



Training module: FINISHING, PRINTING and FUNCTIONALIZATION
Course: Basic Principles of Textile Printing

The course is developed under Erasmus+ Program Key Action 2:
Cooperation for innovation and the exchange of good practices Knowledge Alliance

ICT IN TEXTILE AND CLOTHING HIGHER EDUCATION AND BUSINESS

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Topic 1: INTRODUCTION with a brief HISTORICAL OVERVIEW

- Historical aspects, early from up to date development, current position, future aspects



- ✓ Short historical overview of textile printing technology and machinery
- ✓ Early development of techniques that preceded rotary printing
- ✓ Introduction of flat screen printing to industrial production
- ✓ The most significant development milestones that were reflected in the development of textile printing (e.g. synthetic fiber development)



FROM / TO





□ INTRODUCTION

- Textile printing is the dominant technology in the design and production of patterned textiles, and although it is based on the exact sciences of physics, chemistry and mechanics, it cannot actually be defined as technology alone. Textile printing is a kind of industrial art that, on the one hand, requires an engineering and technological, and on the other hand an artistic approach. Analytically, it is a process of unifying creative ideas (patterns, designs), colours/dyes (one or more) and textile materials, using dyeing techniques on textile materials but in the given contours of the pattern and with high precision. The print success depends not only on the correct choice of material and the choice of appropriate printing techniques in terms of the material and the given pattern, but it requires a whole range of personal and professional skills of technologists.

Textile printing machinery can be compared with musical instruments:

The success of the results varies equally the quality of the instrument as well as the skill of the one who plays!



- ❑ In this course, the basic exact aspects of textile printing will be explained, but it should be borne in mind that in textile printing, whether there are conventional or digital technologies, there are a number of experiential parameters that require skill, which is acquired through practice. Even in modern industrial processes, fully automated and based on information technology, certain phases of the process require experiential knowledge and skills of staff. In textile printing, the interaction between dye or pigment and textile substrate is so complex that even the slightest change in the physical, mechanical, structural or raw material characteristics can lead to significant changes in colour reproduction and print quality. Textile printing requires a multidisciplinary approach.
- ❑ Understanding and application of textile printing requires knowledge and skills from several fields (textile technology, rheology, chemistry, physics, mechanical engineering), but also the ability of wider approach and understanding of artistic, aesthetic and creative components of textile printing. The printer must be well acquainted with materials, their dyeing as well as physical and mechanical properties, must also know the principles of interaction between dyes and textiles, must know the technological limitations of conventional printing technology to communicate with the design team intervention and design adaptation.



- Printing can be most simply defined as local dyeing of textile material in the given contours of the pattern. The difference between dyeing and printing is that instead of uniformed colouring of the whole surface of the substrate in case of dyeing process, by printing, a colour is applied only to the target areas, thus introducing various colours, patterns, and designs to the textile fabrics. Also, the difference is in one phase of the process, which can best be shown by the scheme on Figure 1.

