High Volume Digital Printing Solution for Photofinishing Applications

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Short Abstract

Digital processes have been replacing conventional analog ones for the past thirty years. With the arrival of high quality digital cameras, the whole art of photography is not only dramatically changing on the capturing side but also on the printing side : 85 % of the digital camera owners will use digital photofinishing to develop their pictures thereby changing the nature of industrial photofinishing. Since its foundation in 1988, Xeikon has been committed to promoting and innovating every aspect of digitalization in commercial printing applications. Xeikon entered the market of digital photofinishing @ Photokina 2000 with the introduction of the D2F2 (Dry Digital Foto Finishing) technology. The D2F2 technology, the fastest available dry digital printing technology, will lead wholesale photo finishing in the digital era of the 21st century.

Introduction—Distinction Between Printing And Photographic Paper Imaging

For more then 150 years, photography and printing have coexisted without much interference. Where Printing technology was ideal to create multiple copies of one image, photographic paper imaging proved economical for creating one copy of multiple images. For that reason, printing has always been broadcasting technology where the focus lay on distribution of mainly text-based information. In the beginning of the photographic era, imaging was done directly onto photographic paper, and was therefore limited to one copy only. Later this changed by separating image capturing and printing with the use of photographic film. One image on film could then be multiplied on paper as much as needed. This separation of input and output is very important since it created possibilities to broadcast images using printing technology and other multimedia services instead of photographic paper. In the last decade, the need for customizing the growing stream of information has led to the successful introduction of new technologies. Internet services and digital printing technologies like inkjet[1] and electrophotography create possibilities to tailor the information stream to the need of the customer. This brings us back to the narrow casting model of photographic paper imaging. It is clear that, with the change of the underlying technologies, both printing industry and photographic paper industry will merge together and they will both serve the same markets. The Xeikon digital printing technology is developed to fill the need of customization for graphic arts printing and is well positioned to play a significant role in the digitization process of the high volume photographic imaging markets.

The following sections of this paper will discuss the three main areas of central lab photofinishing that benefit from the Xeikon D2F2 dry digital photofinishing solution:

1. Integrated digital workflow
2. Image quality, consistency and permanence
3. Flexibility of substrate, formats and finish.

Integrated Digital Workflow in Central Labs

The digitization of the workflow in the wholesale finishing lab is a logical consequence of the growing influence of digital media like PictureCD and capturing devices like digital cameras and scanners. At the same time, the digitization will help to streamline the non-efficient re-ordering process. At this moment most digital central lab services are stand-alone configurations that do not make full use of the possibilities of digital workflow. Figure 1 shows an example of the common workflow in a central lab.

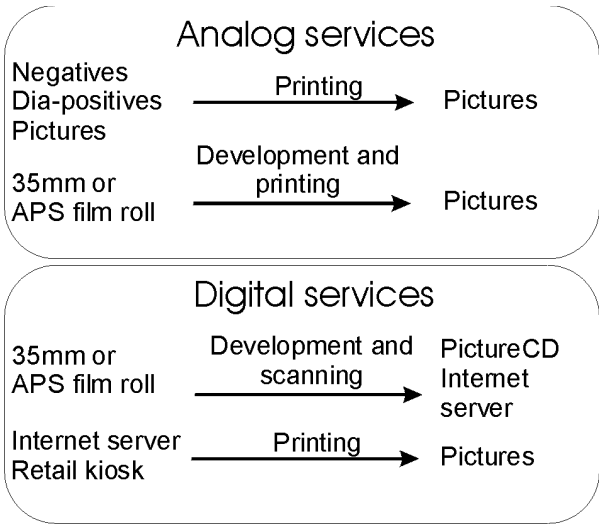

Figure 1. Typical central lab workflow

The separation between the different operations makes optimization of resources difficult. The future central lab will be organized around a central data network that connects inbound and outbound data and product streams. The path that a specific job follows, will be dependent on the customer order and will be managed completely by the Batch Management Control computer. This will increase greatly the efficiency of the resource planning. As part of the outbound flow, the Xeikon digital wholesale photofinishing solution will be able to print pictures in a sequence that is totally disconnected from the inbound sequence. Digital images can be sorted and printed to match well-defined geographical distribution area's, clients or photographic products. Figure 2 shows an optimized totally digital workflow.

