Compression Resist: Shibori, Clamp-resist, and Ikat 防染印花

'Itajime gasuri: digital warps'

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Itajime gasuri, Kyokechi, Board Clamping, Ikat, Digital Warps.

Abstract

Itajime gasuri is a Japanese resist technique, which today is almost extinct but was originally employed to patterned warp yarns by clamping them between two boards engraved in high relief. When the clamped bundle was then immersed in a dye-bath, the dye was unable to penetrate into the areas under pressure and the resulting dyed and finally woven cloth produced an ikat like pattern.

A process invented by Tomoshicihi Miura in 1837 to copy and increase production of the labor intensive textile dyeing technique ikat was re-discovered by the highly skilled Craftsman and Japanese weaver Norio Koyama, who in 1996 when visited in Japan was the only remaining craftsperson to still employ on a commercial level, the traditional process of *itajime gasuri*: the utilization of identically carved wooden boards to resist pattern fabrics. As a silk weaver, Norio Koyama, became interested in the process of *itajime gasuri* having purchased the last remaining full set of traditional clamping boards. Teaching himself the intricate and precise processes involved with the technique and required to produce lengths of fabric with patterns similar to double 'ikat'.

A present of eight old boards to the author enabled the technique to spread to Europe and has enabled further research to be carried out into the processes involved and along side advancements in digital technology provided an opportunity to reinvent the process by employing old or newly digitally machined boards to produce modern versions of such textiles, which when combined with digital technology in the form of image manipulation and digital printing both onto prepared fabric bases and warps prior to weaving has enabled the process to reinvent itself and design qualities achieved with such a technique evolve into a patterning method for the 21st Century.

The excitement occurs when a process invented by Tomoshicihi Miura in 1837 to copy and increase textile production of the resist dyeing technique ikat can be once again employed to create textile designs if new *Itajime gasuri* boards are created with digital manufacturing techniques and digital scanning along side digital printed will once woven produce an ikat effect: A complete cycle of creativity and innovation being achieved.

1. Introduction: Historical Context

The resist patterning technique *itajime* or clamped resist at its most basic level is quite simple and direct but at its highest levels of development required complex patterning and carving skills. As one of the rarest forms of resist patterning, clamp resists require neither the pastes or waxes of batik nor the bindings of tied and stitched resists, but instead relies upon the compression of folded cloth or yarn created by clamping the bundle between boards or sticks. (Hann, M & Wells, K. 2000) After dyeing nothing needs to be removed although the preparation of the traditional boards requires skill and labour, which was only justified by their durability and the ability to repeat the design again and again. The soft edged but ghostly images produced are found in no other resist or print media. According to Larson in the '*The Dyers Art, ikat, batik, plangi.'* (1976. p.77)

> 'Usually but not always, the motifs are negative in the shade of the un-dyed cloth; the one colour is that of the dyed ground. The exception being some older examples of this technique that were produced in three or four colours, often employing more than one set of blocks that required precise registration to achieve the effect.'

The Japanese term *itajime* literally means 'board clamping' (Wada, Y., Kellogg Rice, M. & Barton, J. 1983*) ita* (slab) and *shimi* or *jime* means clamp. This technique involves the process of folding cloth in two or more directions and clamping it between boards or sticks. In its simplest form the boards and sticks remain plain and the pattern that is created is caused by the penetration of dye into the exposed folds of cloth. In its more advanced form, thin wooden perforated boards or blocks, carved with identical patterns are employed, but not in the same manner as wood block printing, where the raised area takes the colour which is directly transferred to the surface of the cloth creating a 'positive' image. This technique utilises a 'negative' method where folded fabric is laid in-between two carved boards or blocks in which the design on each board matches the other precisely. During the dyeing process great pressure is applied to them through various clamping techniques, which prevents any dye penetrating the raised areas of the design. The dye instead seeps through the lower levels producing mirror image patterns on a dyed ground. (Leighton –White, S. 1994)

Buhler (1977) in his small book *'Clamp Resist Dyeing of Fabrics'* provided a complete record and discussion of the origins and diversity of this patterning technique throughout the world. In it he discusses the earlier Chinese term *Kyokechi* also used to define this technique, which is thought to have been in use during the T'ang period (618-906 AD). Most of the preserved fabrics found in Chinese