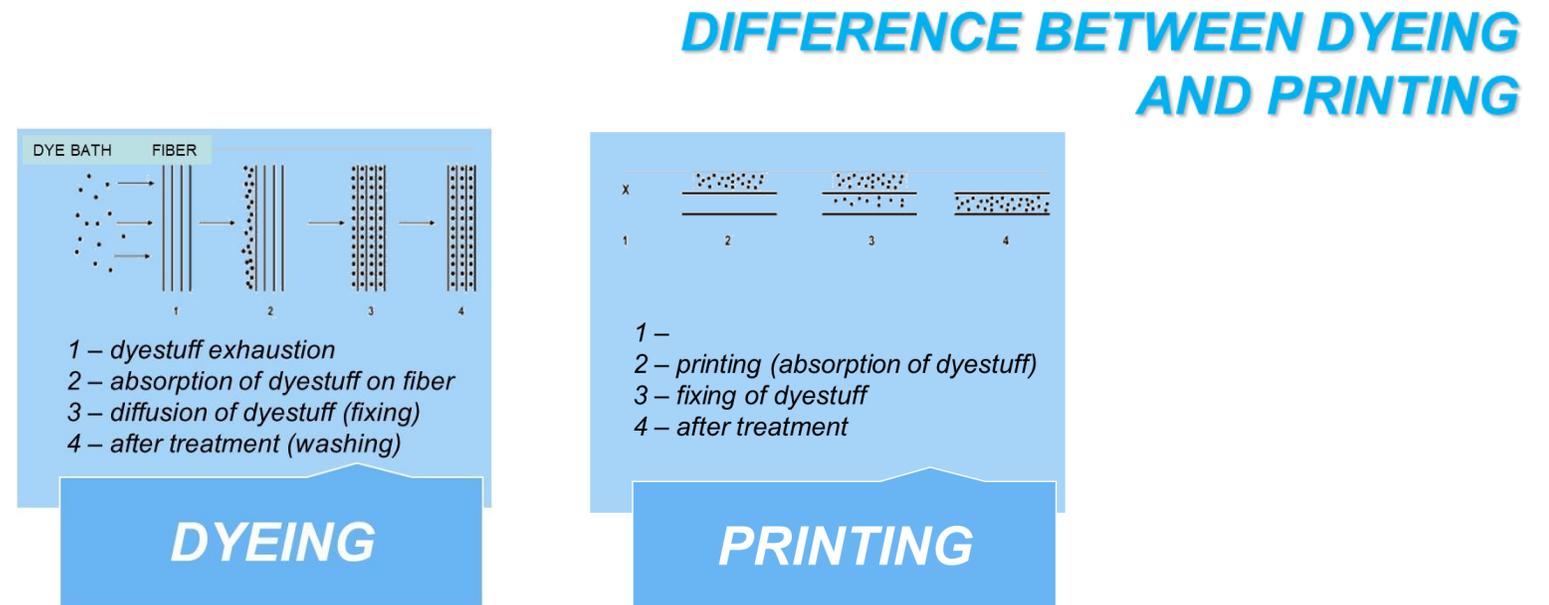


Figure 1: Difference between dyeing and printing



❑ PRINTING TECHNIQUES DEVELOPMENT IN EUROPE

- ❑ The need to decorate clothing, space and objects that surround us, and the need to look at the beauty of nature in wearable objects and clothing, appears very early in history. From the time before history, man has the need to add color to the world around himself, his environment, his living, the clothes he wears.
- ❑ **2000 BC.** It is believed that the earliest forms of decorating textiles have developed in some type of printing in India. The findings refer to the domestic production of printed textile materials in India during 2000 BC. Also, there is evidence of very early use of printing and decorating textile printing in China and Japan.
- ❑ **The oldest printing technique** was using **blocks** with raised printing surfaces, which is covered by paint and then pressed on to the fabric. By repetition, the image from a single block builds up into a complete design. The earliest blocks were made of clay or from wood.

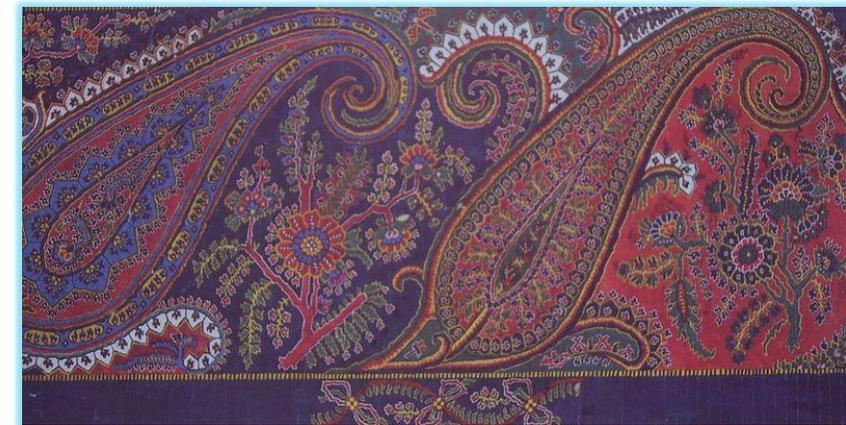


Wood block for textile printing



Wooden blocks and wood block printing

- ❑ **The earliest finds of wooden blocks** are from ancient Egypt, found in tombs near the ancient city of Panopolis. Specimens of printed fabric from the same time and location were also found. By the 14th century, wooden block printing was established in France, Germany and Italy, although most of the printed textiles, until the 17th century, were imported from India by Portuguese sailors and traders.

