

# Soft Proofing using LCDs – Case Newspaper Workflow

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Abstract: As the technical improvements accelerate, the premedia (prepress, repro) colour workflow is on the way to full digitalisation and automation, especially the business-to-business workflow. In this context soft proofing will save time, money and will reduce the environmental impact due to reduced material and transportation needs. However, the main application areas for soft proofing are somewhat different depending on the industry implementation, e.g. newspapers and commercial printing have different needs and thereby they use soft proofing in somewhat different ways. The aim of this paper is to map the technical criteria and routines that are needed to achieve an optimised colour management system for various premedia situations. The focus is on soft proofing in order to find out where soft proofing can be used, the pros and cons of using soft proofing, and the colour tolerance aspects. One interest is to specify the technical demands that are needed while using Liquid Crystal Displays (LCDs) in the workflow. Since the development of LCD techniques is fast and the prices are decreasing, many professionals consider switching their Cathode Ray Tube (CRT) monitors for LCDs. This paper looks into the possibility of such a conversion and the necessary aspects of soft proofing on LCDs for the newspaper industry. A suggestion will be presented on how to achieve an optimal and stable soft proofing system.

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## INTRODUCTION

The ability to match colour images displayed on monitors, to images produced when the same digital file is rendered by a proofing and printing system, is of increasing importance in the Graphic Arts Industry. Hard copy colour proofing in the fast newspaper premedia production flow is a less appealing method since it is time consuming and costly. The entire premedia workflow is on its way to full digitalisation and automation and the display technology and colour management systems are developing a higher standard. Therefore the use of soft proofing for fast printing workflows is a prerequisite.

The main application for soft proofing, is for visually control of colour accuracy, control of the page order and layout before and after the ripping, as well as control of page content on film and plate or the Computer to Plate (CTP). The proof is supposed to show status of postscript (PS) files, page transfer, colour separations and references, to function as template for the printing, to show production tracking and to be a communication tool in the chain between the image producer and the printing person.

What a specific soft proof represents is differently viewed depending on workflow, but in present day newspaper production the monitor proofs are mainly used as described above. That is; for management of the production devices visually and digitally. Apart from the image processing, the monitors are not set (e.g. calibrated) for correct visual evaluation and control of the colour accuracy.

The graphic arts industry is generally rather slow to apply new technology changes, but the newspaper industry is, with its time critical production flows and higher colour tolerance levels, more eager to try new possibilities. As for monitors, the newspaper industry is about to introduce desktop Thin Film Transistor (TFT)-LCDs instead of CRT monitors. Recent hesitation to implement LCD in the production flow is due to the rumour that LCDs would not be compatible with the technical demands needed for a graphic production flow, compared to the former high purchase price.

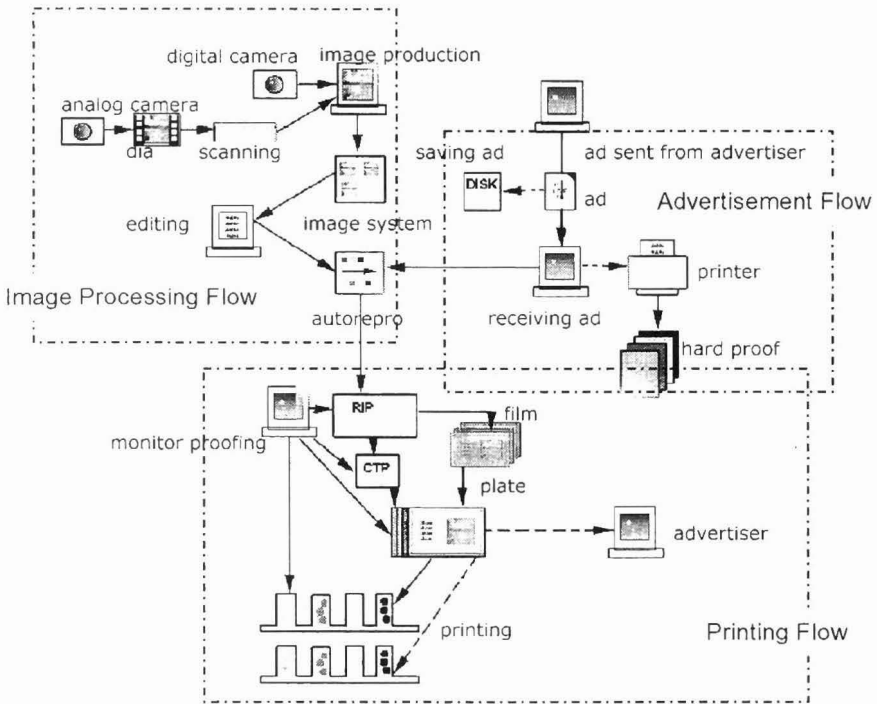
In this paper we will discuss the possibility of using present LCD technology in a newspaper production flow comparable to the use of CRT, the demands and adjustments, as well as the increasing implementation of soft proofing to achieve a stable colour management newsprint production flow.