Turkistan and Japan (Shoso-in Treasure House in Nara) belong to this time, which as one of China's periodic cultural and political zeniths. The clamping techniques employed during this period can only be surmised by careful examination of surviving fabrics which are mostly made from cultivated silk, it appears that by folding the cloth in half or quarters produced symmetrical designs as many existing *kyokechi* appear to have been folded in this manner. By employing loosely woven or thin fabrics many layers could be clamped at a time, facilitating mass production. The only minor draw back with employing this technique seems to be that the area where the boards met was always reserved in white. A design problem that appears to have been more than compensated for by the ease with which the dyer could repeat large-scale designs in any number of colours. (Figures 1. & 2.) (Bühler, A & Fischer, E. 1977)

Figure 1: Silk fabric patterned with *Kyokechi Clamping Boards.* Japan Nara Period (Bühler, A & Eberhard F. 1977. p.114)

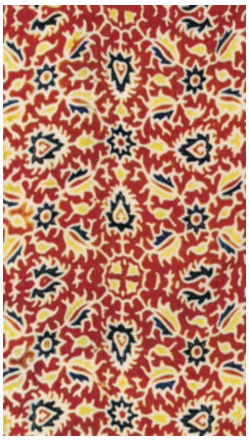

Figure 2: Clamped Silk Lining of a Chinese Bedspread. Origins thought to be Indian c15020 (Bühler, A & Eberhard F. 1977. p.118)

From China, clamped resists spread to Japan, Central Asia and even Europe where they are likely to have been produced locally under Chinese influence. In Japan, patterned textiles employing this technique gradually declined during the Heian period (794-1185 AD), the reason for which is uncertain. The carved boards were difficult to make but no more than the stencils employed in the *katazome* technique. It is more likely that changes in fashion with a rejection of things Chinese and the replacement of the complex woven and dyed fabrics with solid coloured cloths led to its demise. (Leighton–White, S. 1994) The process of clamped resists degenerated and then vanished only to reappear during the 19th Century in a simplified and slightly altered form known as *itajime.* The clamped resists in Japan are thought to have been revived or reinvented in 1837 by Tomoshicihi Miura in Yamato near Nara, and were used to resist dye warp and weft threads. (Leighton–White, S. 1994) The process became known as *itajime gasuri* (kasuri, gasuri means an ikat like pattern). With this technique yarns were passed between a series of boards engraved in high relief and, when immersed in a dye-bath, the dye was unable to penetrate to the areas under pressure. (Anon, 1967) By 1958 this technique, in turn, was almost extinct. At the time carved itajime boards were still being employed to dye silk fabrics with red and white designs, to be used as kimono linings and innerwear but it is thought that further development through the simplification of the patterning technique did not fully happen until the advent of synthetic dyes. The main explanation for this is being the observation that natural indigo will not penetrate well through the large amounts of folded fabric necessary for this method of patterning but chemical dyes do, bleeding into soft beautiful shapes.

In Europe with the onset of the industrial revolution, during the latter half of the 18th and early 19th Centuries, patterning machines that applied this basic principle were developed to increase production and aid the mechanisation of many hand processes. One technique allied to *Kyokechi* was the Golgas method, named after a German printer working in Normandy in 1762. The machine known as a Gallegas employed identical matching engraved wooden boards to dye flannel under pressure with a variety of colours at once. Dye was often mixed with a mordant prior to being applied to the plates where each colour had its own channels in which to run to the clamped fabric. The resulting design tended to have blurred outlines. (Robinson, S. 1969) Another was invented in 1802 by the Scotsman Monteith, in an attempt to copy the red and white spotted bandannas exported from India that were so popular at the time. He developed a technique of destroying the red dye (Turkey red), back to the base white thus creating white patterns on a red ground. For this madder dyed cotton was layered between two identical cast lead plates, both of which were perforated with the same pattern, this was the birth of the bandana handkerchief. (Storey, J. 1985)