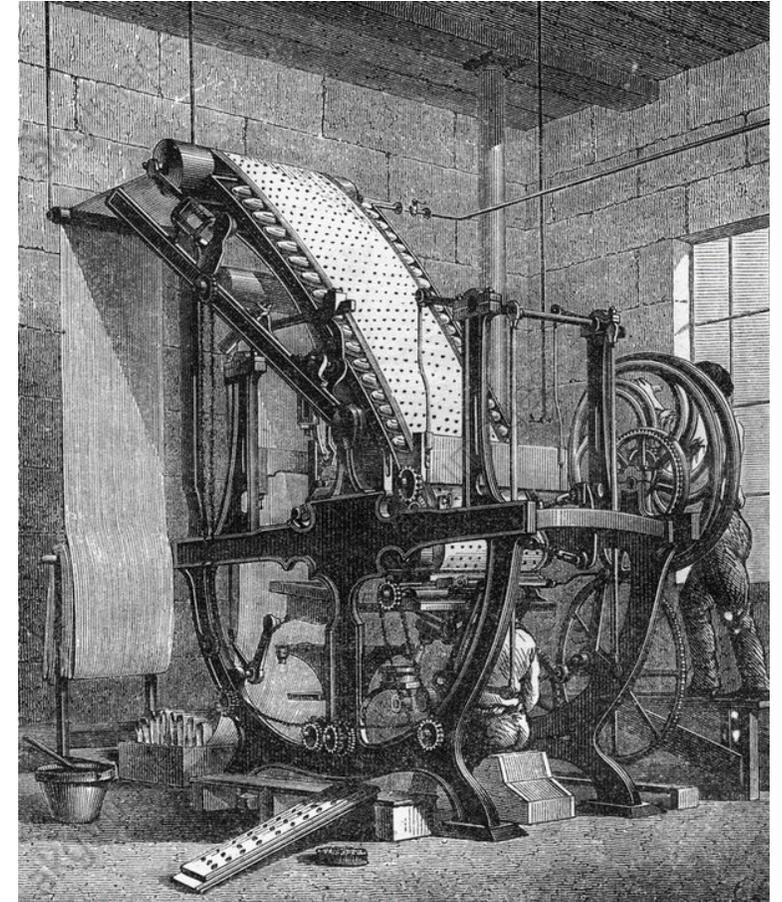


Paisley printed design from India, imported to Europe during the 17th century, which became extremely popular during the 18th century. ⁷

- ❑ Another printing technique that developed in Europe between the 15th and 18th centuries was the technique of printing on **engraved copper plates**. In the 15th century, the development of the technique of printing with engraved copper plates for reproducing images, on paper, began. The Irishman Francis Nixon, during the middle of the 18th century, came up with the idea of **how to adapt the existing into textile printing technique**. The technique is called *Intaligo*, and **is considered one of the most significant innovations of the 18th century providing a vital step towards a machine-based industry**.
- ❑ **Printing with engraved copper plates did not displace printing with wooden blocks**, because, despite the possibility of printing more demanding patterns, there was a problem of moving the textile, which caused errors in fitting the effects. **This difficulty spurred an innovative way of thinking and the idea of turning a copper plate into a copper cylinder was born, thus beginning the history of the development of rotary continuous printing**.
- ❑ **1783** - Scotsman **Thomas Bell** patents a roller textile printing machine with engraved copper cylinders. By 1840, as many as 435 such machines had been put into operation in England alone. The invention marked a significant increase in the production speed, which over time caused the complete declining of the printing technique with wooden blocks.



- ❑ Rotary printing with engraved copper cylinders was highly economical for mass production of larger quantities of printed textiles, but for smaller production volumes and for individualized design, the technique was too complicated and too expensive. For such, smaller, individualized series, the technique of printing with wooden blocks remained for some time, but slowly during the 17th century a different approach began to be adopted, based on the ancient Japanese **stencil technique**.
- ❑ Based on the Japanese technique in which stencil parts were tied to human hair, **in Lyon, in 1850**, silk gauze was first used as a supporting stencil base. The technique soon became known as **screen printing**.
- ❑ In 1834, although engraving copper rollers were already widely developed at the time, **Louis-Jerome Perrot** patented a **wooden block printing machine**, which achieved relatively limited success. The machine was able to print three colors simultaneously with a maximum repeat of only 15 cm. The technique was named ***Perrotine printing***.



