Digital Printing Adds New Dynamism to the Decorative Markets

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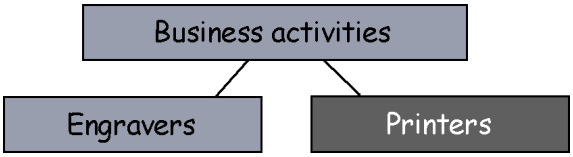
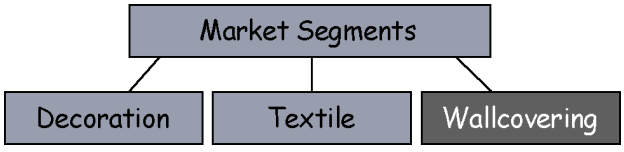
The Decorative Design Market

Barco Graphics is divided into a number of business activities each focusing on specific niche markets. The Decorative Design System Division provides workflow solutions for the decorative markets. Until recently the Barco solutions only covered pre-press software packages for the two different business activities in the decorative market being firstly the *engravers*; producers of the gravure cylinders, flexo rollers and rotary-, galvano- and flat-screens and secondly their customers, the actual *printers.*



The software packages were mainly used within 3 different market segments: the *decoration* market including the laminate and vinyl market; the *textile* market: only focusing on transfer printing and high quality screen-printing and the *wallcovering* market.



In these 3 market segments more or less the same workflow is applied: an original image is scanned, put into repeat, separated in spot colors and colored into different color sets. A calibrated paper proof is generated and used as the standard for print production. Next a very time consuming analog proof printing process starts. Later in this paper it will be explained why it can take very long from initial design to placing a decorative product to the market, sometimes extending the complete production cycle to a matter of months.

Because of the similarity of the 3 market segments we will only focus in this paper on the wallcovering market and use it as an example for all 3 segments.

The Wallcovering Market

During the last years sales of wallcoverings have been stagnating or even declined because of the success of paint. Pasting, cutting, and matching the repeats seamlessly, as well as equipment requirements (scraper, smoothing tool, table) and drying time all conspire against the desire to decorate in a quick and easy manner. In contrast, a bucket of paint, a roller and a few drop cloths are relatively easy to manage. And what happens if the homeowner wants to redecorate the house? These are major reasons why paint is gaining interest as the favorite wall decoration of choice in the home market. Manufacturers and distributors are convinced that digital printing will give a boost to their sagging sales and shrinking profit.

Digital printing will not solve the installation problems but personalized wallpaper and borders would bring equal or better satisfaction for the homeowner.

On the other hand the manufacturer sees more profitability in short runs, customizability and efficient inventory management. These advantages are drawing growing numbers of wallcovering companies to digital printing.

The Market Trends

Using existing, conventional printing methods (see later) wallcovering companies face several limitations and challenges. Therefore wallcovering companies must be able to identify where digital technology can fit as a complementary method to conventional printing. We have seen a migration to digital printing in other prepress areas such as the document world. These industries were also not that quick to realize the advantages of digital imaging but over time they began to understand that digital printing could even replace traditional production methods. Key advantages such as

- Reduction of inventory cost
- Shorter run length
- Greater design freedom
- Less risk of selecting non-selling patterns
- Personalized printing

will over time gain more and more interest among wallpaper and borders suppliers.

Conventional Printing Technologies

Wallcoverings are printed with at least three printing technologies: flexography, gravure- and screen-printing.

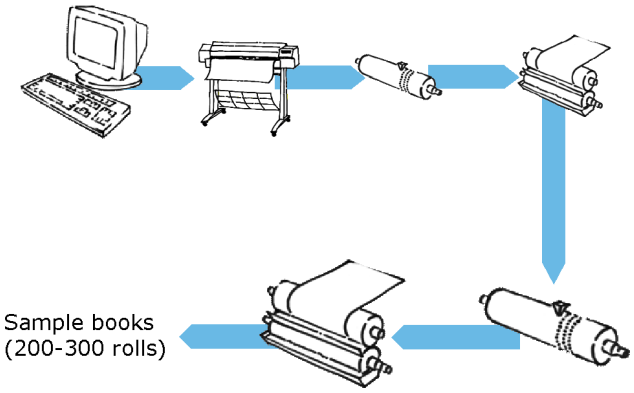
Flexography is a very simple printing process using the technique of direct rotary printing with rubber or photopolymer plates. Fast drying solvent or water based inks are used (similar to gravure inks). It uses a very simple ink system and it is almost exclusively a reel- or web-fed process. The technology is suited for long run web work, printing large areas of solid color, and brilliant colors on different substrates: from thin paper to heavy corrugated board to vinyl and foils.

