

The Technological Impact of the Introduction of Digital Ink Jet Technology into the Textile Value Chain

Kasper Nossent; TenCate Advanced Textiles; Nijverdal, The Netherlands, Gerrit Koele; TenCate Advanced Textiles; Nijverdal, The Netherlands

Abstract

The current textile industry is dictated by robust industrial processes that have been developed over the past centuries. Unfortunately these processes lack the ability to adapt to the fast changing demands and requirements of players in the value chain.

The introduction of digital inkjet technology as an enabling technology into the value chain of the textile industry will not only introduce a whole new range of products that can not be produced by the traditional production process. It will also add a new dimension to process control and product quality; process reliability and flexibility, i.e. working towards capable process. Moreover it will be the technology that brings mass customization closer to the market.

This paper will focus on the technological impact of digital inkjet technology in the current textile value chain.

Introduction

Ink jet technology found nearly three decades ago its first applications in the printing and graphics market. But nowadays ink jet technology is becoming a breakthrough technology in several key technological and industrial areas. The growing rate of adoption and implementation is driven by the ability to enable a high degree of manufacturing flexibility and product differentiation; new products and product concepts; shortening production run lengths; and enabling just in time production and on site production.

Jetting Technology & Market Evolution Curve- "The Next Wave Has Started"

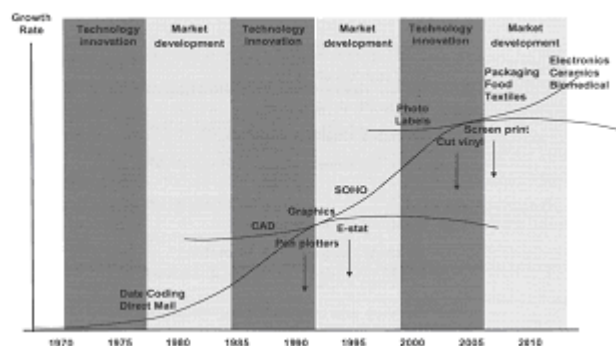


Figure 1. Market Evolution of Ink Jet Technology [1].

Figure 1 and 2 show the estimated market evolution and growth rates in the coming years for ink jet technology in several market areas. It can be observed that textile applications show a strong growth rate. Nowadays ink jet technology is primarily used in the textile industry for graphics printing; but new technological applications are under rapid development.

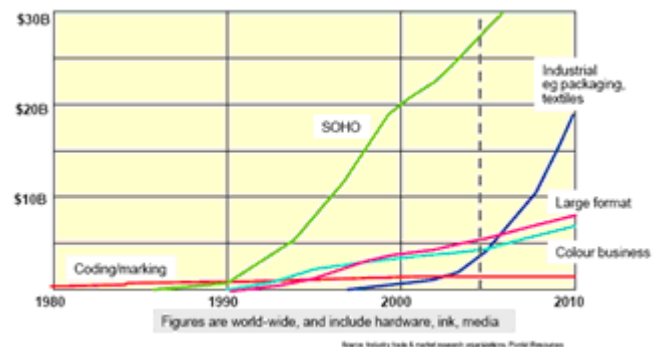


Figure 2. Market Growth rates for Ink Jet Technology [2].

The textile value chain

The current textile industry relies on robust; rigid and labor intensive production processes that have evolved over the past 300 years. The majority of these processes are dictated by the economies of scale and only a small fraction is driven by highly specialized production for niche market applications.

The textile industry is under constant pressure to adapt itself to the ever changing demands and requirements of players in the value chain and its end users; but also to the ever changing economic environment. Therefore the industry is forced to constantly invest into R&D; new products; new and more efficient process and to re assess their business models in order to maintain its competitive advantage.

Ink jet technology might be able to full fill the wishes of the industry to be able to increase their efficiency in terms of materials, energy and costs but also to convert the industry into a highly flexible industry that can meet the demands for flexible production, just in time production and more product differentiation and eventually (mass) customization.