Perrotine printing machine

- ❑ The development of silk screening as a modern, highly productive, industrial method for the production of patterned textiles takes place alongside the progress of printing screens fabrication. Precise reproduction of the desired design with silk screen requires a stable screen first. At the beginning of development, natural materials such as cellulose materials (cotton, viscose, cellulose diacetate) or silk, which are characterized by high hydrophilicity, were used to make meshes or screens. This caused significant absorption of water from the printing presses, resulting in stretch and deformation of the template, and thus of the sample being printed.
- ❑ **Wallace Charoters** (Du Pont - 1930s), synthesizes the first PA fiber commercially named Nylon, which marked the revolution in the textile industry itself as well as in the development of screen printing techniques. The use of hydrophobic synthetic fibers for the fabrication of screen meshes made it possible to produce dimensionally stable, non-absorbent high-strength screens, which can be fastened to wood or today's metal frames under precisely defined rigidity and uniform tension without any change in tension under the influence of water contained in printing paste (for pastes on water bases).
- ❑ The use of synthetic meshes and metal frames enabled the mechanization of the textile printing technique, which in the 50^s of the 20th century became fully automated. At the later stage of development, rotating screens are introduced, which further improves the automated method of textile screen printing.
- ❑ **60^s of 20th century till today** – development of various digital techniques of textile printing.

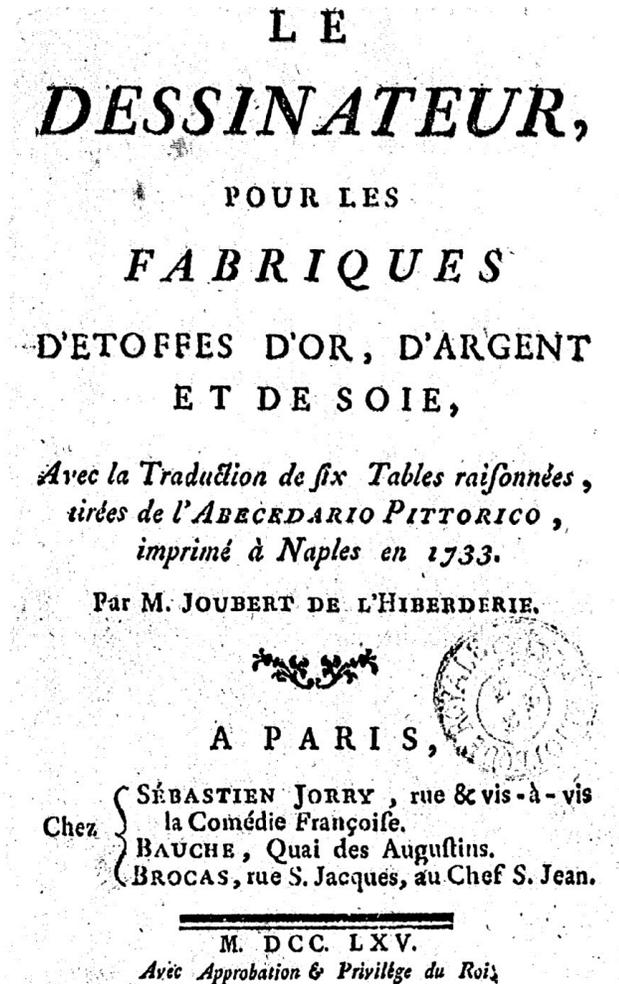


❑ HISTORICALLY IMPORTANT STYLES AND DESIGN

- ❑ The importance of printing in the commerce of Europe was very significant in the 18th century and the growth of the textile industry was clearly stimulated by the demand for prints. It should be noted that, for example, in the UK, before the development of spinning technology, a printing factory was already established, employing more than 100 workers in each unit.
- ❑ In the textile printing, the term ***applied art*** comes to its fullest expression. Throughout history, art and design were integral parts of textile printing, and along with the development of technology and various textile printing methods, the development of textile design can also be followed.
- ❑ Prior to the development of self-contained printing production in Europe, printed materials were imported from Asian countries and popular pattern styles were dictated by these. The first to bring samples of printed cloth from the Asian world, primarily from India, were sailors and merchants. They are also considered connoisseurs of the ideas of textile printing on Europe, which begins in the second half of the 17th century.
- ❑ Soon, with the development of printing technology in Europe and the opening of textile printing production facilities, an activity that we can call the foremost design is developed. Initially, the production of printed cloth in Europe was made to reproduce original patterns imported from India.