Gravure printing uses very expensive copper-plated steel cylinders. It is used to print high quality continuous tone effect on low quality, cheaper grades of paper. The gravure presses for decorative printing usually have a maximum width of 2,4 m and up to 16 printing units (very large machines). They are only profitable for very long runs because of machine time setups, and the very high cost of production cylinders.

Rotary screen printing prints both linework and continuous tone elements. The squeegee is mounted inside the screen and ink is automatically pumped into the cylinder.

Conventional Workflow

The first step in a conventional workflow is the pre-press stage. Starting form a digital or scanned original, a repetition is defined and generated. The repetitive job is separated into spot colors (not CMYK) and colorways are generated (colorway = use the same separations and link new ink combinations to those separations). At this stage a digital proof is printed and used as the master for further production. Test cylinders are manufactured and the proof printing is done on a so-called baby-press. Only when the digital proof matches the proof print and if the selected colorways can be printed, production cylinders are ordered.



Finally production runs can start taking a huge setup time: mounting the cylinders, entering the paper and trying to match the original print. This work is all done for only 200-300 rolls of wallpaper that are used to generate 1000-1500 sample books.

Digital Workflow

Barco Graphics has a tradition of providing total solutions and has all the elements to deliver to the customer a complete digital pre-press workflow: Barco offers a suite of products for the origination, color management, imaging (film and plate setters) and file transfer architecture as well as screening and RIP technologies. Now to complete the full digital workflow, Barco is building an industrial digital color press for short-run, sampling, personalized and fully variable data production printing.

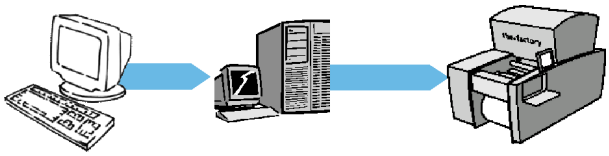
From the origination (see above) the digital files are sent to a Print Server, handling job management, screening and color control.

The job manager is used to set job parameters, defining job tickets, scheduling, launching and tracking the jobs. It balances and optimizes the workload over multiple Digital Presses in the network. Also digital links with the accounting department, the consumable purchase department and handling, etc can be established.

Transforming the job from the original Design Colorspace (typically more than 6 spot colors) to the Press Colorspace (up to 6 colors), ripping objects instead of pages, using Variable Data Description Files is all handled by the RIP. The RIP-ing process should of course take place while printing to minimize stand still time.

Screening technology used in conventional printing is not applicable and needs to be redefined to accommodate digital presses and digital printing technology.

The complete digital workflow cannot exist without a supporting color management solution. What you see on the monitor needs to match what you get after printing (WYSIWYG). A color management chain between the pre-press and the printed result is a must. The digital workflow also needs a possibility to feedback at any moment to the conventional printing method. Barco provides wallpaper customers an open system that makes it possible at any moment to continue a ‘digital’ job in a conventional way.



The Digital Press is designed to print on the substrates of the industry, with the inks of the industry and should deliver a print quality which is as close as possible to the quality of conventional printing. Before designing such a digital press, Barco had to investigate the available technologies (see later).

The total digital workflow for the decoration market, called InSpiration, brings enormous opportunities to the wallpaper printers.

Shorter Run Lengths

Digital printing enables printing of even micro runs in an economical way. Printing one meter test material or 100 rolls of wallpaper; it does not matter, a digital press handles it all. This is all done without any setup or purchase of expensive cylinders, without very time consuming stand still times for paper changes and colorations, no paper wasted during set up, etc. One may say: ideal for printing of sample books.

Shorter Lead Times

The wallpaper customers are all confronted with shorter lead times. The elapsed time from the original design idea to the final product on the customers' shelf has dramatically reduced over the last five years. That requirement can never be matched with a conventional workflow. The advantage of our whole digital workflow needs no further explanation: immense reduced lead times; from several months to several days, and this is not even taking into account all the cost savings. This digital workflow is therefore ideal for test marketing: every idea can immediately be printed and presented to the customer on his final production material.