2. Traditional Materials and Methods

Historically *Itajime* or older technique of *kyokechi* was created using carved boards or blocks. They vary in size but those that still survive from Japan are normally found to be one of three common forms; all are rectangular slabs between 27- 47 cm long and 22cm wide and no more than 1cm thick. They are made out of a hard wood that does not warp and has usually been lacquered to prevent dye penetrating the wood. Some are carved on both sides, some only on one (which necessitates twice the number of boards). Some have no carving on the edges, which gives a characteristic line of plain dyed fabric from the space created between the two boards. Others have carved edges, or were dyed with a separate edge piece added. Each board is carved on one side with a mirror image of pattern

that exactly matches the carving on another board thus acting as a pair, in the areas of carving; holes are drilled through the boards facilitating the passage of the dye to the clamped fabric held between the boards. The design tended to be carved out of the boards creating a coloured design on a white background once the fabric was dyed the dye solution passing through holes in the motif areas; the opposite, in which a white design is created on a coloured background, is produced using two boards in which only one of the pair is carved, the other remains smooth. The fabric to be patterned is carefully laid out on the smooth board and the relief board laid on top and firmly clamped. Dye (mostly blue, indigo) was then poured along grooves on the outer surface and through holes in the carved upper board. After sometime the boards are turned over so that any superfluous dye can run off. (Wells, K. 1998) (Figure 3.)

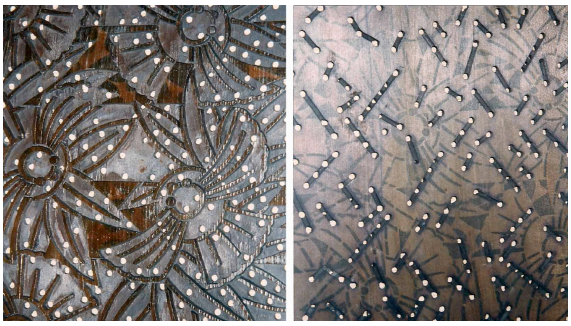

Figure 3: Front and Back of old *Itajime* (Carved Clamping Boards) in Japan 1996. The Shigeki Fukumoto Collection September 1996.
(Wells, K. 1996)

Traditionally the fabric that was to be patterned was folded three or four times, depending upon its thickness, before clamping between single pairs of boards or blocks. Thus mirror image patterns of considerable complexity were created once the fabric had been dyed and unfolded. If a design of more than one colour were to be created, the fabric would remain folded after the first dyeing procedure and would then be re-clamped using a different set of boards. This would be repeated with other boards if more colours were required. The use of different boards one after another was possible without great risk as the designs covered a large area and motifs would often run into each other. It does however require great care. Single pairs of boards are normally employed along the length of a cloth but with the technique of *itajime gasuri* (the clamping of warp and weft threads*)* the boards were carved in series, on both sides, thus requiring a stack of up to a hundred boards for one design. The pattern would often alter from the face to the back of the board creating a larger repeat in the finished fabric. Two diagonal and a third perpendicular registration grooves are often found on the edges to assist in accurate alignment of the boards. A series of boards would start with these diagonal grooves at the outer edge on the first board of the series, which would slowly move inwards as the stack of boards grew, forming a triangle once all the boards were in the correct position and fully aligned.
The designs carved into the boards for this technique are at their simplest a series of groves and ridges cut across the width of the boards that create a series of stripes on the cloth when dyed.

2.1 Case study: Itajime from Kimono to Couture
As a technique, *itajime* is no longer employed industrially with the exception of the Japanese craftsman, Norio Koyama, who in 1996 when visited by the author was the only remaining craftsperson in Japan to employ the traditional process of *itajime gasuri* (the utilisation of identically carved wooden boards to resist pattern fabrics) on a commercial level. As a silk weaver, Norio Koyama, became interested in the process of *itajime gasuri* having purchased the last remaining full set of traditional clamping boards. Teaching himself the intricate and precise processes involved with this type of resist patterning; the arrangement and dyeing of warp and weft threads and the precise weaving required to produce lengths of fabric with patterns similar to double 'ikat'. The silk fabrics he created using this patterning method were used to produce traditional kimonos in which he gained recognition for the fine craftsmanship and skills involved in their dyeing and weaving. Under the encouragement of a personal friend, the fashion designer Issey Miyake, Koyama started to experiment using pre-woven fabrics instead of yarn with the striped carved boards designed for *itajime gasuri.* (Figure 4)