- ❑ After the end of the 17th and the first half of the 18th century, every manufactured fabrication of printed fabrics (France, England, Germany, Italy) is developing its original design direction, within the current fashion trends.
- ❑ But it is still not possible to talk about the independent profession of a textile designer. Namely, the leaders of production in printing manufactories were at first also "designers", and there is still no separate, artistic profession of a designer who would develop style and be separate from technologists - printers.
- ❑ Designing textiles, or finishing and decorating textiles with painted or printed patterns is almost as old as textiles. But there are no records and available written information about textile designers until the 17th century. The first book on textile design was issued in the early 16th century, and it was a sample book.
- ❑ The **first book on textile designers** was written by **Joubert de l'Hiberderie** and was issued in the **early 18th century**. **Textile design becomes a legitimate profession with the industrialization of textile production** (transition from the 18th to the 19th century). According to Joubert de l'Hiberdeire, a textile designer is not just an artist who possesses a peculiar talent, but also possesses the knowledge and ability to guide the entire process from the idea to the realization.



□ „CALICO” printing

- The first printed cloths imported to Europe in the 17th century from India and becoming very popular, were "Calico" fabric. **Kaliko** (by Indian town Calicut today Kozhikode) - solid cotton fabric in canvas. **Calico printing** - an alternative to the name of Calico fabric imported from India at the beginning of the 17th century and characterized by large motifs of large floral patterns. The printing technology that was originally used in India to produce calico-printed fabrics is printed with wooden blocks and as such is transmitted to Europe and is applied in more elaborate forms (original wood block printing, metal plate printing and engraved copper plates - **manual printing techniques**) until patenting the rotary printing method in copper rolls - **machine printing technique**.



Contemporary Calico fabrics



- ❑ The most popular calico style, which ruled Europe from 1600 to 1800, is certainly **CHINTZ**. It was characterized by floral motifs printed or painted on cotton calico fabrics, and represented the so-called fashion for the masses.



Examples of patterns “calico” (chintz) fabrics



CHINTZ dresses (1700-1800)



❑ The most significant names in styles development

- ❑ The original pattern and general style, which was developed by a designer and manufacturer **Jean Baptiste Huet** (France, 1745-1811), which has become popular until today, is known as "**Toile de Jouy**".
- ❑ Swiss Christophe Oberkampf (1738-1815) opens a factory for the production of patterned cotton material, in *Jouy en Josas*, near Paris. **Jean Baptiste Huet**, the leading designer and art director, develops the original textile sampling style of pastoral scenes from everyday life, featuring couples on excursions or driving the chariots or life scene on a farm, nature, etc. The factory becomes exceptionally known and popular, and Hute's style, known as "**Toile de Jouy**", remains popular until today and goes beyond the application of textiles (kitchenware, wall coverings, decorative items, furniture, etc.).