## COLOUR WORKFLOW IN NEWSPAPER PRODUCTION

Generally, the newspaper companies have comparatively good colour quality in their final printings (the newspapers). By the initiating of grey balance control, the newspapers have improved their colour management strikingly, but still claims for incorrectly printed advertisements occur.

The most important parts of the image and colour management in the newspaper production is the rendering of pictures for the articles, Figure 1; Image Processing Flow, and the advertisement materials, Figure 1; Advertisement Flow. The colour management concerning the advertisements could be considered as most important since mistakes in the ads will be costly for the newspaper companies. The advertisers, skilled in this or not, almost exclusively make the image and colour handling of the advertisements. When the ad is received at the newspaper company, the image quality is automatically checked and no colour correspondence between sender and receiver is guaranteed [Leckner 02, 1].

In the newspaper premedia reproduction flows soft proofing is used for visual checking for missing or incorrect page disposition and for digital measurement of the colour quantity after halftoning. Visual comparison of the colour correctness is usually not made in the premedia production flow. It occurs at some newspaper companies when an ad is checked after complaints of a printed ad. For the correctness of colour, the newspapers trust the advertiser to send a correctly colour managed advertisement. The newspaper companies trust the production equipments to be correctly calibrated and that the ICC-profiles are optimised for the printing, and then control the colour printing expressly by the grey code.



**Figure 1.** Newspaper productions flow consisting of mainly three parts; image processing and editing, advertisement receiving and managing and printing flows.

### Present colour management systems used at newspaper companies

Today the analogue photos are made, developed and scanned, or made digitally, and transferred to the computer, where the images are for example pared and sharpened, and later saved in RGB-mode. The editor then decides the size and paring of the image in the article. Subsequently the image is separated by ICC (International Colour Consortium) profiles, [ICC 01], pared etcetera (depending on what the editor have decided for the image to fit in article), in the autorepro, Figure 1; Image Processing Flow.

Approximately ten percent of the ads received by the newspaper companies are incorrect in some way (e.g. unseparated and wrong resolution) [Leckner 02, 1]. The incorrect ads are then separated by force,

which usually gives satisfactory results. As a receipt of the ads submitted, the newspaper company saves an unopened copy of the ad or print out one of each separation on a black and white printer, in case of later complaint of the printed ad, Figure 1; Advertising Flow. If there is a complaint of the ad, the newspaper company unpack the saved copy and use visual soft proofing or hard copy prints, as well as measuring the grey balks, to reveal who was responsible for the misprinted ad, the newspaper or the advertiser.

For the premedia and printing flow, the operator controls the process by computers by checking the adjustment of the printing set-up and the page content visually on monitors and by digital measurements, Figure 1; Printing Flow. At some newspaper companies the advertisers are able to connect to a browser and view their ads by the time the ads are made to plate. In this stage the advertiser can make a complaint if not satisfied, before printing. Though there is no colour management guarantee at this stage at present (so this part has no actually purpose).