Impact of Ink Jet Technology in the Textile Value Chain

The implementation of ink jet technology into the value chain of the textile industry will not only be driven by sheer technological advantages but more often by business and competition related motives.

Ink jet technology for printing and graphics applications is already an established technology in the textile industry; but only contributes for less than 1% to the total amount of printed fabrics. Due to the advantages of scale the rotary and screen printers are

still responsible for the largest part of the market. These market shares are expected to change rapidly when new and faster ink jet printers enter the market. Figure 3 shows that for small run lengths ink jet already has the competitive advantage, but due to the relative impact of variable costs such as ink prices screen printers and rotary printers are still competitive for large production runs.

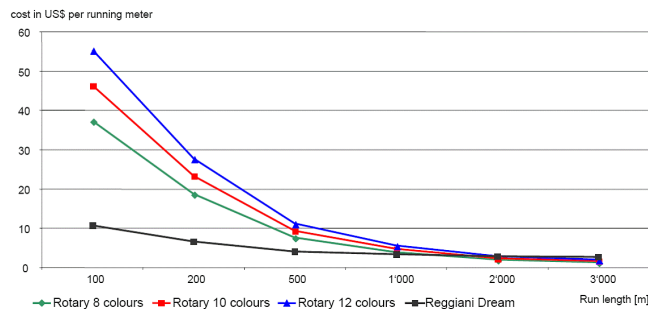


Figure 3. Costs per m for rotary vs. ink jet printing.

It can be argued that it is a matter of time before the ink prices for ink jet printers will drop to the level of screen and rotary printer inks forced by the economy of scale when ink jet printers will be implemented on a wide scale in the textile market. This is especially true for applications that consume large quantities of inks, like for example dyeing.

From a technological point of view ink jet can bring some real advantages compared to traditional textile finishing methods. For example ink jet technology introduces the possibility to use single droplets as building blocks for a product by positioning them individually in the 3D matrix of a textile substrate. This way of product or functionality engineering is unknown to the current textile industry; due to the absence of suitable application technologies.

Ink jet technology can also be used in addition or integrated in existing production processes, see figure 4, but also as a substitute for; especially in the areas of fine coatings or finishes; dyeing processes and coating processes. The advantages here are primarily related to more flexible production process; higher degrees of product differentiation and capable processes.

The use of digital technology instead of the analogue textile processes introduces the opportunity of sophisticated digital data sharing; not only on corporate level and between successive process stages; but even more important between different steps in the value chain even up to the end users.

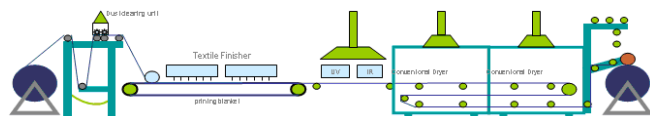


Figure 4. An ink jet process integrated in a textile finishing line with conventional textile equipment.

The introduction of digital production process technologies also enables the possibility to upgrade to higher levels of process automation; the advantages of higher levels of process automation are not only technological; but will also highly impact business related aspects such as cost efficiency; shorter times to market and flexible production.

It can be observed that more and more industries have to adapt to an increasing demand for product differentiation and higher levels of product customization. To keep up with these demand industries have to work towards higher levels of automation; flexible production processes and shorter times to market. A good example here is the automotive industry that provides customized solutions on a mass scale.

Within the textile market there is also a move towards higher levels of product customization; but nowadays mostly in the higher price levels of the market; due to the high manufacturing and overhead costs. Providing customized solution to the mass requires high levels of process automation and highly flexible processes; not only at the level of retailers or garment manufacturers but even more so at the level of textile producers and finishers. Figure 5 shows the setup of a value chain organized to produce customized garments. The use of ink jet printers in this chain is crucial; because they increase the flexibility within the rigid textile manufacturers and therefore making it possible to keep the supply in line with the highly flexible demands on the end user side.

Mass customization can therefore be seen as one of the business related aspects that really benefits from the use of ink jet technology.