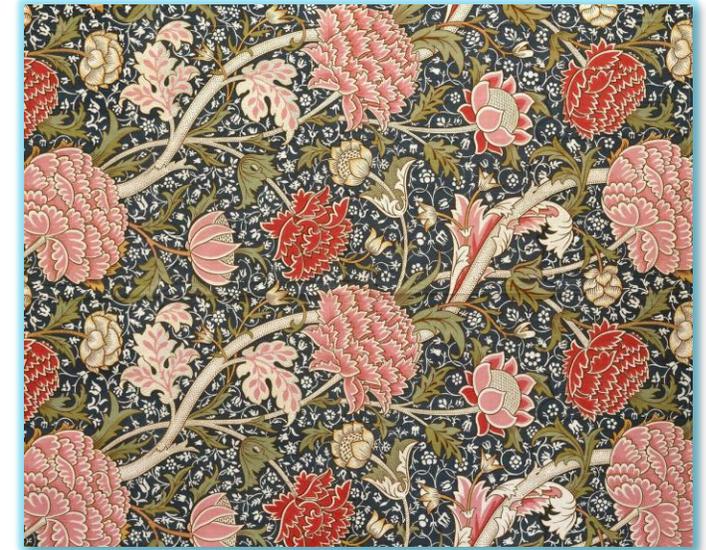
Original *Toile de Jouy* styles



Contemporary
Toile de Jouy style



- ❑ **William Morris** is best known as the 19th century's most celebrated designer
- ❑ In 1861, with six partners, he co-founded a decorating firm, Morris, Marshall, Faulkner & Co. The company was reconstituted as Morris & Co. in 1875.
- ❑ Morris's published lectures on subjects as diverse as pattern design, dyeing techniques, and the social role of art reached a wide international audience. His visual style and his views on materials, hand-making, and the value of craft were highly influential. **He is considered a founder of the Arts and Crafts Movement**, and his mark can be seen everywhere from the Bauhaus Movement to the works of twenty-first-century artists and craftspeople.
- ❑ The first printed fabrics made by Morris's company were copies of chintzes, produced using blocks rather than the modern roller method (a revivalist rule that Morris would stick to throughout his career). He later switched to more complex patterns and techniques such as indigo discharge.



- ❑ **Charles Francis Annesley Voysey** (1857 - 1941) - One of the leaders of the Art and Craft Movement ("Art & Craft"). Inspired by the works of William Morris, he designs complex patterns intended for a block press which was still being applied in the second half of the 19th century. Voysey's early work was as a designer of fabrics, wallpapers, and furnishings in a simple yet timeless Arts and Crafts style.
- ❑ **John Henry Dearle** (1860-1932), British textile designer, direct student of William Morris and later leading designer and art director after Morris's death at Morris's print production company.



John Henry Dearle designed fabric



Charles Voysey textile design

❑ CURRENT POSITION AND FUTURE ASPECTS

- ❑ Nowadays, the application of screen printing machine in screen printing industry is more and more popular and valued. Almost all walks of life will come into contact with screen printing machine, and manual screen printing machine, semi-automatic screen printing machine transition to fully automatic screen printing machine is the development trend of screen printing industry. Many enterprises have to develop automatic screen printing machine under the trend of higher and higher labor cost for the products with high requirement and fast production efficiency. This is also the development direction of silk screen printing industry.
- ❑ In 21st century, screen printing in general, is moving into another phase of growth. Over the years that it has been used substantially as, originally developed, graphics production process technique, it has been develop in ideal for processes that are crucial to the development and production in advanced manufacturing. It is now considered as a mass imaging technology.
- ❑ The need for high precision and continuous control of all parts of the printing process have encouraged the development of printing technology into the area of high precision engineering.

- ❑ With the advent of new technology, screen printing has found new applications to stay relevant in the digital age. It might come as a surprise that a printing method as old as screen printing has found new life in the age of technology, but what made screen printing a mainstream printing method is just what's made it successful as a modern manufacturing method: the ability to lay down a precise and measurable deposit of ink on a substrate. Except when it comes to newer screen printing applications, it's not always ink that's being deposited; it can be conductive silver and dielectric, as well as industrial lacquers and adhesives.
- ❑ So, the screen printing is going beyond garments in the modern age. Screen printing is being used to print miniature circuits on ceramics, and to manufacture flexible circuits, membrane switches, touch panels, solar cells, lithium batteries, and similar. Screen printed technology is also applied in smart phones production.
- ❑ Screen printing also, find its application in flexible electronic production, all the more so as the market of flexible electronics grows.
- ❑ In medicine, screen printing is used to manufacture blood glucose test strips, to print transdermal patches, which allow people to receive doses of medication such as insulin, as well as medications to help people stop smoking and treat motion sickness.

- ❑ While other technologies have made their way into the commercial printing industry, screen printing is here to stay. The centuries-old technology remains popular in its traditional applications, such as garment and sign printing, and new uses for screen printing in technology, medicine and other fields continue to be developed all the time.
- ❑ Some technologies that would not be possible without screen printing:
 - ✓ Mobile phones, various biomedical sensors, flat screen televisions, touch panels, membrane switchers, electroluminescence, thin film heating elements, heated rear windscreens, fuel cells, smart fabrics, optical discs, automotive dials, printed antennae, special effects graphic printing, sports-wear decoration, electronic camouflage.
 - ✓ One of the more innovative applications has recently been produced in the Department of Electronics and Computer Science at the University of Southampton. It is the world's first screen-printed digital watch on fabric. Using screen printed paste inks the necessary, conductive, resistive and electroluminescent inks were applied to the fabric.
- ❑ For a printing process with such a long history be assured that screen printing will continue to expand its applications. The future of the continued growth of screen printing is based on the imagination of young people, who are the engineers and scientists.