Inventory and Space Costs

Clearly one of the biggest costs for the wallcovering industry is the inventory cost. The different printing processes used in the wallcovering market are only suited for mass production. Cylinders take a long time to prepare, sometimes extending the whole production cycle from original design to final production to a matter of months. Gravure- and screen- printing have proven to work well for high volume production, but in addition to long production runs, tooling costs and screen changes can be problematic. Preparing a press for production costs that much time that only quantity printing makes wallpaper business profitable. Therefore distributors must stockpile hundreds of styles, patterns and raw materials. Digital printing on the other hand enables Just In Time fabrication, order today what you will get delivered tomorrow.

A special hall is needed to store wallpaper because it needs a climate-controlled environment to preserve color quality and prevent product degradation due to molds and mildew, drying out and others forms of spoilage.

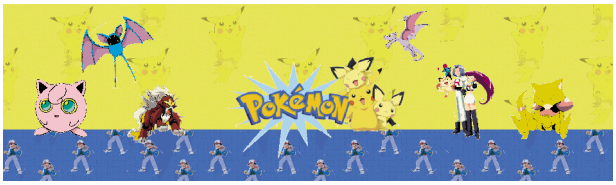
Not only the paper must be stored, also all the different cylinders must be kept for reuse. In some companies even small samples of the ink mixtures used are gathered.

Manufacturing wallpaper means enormous floor space; not only for stock reasons but also because of the printing machines itself. Conventional printing machines are huge with very big drying ovens (10 meters and more). A digital press on the contrary, using for example UV inks can fit onto as little as $10m^2$. Such a small machine also enables decentralized printing. Localization, follow local trends, is a direct consequence of this decentralized printing.

More Product Variety and Differentiation

Pattern limitations inherent to conventional printing technology hinder wallcovering designers, and this also stops the growth of the industry. Without variety and innovation in wallcoverings imagery, customers are not likely to invest in this type of decoration. A digital wallpaper design is not longer limited to the repetition of the maximum cylinder circumference of a gravure press. Our Digital Printing Solution for the decor market, called Inspiration, includes the PrintStreamer technology, making it possible to design a wallpaper border that can vary across the wall without a single repetition.

Imagine a teenagers room covered with his current favorite football team, or children's room with a personalized Pokemon comic all across the wall.



Digital printed wallcoverings provide the freedom for design professionals to create what customers want, and order exactly the amount they need, when they need it. Wallcoverings can be manufactured to individual customers whishes.

Another advantage of digital printing is that different color sets generated on the ARABESQUE^{MC} Colorways software are generated and printed in a split second. The different colorations can be sent to distributors and only after placing the order volume printing is started.

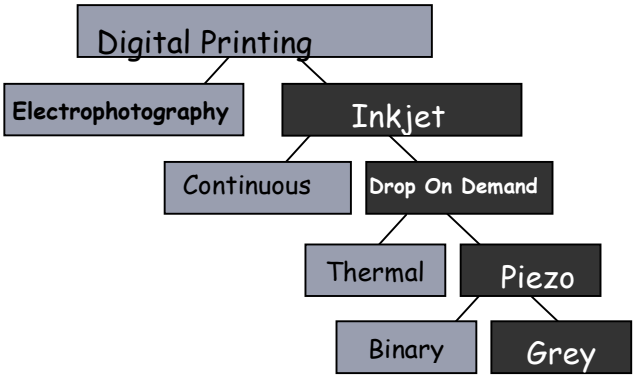
Mass Customization

The home market is a small market compared to the requirements of professional markets such as hotel chains (Sheraton, Holiday Inn,..), or famous design and fashion houses (Hermes, Lacoste,..), large companies, and banks or other. They all invest a lot in marketing and brand differentiation- and recognition and are therefore willing to pay a lot for personalized decoration materials. Image a wallpaper border with their logo on it, or with sales actions on it. It all becomes possible and affordable thanks to industrial digital printing.

The Digital Solutions

Meeting the requirements of the industrial printing world is prime to Barco Graphics. This means that the.factory needs to print on the substrates of the industry, with the inks of the industry, and a quality comparable with conventional printing technologies.

Barco selected a technology that has brilliant future perspectives.



The "other" digital printing technology to take into consideration next to electrophotography was inkjet.

Within inkjet we identify 2 main groups: Continuous inkjet and Drop-on-Demand inkjet. Continuous inkjet print heads are cheaper and have a much higher firing speed. This is clearly an advantage.