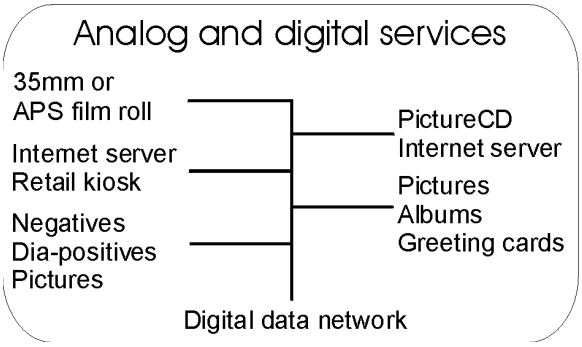

Figure 2. Digital central lab workflow

Image Quality, Consistency and Permanence

Well known quality issues in traditional analog photofinishing are the difficulties caused by the differences in contrast range of color negative films and color negative photographic papers. Unsolved problems include: color cross-overs; unsharp images; and scratches, dust, fingerprints and other contamination on the film.[2] Today, automatic analog print systems skip more than 10% to 15% of prints, although some of them could be improved via digital enhancement software. The software copes with the different tonal ranges of the film types and converts them to a reference color space adapted to the Xeikon printing process. The D2F2 imaging system is composed of 2x 4 LED arrays. The resolution of the LED arrays is 600dpi with a dot size of 40µm. Since the LED array illuminates all LED's simultaneously, there is enough time to modulate the light of each individual LED with a 6 bit accuracy to create continuous tone images. In practice the imaging is a hybrid composition of 212lpi halftoning and 6bit continuous tone resulting in 576 grey levels per color.[1]

$$\left[\frac{600dpi}{212lpi\times\cos(15\deg)}\right]^2\times 2^6 = 576 \qquad (1)$$

This compares with a 9 bit continuous imaging system or a 4800dpi imagesetter. The color printing system is based on 4 color CMYK and pigmented micro-toner particles. The development process is dry and based on electric forces created between the charged Organic photoconductor and the charged toner particles. Humidity and temperature of the environment and substrate influence the electrostatic behavior. Therefore two separate conditioning systems are used. One system keeps the environment in the DCP at 30°C and 33%RH. The other system measures and controls the conductivity of the substrate by means of a charge decay instrument and a closed loop roll-heating system. With this narrow control of the operational window, color variations can be kept very low and output is consistent and predictable.

Since the toner particles are composed of polyester embedded pigments, the permanence of the print is not dependent on process parameters and is very high. Together with the UV-coating layer, the print can stand attacks from water, solvents, O3, direct sunlight and heat.

A light-fastness benchmark between traditional Silver halide photographic paper and Xeikon D2F2 print (Figure 3) show that not only the density is preserved longer, the colors also fade equally avoiding disturbing color shifts.

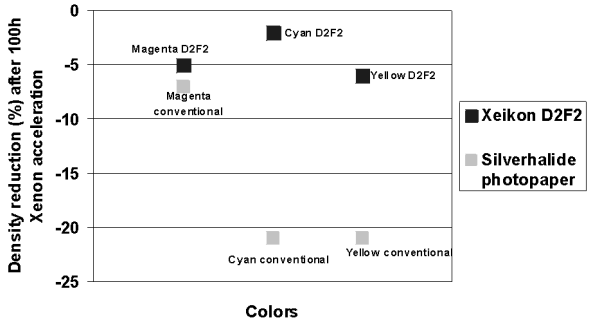

Figure 3. Lightfastness comparison between Xeikon D2F2 and traditional Silverhalide print.

Flexibility of Substrate, Format and Finish

The Xeikon D2F2 system is composed of 3 major components:

1. IntelliStream digital front end
2. DCP 320D or DCP 500D duplex printing engine
3. UCOAT finishing system

The digital front-end system is equipped with a Raster image processor to process postscript data, an image buffer or streamer and an IntelliPac creator that allows real-time processing of more then 8000 bitmap-images per hour. With both RIP and IP-creator connected, you can combine at print speed digital images with frames or other background images that are pre-

ripped and stored on the IntelliStream. . Figure 4 shows the total DFE configuration.

The printing engine is based on the Xeikon DCP 320D (320mm) or DCP 500D (500mm) one-pass-duplex digital color web presses. Figure 5 shows use the diagram of a DCP engine. By printing on both sides at the same time, it is possible to put information on the back of the picture in full color. This can be negative number, date or even logos or advertising. Also albums can be produced in the same manner. The engines can print on a wide variety of substrates tailored to the desired product or application.

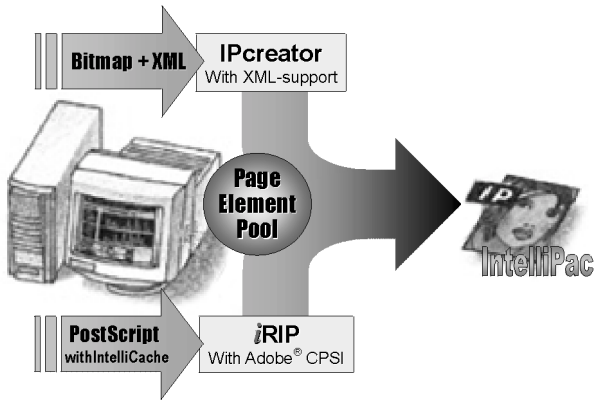

Figure 4. Xeikon D2F2 digital front-end

High added value products like greeting cards, albums and calendars have not been adopted widely by the public because of complex ordering and cost. With the possibilities of online services this changes and the D2F2 system provides the possibility to produce these products in a cost-effective way.

