textile library, namely: remote material 'presence'; user contribution, authorship and editing; a knowledge pool or creative commons; and facilitation of project collaborations.

A subsequent stage in this research will be to take the findings and apply them to a textile library, studying the benefits to users through observation and feedback questionnaires. The results of this will be used to modify and rank the attributes put forward in this paper.

Whatever technology and methods are embraced, the main challenge for textile libraries is to work successfully in an 'untethered' format that harnesses the contributions of the users and works well remotely even if there is still a physical base.

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include TechnoTextiles, SportsTech, Cyborg – the Man-Machine, TechnoTextiles 2 and the forthcoming Advanced Textiles: Design for Wellness + Health, all with Thames and Hudson. Exhibitions curated include: Cyborg for the Stedelijk Museum in Amsterdam, The Fabric of Fashion an international touring exhibition for the British Council and TechnoThreads for Science Gallery, Trinity College, Dublin.

**Tom Barker**

Professor of Architecture, Innovation and Design, University of Technology Sydney  
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Tom Barker's interests revolve around collaborative multidisciplinary practice in architecture and design. His expertise includes: materials and technology, sustainable design and creative industry policy. He has researched extensively in these areas in a number of countries, as well as advised government and non-government agencies on art, design, sustainability and creative industries. From 2005-2009, while a professor and head of department of IDE at the Royal College of Art in London, he set up the GoGlobal collaborative international project research - running projects in China, Thailand, Japan and Ghana.