A major disadvantage however, is the limited choice of inks that can be jetted with this technology: The charging of the inks to enable deflecting tolerates only a specific ink type. Another disadvantage is the ink wastage generated by continuous inkjet or one has to recycle the deflected ink. Drop-on-Demand and more precisely Piezo driven technologies don't have to deal with these restrictions. What's more, DoD PZT inkjet has, from a technology point of view, the ability to jet different types of ink: Solvent based inks, oil based inks, aqueous based inks and UV curable inks. Other technologies such as thermal inkjet are again much more limited as far as the choice of ink type is concerned. DoD PZT offered the right perspectives for industrial printing applications.

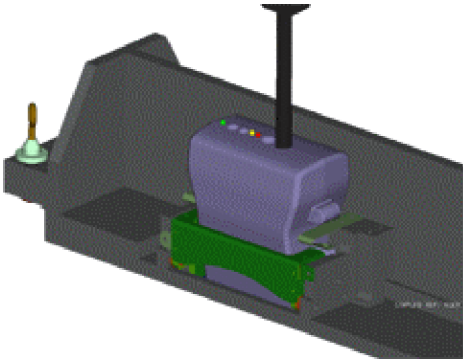
Common ink jet heads are so called 'binary'. In other words, they always print the same drop size. The one the.factory is using are 3 bit gray scale, capable of generating 7 different drop sizes. Taking into account the 0-volume drop size, this means 8 levels (2^3). The different drop sizes are formed through firing (much smaller) sub drops at a much higher frequency. It clearly is a big advantage if the printing device itself can produce different tints of the ink, by varying the drop volume. Combining these different intensities (gray levels) with a stochastic screening technology results in doubling the visual resolution and the apparent print quality.

The Inkjet Cartridge System

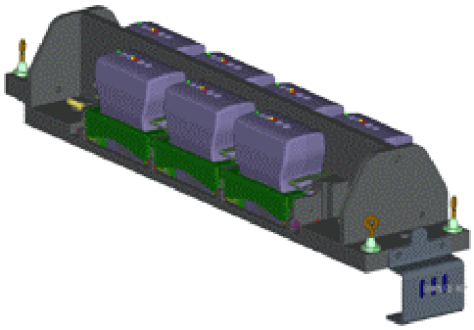
From selecting the DoD, gray scale PZT technology to selecting the best and the most promising inkjet heads was another challenge. Taking as a requirement the printing of minimum 4-colors, the footprint should be very small to optimize image quality and curing. Only the Xaar gray scale technology enabled us to build a matrix of inkjet heads allowing to print at maximum speed and quality. The way the PZT ink chambers in the heads are build, the so-called shared wall DoD technology, results in a very compact inkjet head and allows Barco to build up to six colors into one print unit.

The inkjet heads are built to live a long life, an industrial lifetime. Never relate to SOHO inkjet life times. MTBF calculations have shown that when operated during 2 shifts of 8 hours per day (of which 6 hours of printing per shift), they should last 3 to 6 months, depending on the application and average coverage.

Barco has designed an inkjet cartridge system that allows easy set-up, maintenance, and replacement of the individual cartridges. One cartridge contains 2 inkjet heads. The inkjet heads are mounted face-to-face, tightly assembled within highly accurate self-positioning brackets. By slightly offsetting the individual heads in the cartridge, Barco doubles the resolution of the individual heads. The cartridges are featured with ink manifolds, ink-level sensor and steering-, and calibration electronics. To enable easy change over, the cartridges are equipped with quick-coupling connections for vacuum, pressured air, and conditioning, electronic-, and data connection. All these components will reside in a sealed cover.



The cartridge can be seen as the basic unit on modular color bar, whereas the color bar on its turn is the basic element in the modular SPICE design. This concept allows us to tailor the digital engine to the customers need; by increasing the number of cartridges on a color bar, Barco can increase the printing width, by increasing the number of color bars, Barco can extend the number of printing colors or the color gamut.



The cartridge is an important element in the modular SPICE concept; therefore Barco assembles these cartridges itself. The expected lifetime of an individual Xaar technology inkjet head is 5 billion droplets. Our mechanical design allows easy cartridge replacement.