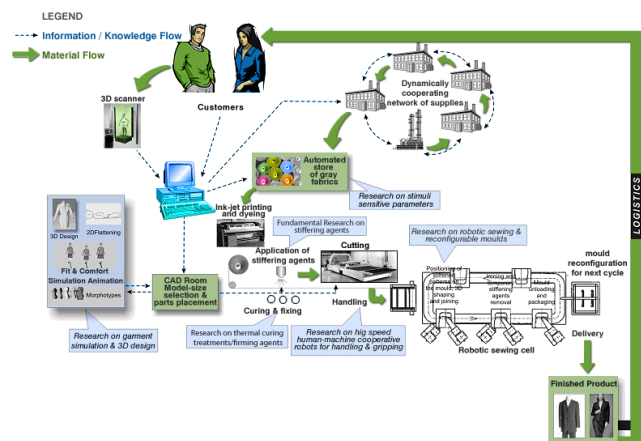


Figure 5. Schematic overview of a garment customization process; starting with the end user and ending with a customized garment. Ink jet technology is used to customize the finishing and dyeing of the fabrics that are used in the garment.

The textile industry finds itself in a very competitive environment where cost leadership and quality leadership are the biggest market drivers; not only regional or national; but even more on European or international level. One of the biggest threats for the European textile industry is the increasing competition on cost leadership and quality leadership with Eastern Europe, but more over Asia.

One of the biggest disadvantages of today's textile production processes is the high labour intensity; this is especially true for textile finishing processes and garment manufacturing. With the high costs of labour in European area this puts a heavy burden on the production cost prices compared to areas where labour is much cheaper.

It can be argued that moving towards higher levels of automation in the textile finishing and garment making industry will eliminate a great deal of the labour costs involved in these processes and therefore increasing the competitiveness of the Western European region compared to Eastern Europe and Asia.

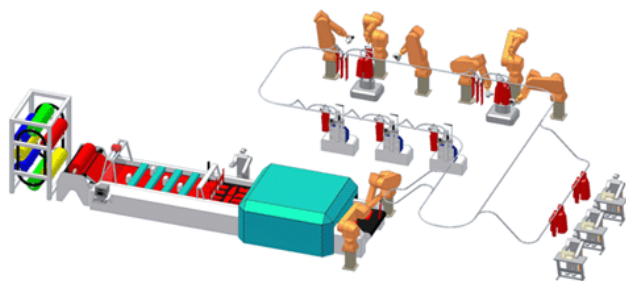


Figure 6. A fully automated garment manufacturing line combined with an ink jet finishing/printing machine.

When highly automated and flexible finishing processes based on ink jet technology are combined with automated garment manufacturing, see figure 6, a large share of labour costs are eliminated from the value chain and in effect the burden of labour costs on the cost prices is reduced. This means that the burden shifts towards production factors like energy and raw materials which have a much lower variation in price on a world wide scale; and in effect the most efficient production site will be as close as possible to the end users.

Conclusions

The benefits for the industry can be enormous, not only will ink jet technology enable new products; more flexible production processes and even more important it will bring (mass) customization closer to reality. It will also strengthen the competitive power of the industry and even more important it can bring the labour intensive production back to Western Europe due to its ability to enable high levels of automation.

Although ink jet has the potential to radically change the textile industry the implementation process will be slow. The textile industry is very traditional and has a natural resistance against radical changes. The industry is also driven by technological developments from outside their own technological path; this is especially true for the textile production and finishing companies.

In order, for the textile industry, to successfully implement digital ink jet technology into their value chain, a certain 'absorptive capacity' [3] needs to be developed for adopting this technology from outside the textile industry. This means a large investment in R&D and fundamental research in order for the industry to fully comprehend the potential of the technology and to make full use of the added value of the technology.

Acknowledgements

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Author Biography

Kasper Nossent graduated from the Saxion Hogeschool as a Chemical Engineer (Bsc) and received his Msc. in Innovation Management from the University of Utrecht. In 2006 he joined TenCate as a project coordinator and works in the area of ink jet technology and textile finishing.