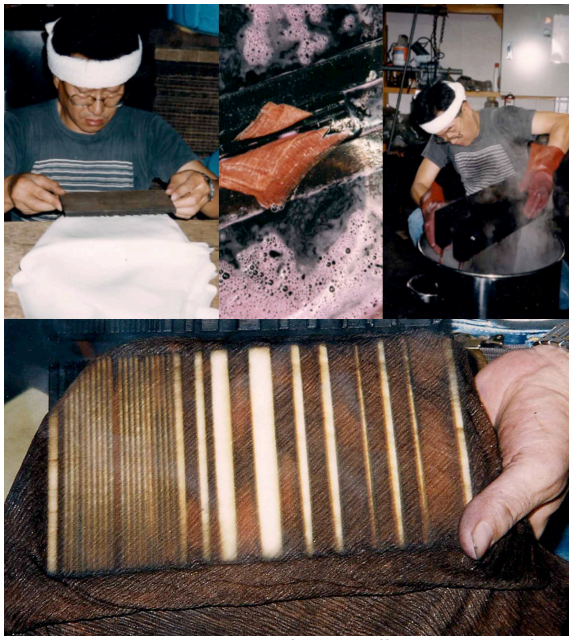

Figure 4: Norio Koyama dyeing silk organza with *itajime gasuri* (Carved Clamping Boards) in 1996. (Wells, K.1996)

He discovered that woven fabrics would absorb the dye in a different manner producing striped designs across the width of the cloth, if the fabric was pleated or folded, different effects could produced quite quickly.

Koyama no longer produces the traditional *itajime gasuri* fabrics used in the creation of unique silk kimonos. This is due mainly to the slow speed and time needed in the dyeing and weaving of the patterned threads. By 1996 he had dismantled his loom and only produced designs onto cloth. By using pre-woven fabric he is constantly re-inventing ways to employ the carved boards he has, although he does have new patterns cut, the cost and skills involved prohibits rapid change in design and denies the flexibility found with other shibori processes. A new set of boards were very expensive to have carved and would only be commercially viable if he had a large enough order to warrant the expense. The boards and clamped cloth are extremely heavy and special lifting mechanisms are required to hoist the clamped boards into and out of the dye bath. In this case the whole pile of boards and fabric are totally submerged in the dye bath or placed under a spraying mechanism, unlike the previous methods where dye was poured through holes and groves in the top board. (Wells, K. 1998) (Figure 5)

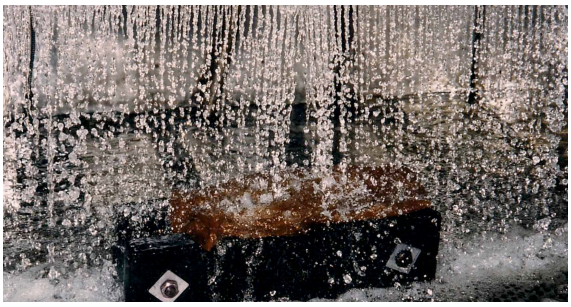

Figure 5: Dye spraying mechanism at Norio Koyama workshop in Japan in 1996. (Wells, K. 1996)

2.2 Developments of the technique

In 1996 the Japanese designer Norio Koyama made a gift of eight boards to the author, (Figure 6.) this has ensured that the knowledge of such an ancient technique continued to be developed as a resist patterning technique into the 21st Century. These boards formed a major contribution to the PhD 'Resist patterning for Contemporary Fabrics' and were employed for the production of unique resist patterned design work as part of this research degree.