SPICE Concept

The Single Pass Inkjet Color Engine is the name of the actual digital print engine. Thanks to the single pass concept (a static array of inkjet heads) maximum printing speeds can be obtained. The heads are not moving (thus not wasting precious time) and the substrate is presented under the web. Static print heads allow us to print at the top speed of the inkjet heads. The opponent of single pass is multi-pass inkjet (scanning inkjet heads). This will always be a slow concept: The web has to wait for the inkjet print heads to make the XY movement.

Barco has implemented a matrix of cartridges to print the maximum print width of 65 cm. To obtain an invisible stitching the cartridges overlap. In reality the overlap is only some nozzles. Stitching is perfectly managed both in a combination of mechanics, software and hardware.

In a configuration with multiple heads, all heads need to be kept continuously in prime condition. To keep the heads in optimal condition, you need a full automatic maintenance system. SPICE is provided with a preventive maintenance unit. When in maintenance mode the SPICE unit is raised and a robotized cleaning unit cleans them by vacuum pressure while passing under the nozzles without even touching the nozzle but well restoring the pre-firing prime condition of the nozzle plate.

Several types of ink jet heads are of-the-shelve available on the market, but the real challenge was to design and to develop electronics driving the cartridges in the most efficient way and with a minimum of electronics, maintaining the modularity of the concept.

In the.factory configuration the SPICE is placed on a roll-to-roll base engine.

UV Curable Inks

Another important choice: Barco has selected the UV curable inkjet inks, and this for several reasons: UV curable inks adhere very well to a wide range of substrates. UV curable inks have a high rub resistance, scratch fastness and high color fastness. UV curable inks don't contain components that are on the VOC-list (Volatile Organic Compounds). Because of these arguments and more especially for environmental reasons there is a general breakthrough of UV-inks in the industry. Once the ink is well cured, UV-ink is the perfect ink for many industrial printing applications.

The UV-dryer unit hardens the ink immediately after printing. The substrate might be subject to high temperatures during curing. Many solutions such as water-cooled counter rollers or cold mirror lamps can be installed to deal with this. As this (well controlled) curing is the only part of the printing process where heat is involved, this means that heat sensitive substrates such as thin foils or self-adhesive paper can be printed on. Other more appropriate curing systems can be combined to fit the most severe curing requirements.

The color fastness and the scratch resistance are very high and the adhesion is very good for many substrates. The system enables fast printing and drying. The combination of UV curable inks and Drop-on-Demand inkjet ensure that there is no ink waste and no ink recycling is needed. The industry acceptance is a fact for UV curable inks and will become a fact for UV inkjet.

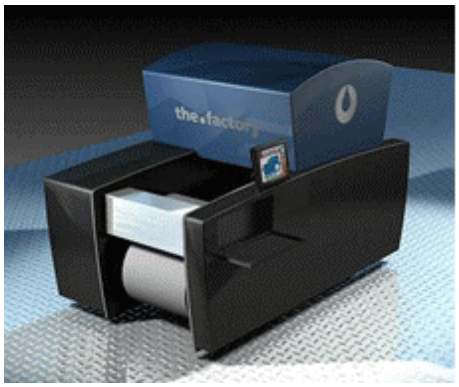
The developments over the last two years clearly show that a lot of the ink restrictions can be solved by the ink providers, most of them having different skills for different applications and substrates.

The InSpiration Solution

Barco is taking a well-calculated pioneering position in the industrial digital printing market, one that will change not only its own business but will add tremendous value to its customers' business – a good recipe for success.

Barco offers a wide range of specialized customer services. Through these services we help our customers maximize the uptime of the configuration, raise their productivity and increase their profits.

Besides the nice look and feel of ink on substrate, the technical aspect of it can be a very important issue in a lot of applications. Using variable data digital presses like the.factory will enable manufacturers to differentiate their products. Traditional printing technologies such as gravure and flexography printing have limitations in flexibility due to the need of producing large print runs to lower the costs, as well as limiting the design flexibility due to the technology.



Presses as the.factory will be able to print up to 800 square meters an hour and will provide ultra-high speed, variable data, digital color printing for industrial decorative applications.

Biography

Jasmine Geerinckx is the manager of the Decorative Printing group. She has an engineering degree in textile and decorative applications and a post- graduate degree in applied marketing. After two years of working in the research department of a textile production company in Germany, she joined Barco as Application Specialist for the Ceramics Printing market. In 1998 she was promoted to manager of the Decorative Printing Applications. In this function she has the worldwide responsibility for the sales-, marketing-, and development of these products.