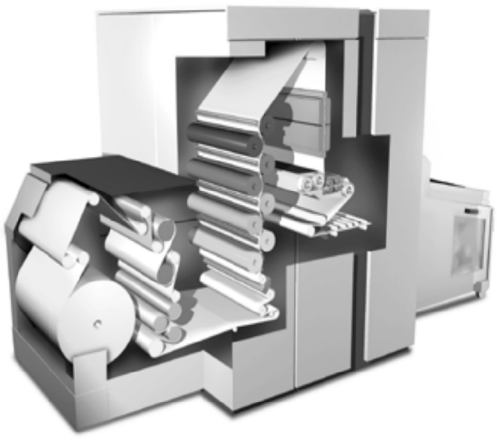

Figure 5. Xeikon DCP 320D digital press

Both cost effective production and high added value products create business opportunities for the central lab in a market place where retail shops start to offer competitive standard photofinishing services. In table 1 you find examples of applications with their appropriate substrate and finish. The applications are a hybrid combination of typical graphic arts and photofinishing products.

D2F2 photofinishing applications

Photo's and enlargements	220 GSM coated paper with simplex printing and UV-coating with supergloss or matte finish.
Photo Albums	250 GSM coated paper with duplex printing of images combined with text and background frames. Finish with duplex UV-coating and binding.
Greeting cards, calendars	250 GSM SBB board with duplex printing of images and text comments. High gloss or matte UV-coating. Scoring and folding
Post cards	250 GSM FBB board with duplex printing and high gloss simplex UV-coating.
Backlit displays	100µm transparent PET film with simplex printing
Business cards	250 GSM ivory board with simplex printing

The UCOAT finishing system is a special Xeikon development for the photofinishing application. This finishing unit can be run either in- or offline with all Xeikon DCP web-printing engines. It is composed of two functional blocks. The first one is the UV-flexographic coating unit. The coating product is a liquid composed of monomers and photo-initiators. By radiation of strong UV-light, the photo-initiators will work as a catalyst for the polymerization of the monomers. The polymerization process will turn the liquid into a completely fixed plastic film. Since the coating product does not contain any solvents and is 100% dry mass, its use is environmental friendly.[3] The UV-flexo unit uses a ceramic Anilox roller as a metering roll for the amount of coating to be applied. The fine structure of the Anilox roller is visible in the applied coating layer and gives an 'Orange peel' effect. To avoid this, a special 'supergloss' technique is used. After applying the coating and prior to UV-curing, a thin glossy film is laminated onto the wet coating. As a result, the coating layer is flattened out. While the coating is squeezed between the substrate and transparent film, the UV-curing is done. Thanks to the 100% dry mass of the coating product, no solvents need to be evacuated for curing and the coating product solidifies while still in contact with the film. Now the film can be removed again and can be used up to 5 times. In figure 5 you can see a drawing of the UCOAT. The achieved gloss levels

are comparable with traditional photos. The additional advantages are

- Ease of operation and maintenance because the coating does not dry out in the machine
- Cost effectiveness of the coating product in comparison with lamination.
- Protection of the print against scratches, solvents or heat.

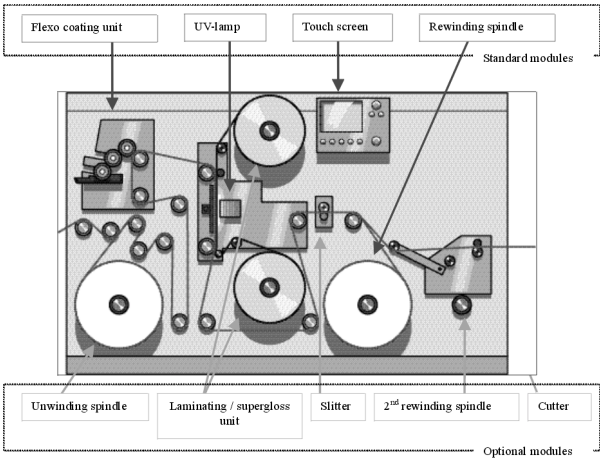

Figure 5. Xeikon UCOAT finishing unit

The second part of the UCOAT is the finishing. The UCOAT can be equipped with

- Scissor knives to do length slitting
- Rewinders
- A guillotine cutter and trimmer
- A puncher that is compatible with standard cutter packer systems.
- An unwinder for offline operation

Depending on the application, the UCOAT can output photos in rolls or completely cut and finished.

Conclusion

The Xeikon D2F2 is currently the fastest and most versatile fully digital photo printing solution for central labs in the market place. By combining the flexibility of graphic arts printing and the variability of traditional photofinishing, it provides the means to the wholesale photofinisher to create various new products and services in a streamlined efficient workflow.

References

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3. Alexander Ross, Eliminating air pollution (VOC & HAP) at the source through the use of ultraviolet or electron beam polymerization. RadTech International North America.

Biography

Bendix De Meulemeester received his M.S. degree in Electronics from the University of Ghent in 1991. Since 1993 he worked for Xeikon where he held various positions in R&D. He is currently working in the Marketing and Corporate planning department where he is responsible for the product development of D2F2.