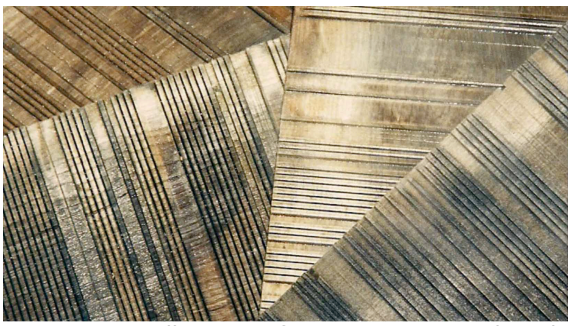

Figure 6: Collection of *Itajime gasuri* boards presented as a gift to Kate Wells (Wells, K. 1996)

The old *Itajime gasuri* boards, originally utilised to dye the warp and weft of fabrics, were employed with a fine silk organza cloth. The cloth was normally folded in half, thirds or quarters down its length to the width of the board. It was then placed between the boards in a continuous zigzag until the total length is placed between the boards. This technique produced a length of cloth with horizontal stripes across its width. But by folding the fabric in different directions geometric patterns were created, the varying thicknesses of cloth caused by the folds created variation in the pressure exerted by the boards producing a design of differing intensities of pattern and depth of colour. (Figure 7) [9]

Figure 7: Design work of Dr Kate Wells for her PhD 'Resist Patterning for Contemporary Fabrics' 1998. (Wells, K. 1998)

3. Advancements and Developments using Computer Aided Design Processes.

3.1 Advancements in the Technique Digital Creation of Boards

With advancements in digital technology and CAM (Computer Aided Manufacture) new life could be brought to such an old resist patterning technique. These technologies can be employed to create precision clamping boards that have absolute accuracy in the matching of pairs and can be carved in a matter of hours rather than days. Laser cutting and CNC woodworking machines combined with vector digital software provides the opportunities to bring such an ancient technique into the 21st Century. Such technology can be used to accurately cut marine plywood, medium density fibreboard (MDF), acrylic sheet and Perspex that can then be used as clamping boards. (Wells, K. 2013) (Figure 8) One of the main drawback is that the plywood and MDF composites that are readily available and are easy to digitally cut, do not retain the stability properties of the slabs of wood that were originally employed with the technique. The glues that are employed in their construction can cause problems with the laser cutting process thus limiting the selection of materials to ones that do not possess the water resistant properties required for hot submersion dyeing and acrylic sheet and Perspex will often distort with the heat of the bath. (Wells, K. 2013)

Figure 8: Collection of digitally created clamping Boards: Jo Newton, University of Derby. 2013 (Wells, K. 2013)

If replaced by cold dyeing such as an indigo vat, the dyes do not saturate the fabric between the clamping boards to the same extent as dyeing for longer periods with synthetic dyes as the short period of time this class of dye requires to colour the fabric does not enable full penetration of dyestuff into the folds of material. To create successful patterning better results have always been achieved with hot dye processing.

3.2 Advancements in the Technique with Digital Coping of Resist Dyed Fabrics.

With an ever increasing demand from the consumer within the textile retail industries; in both the fashion and interior markets, for greater lengths of cloth to be produced, new digital technologies such as scanning and image manipulation through the use of affordable software such Abode Photoshop and Illustrator has led textile print manufacturers and designers to employ such technologies as a method of increasing the availability of textiles that give the impression of being handcrafted.

Wide ranges of fabric bases are now manufactured for digitally printing and the technology has improved with faster printing speeds and colour matching from screen to cloth. Every textile/fashion course at Universities and Colleges now have the capacity to digital print designs that in the past would have been hand crafted. (Figure 9)

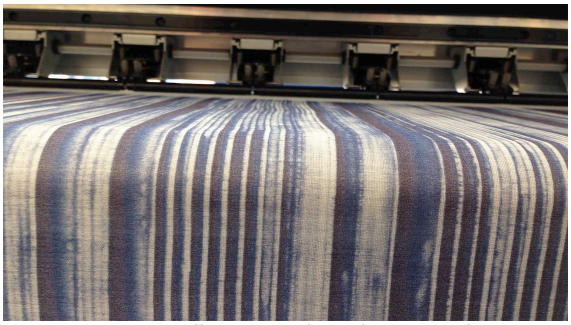

Figure 9: Digitally Printed Indigo Dyed *Itajime gasuri.* Dr Kate Wells (Wells, K. 2014)

But this technology will not replace the aesthetic qualities of a fabric created by resist dyeing.
The use of digital software with so many tools, filters and simple repeating methods such as 'double-mirror repeat' often causes over working of a scanned design. The success of translation from the actual resist dyed fabric to its digital representation requires digital photographing or scanning, CAD manipulation and finally printing, each stage reducing the resolution of the image and quality of the pattern. Often designs become so overworked that the initial qualities of a dyed fabric is totally lost and flattened.

Digital fabric printing technologies create their own problems such as lack of colour depth, colour matching and balance and dye penetration through to the fabric to the back. The majority of digitally printed fabrics become one faced with imagery on the front surface only and appear flat with little depth and do not reflect the colour nuances resist dyeing creates within the fibers and interior of the cloth.

3.3 Advancements in the technique with Digital Printed Warps.

Innovative advances in digital technologies led by a small traditional Textile Printer: Paul Turnbull Prints that still create fabrics that employ the skill and handcraft of Block, Screen but push the boundaries of digital technologies to deliver the qualities often missing in digital printed textiles.
In their Thailand factory the company have become a world leader in developing methods of digitally printing natural fibre warps that once hand woven begin to reflect the softness of *Ikat* in a very contemporary way. (Figure 10)

Figure 10: Paul Turnbull Prints. Digitally Printed Warp for Exhibition. Re-Inventing Linen. Belfast. (Belford, T. 2007)

3.4 Case Study: From Itajime Gasuri to Digital Ikat.

The Author working closely with Paul Turnbull Prints after having visited their factory in 2013 created a series of resist patterned fabrics using old *Itajime gasuri* Boards and Indigo dyeing methods. (Figure 11)
The resulting designs were scanned then manipulated in Photoshop and other digital software to create an image that could be successfully digitally printed onto a warp. Following various design alterations, some to clear away unwanted 'moiré' patterning and others to maintain some of the feel of the original resist dyed textile, a final design was agreed upon to be printed onto a linen warp with a silk viscose weft to be woven through. (Figure 12)

Figure 11: Indigo Dyed *Itajime gasuri.* Dr Kate Wells. 2014. (Wells, K. 2014)

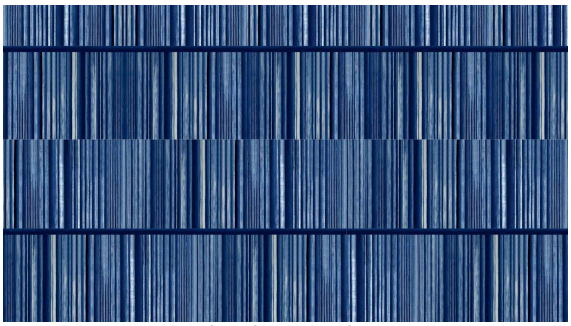

Figure 12: Digitized Indigo Dyed *Itajime gasuri.* Dr Kate Wells. 2014. (Wells, K. 2014)

The final results woven results at time of writing were unavailable but previous board clamping images and other shibori patterning that have been produced in this manner but were originally dyed with acid dyes. These demonstrate that the use of digitally printing warp as a new technique provides a new dimension to a very old process. (Figure 13) Paul Turnbull Prints go further than using digital technology to mimic the traditional, but look at the soul of the handicraft to create new and exciting hybrid textiles.

Figure 13: Digitized Acid Dyed *Itajime gasuri.* Dr Kate Wells. 2007. (Wells, K. 2007)

The excitement occurs when a process initially invented in 1837 to copy and increase production of the labor intensive textile resist dyeing technique ikat can be once again employed to create designs that if digitally printed onto a warp will once woven produce a ikat effect that can be repeated infinitely due to advancements of digital technology: A complete cycle of creativity and innovation being achieved.

4. Discussions and Summary

Across the world the ancient technique of *Itajime* board clamping, as a patterning technique for silk fabric has been constantly invented and reinvented, but over the last few centuries its use has declined to almost extinction. The history and origins of the technique is an enigma as there are examples in Japan that date from the 8th Century but subsequent examples are very scarce until a re-appearance of the technique in Japan in the 19th Century. Since then the use of clamping boards as a patterning technique continued to be employed in a very limited way by highly skilled designers and craftspeople but the employment of patterned and carved boards was superseded in most cases by stencil and screen-printing techniques.

Today with the advances in laser cutting and CNC woodworking there is scope for its reinvention and revival. These machines can be employed to replace the woodcarvers' skill that was once needed for the creation of matching wooded plates, whereas the process of coloration returns back to the hand of the dyer. It is a case of technology meets hand, to create uniquely patterned one-off fabrics. Groups or pairs of precision cut clamping boards made to fit perfectly together unite with the dyeing process creating a randomness that allows variability and creativity within the technique, imparting a uniqueness within the final silk fabrics produced. But complete success relies upon the material that is employed to construct the clamping boards and the thickness of fabric used as the process work best with fine fabric that can be folded into layers for this reason fine silk fabric was traditionally employed for such a patterning technique which, could produce lengths of patterned textiles large enough to create a decorative panel or Kimono with each length produced being similar but unique in its own right depending upon the skill of the dyer.

It is difficult to know if this technique will continue to evolve and develop as a resist patterning process or simply disappear as it has done in the past. As a patterning technique it was used for relatively fast mass production of designs and in the future may be employed again but on a limited scale for the production of unique one-off pieces of resist dyed fabric that are almost identical yet still different.

I*tajime gasuri*. (Kasuri or gasuri means an ikat like pattern), a Japanese technique, which today is almost vanished, was employed to traditionally patterned warp and weft yarns by clamping them between a series of boards engraved in high relief. When the clamped bundle was immersed in a dye-bath, the dye was unable to penetrate to the areas under pressure and the resulting woven cloth produced an ikat like pattern.

By employing digital technology in the form of scanning, digital image manipulation to copy fabrics that have been produced by *Itajime* and other shibori techniques along side other textile digital printing technology both on prepared fabric bases and warps prior to weaving enables the process and

design qualities achieved to evolve into a patterning technique for the 21st Century.

But excess usage of these digital techniques such as image manipulation, tools and filters can take away from the uniqueness of the patterning created by shibori resist dyeing processes. Digital fabric printing technologies create their own problems such as lack of colour depth, colour matching and balance; and dye penetration through the fabric to the back the majority of digitally printed fabrics become one faced and do not reflect the depth of colour resist dyeing creates.

Digital Processes are facilitating the revival rather than the survival of the handmade process and the excitement occurs when a process initially invented in 1837 to copy and increase production of the labor intensive textile resist dyeing technique ikat can be once again employed to create designs that if digitally printed onto a warp will once woven produce a ikat effect that can be repeated infinitely due to advancements of digital technology: A complete cycle of creativity and innovation being achieved. A case of technology unites with the haptic, to create uniquely patterned fabrics and summarized by the quote from Junichi Arai at the International Shibori Symposium in India in 1998.

'What use is high technology if you do not know the soul of the Craft.'

5. Acknowledgements

Norio Koyama, the Japanese textile artist, who gifted eight *itajime gasuri* boards to the author in 1996, which has enabled the technique to be developed further and evolve.

Shigeki Fukumoto, a collector of traditional and historic textiles and artifacts that allowed the author access to his collection of old *kyokechi and itajime* boards in 1996.

Ken-ichi Utsuki, indigo and shibori artist who explained the technique and process of board clamping in 1996.

University of Derby for funding the research in this field.

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7. Author

Dr Kate Wells: Designer, author and educationalist is considered an expert in the fields of textile coloration, design and technology; presenting and exhibiting her design research on an international platform.
In 2010, Kate was awarded the prestigious Society of Dyers and Colourists 'Silver Medal' for prolonged valuable contributions to education in the area of coloration and since then has held the positions of Trustee for the Society of Dyers and Colourists and the Textile Institute.
With over thirty years teaching experience within the United Kingdom which includes working for ten years at the Royal College of Art, Dr Kate Wells is currently employed as a Senior Lecturer in Fashion and Textile Design at the University of Derby. As an active researcher specializing in shibori and coloration processes Kate believes in 'Haptic Textiles' and 'Digital Craft' researching into ethical production methods combining natural dyes with sustainable and recycled sourcing.