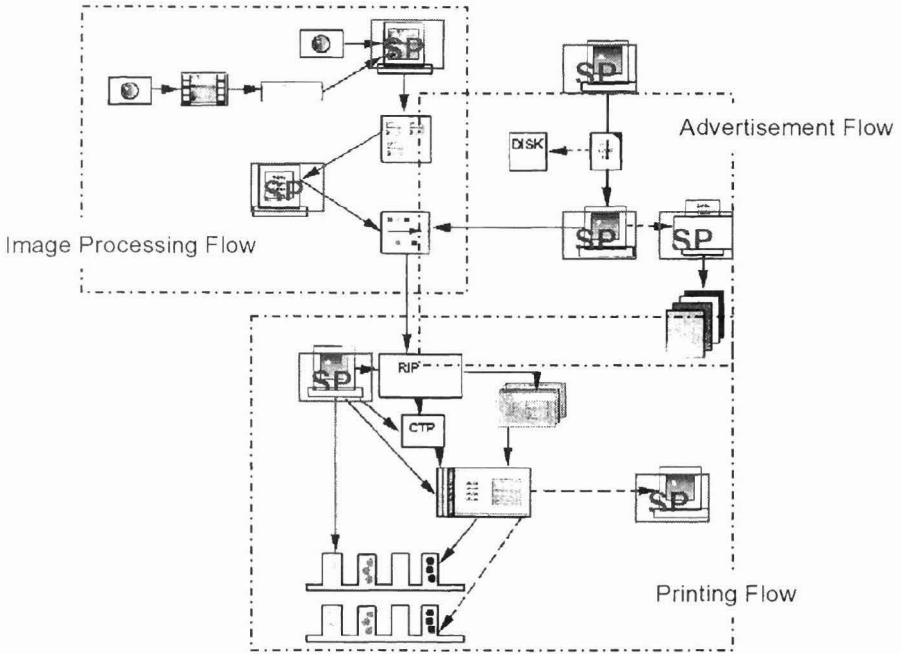
### **Proposed colour management systems using LCDs**

The checking of the colour quality in the newspaper reproduction flow is quite marginal at present. Since printed hard proof is time consuming and costly and the display technology is rapidly developing, the colour quality of the newspaper printing would increase if the colour quality could be checked visually to a greater extent on displays during the production flow. This can be carried out without much loss of time, compared to printed proofs. The hard proof accuracy to the final newspaper is very good at some newspaper companies. Therefore it is only a matter of equipment and routines to get the quality of the soft proof in the same standard as the hard proof.

LCDs seem ideal for the newspaper production flow with their small volumes in already crowded editorial departments, and considering ergonomic aspects such as higher resolution, no flicker and higher luminance, which reduces fatigue and eye constraint, and larger monitor surface compared to volume, which is ideal for edition of newspaper pages.

Generally the lack of adjusted standardised ambient light in the premedia premises precludes correct colour accuracy proofing conditions, as well as lack of frequent calibration and colour management routines. These factors are not vital for the colour management workflow but essential. And quite easily attended.

The proposed colour management flow is shown in Figure 2.



**Figure 2.** Newspaper productions flow with proposed soft proofing stations and places where LCD would fit as proofing display (SP).

At the image processing, where the newspaper article graphics are entered into the system and processed; the colour reproduction is most essential. Since the stability, colour reproduction and viewing angles of present LCDs are good enough [Gibson et. al, 00, Leckner, 02, 2 ]; LCDs could be used in the image processing part of the newspaper production flow. Since the image managing process is rather automated the editor could do the imaging processing instead of an image operator, saving time and money, Figure 2; Image Processing Flow.

With today's technical development of LCDs, the advertisers are probably going to use LCDs to a greater extent. The colour management, if calibration and correct set-up have been executed properly, is similar on a LCD and a CRT monitor. Already when the newspaper receives the ad, Figure 1; Advertisement Flow, the colour should be checked to be

correct, Figure 2; Advertisement Flow, not only halted by force when non-separations and erroneous resolution occur. Today the advertising material is sent to the newspaper companies mainly electronically and in different file formats. The tendency is that the newspaper companies soon will receive all the ads in Portable Document Format (PDF) or PS [TU, 02]. If a grey balance/measuring strips or similar is included in the PDF ad file, the colour would be checked already in the initiation of the production flow by soft proofing (on LCD), Figure 2; Advertisement Flow. This would avoid printed proofs/separations and would streamline the digitalised workflow and improve the final colour prints.

Correctly reproduced colour on (LCD) displays would also serve the repro process, since the colour could be controlled visually through the rip, film and plate process, Figure 1; Printing Flow. To allow the advertiser to check the ad during the production flow and point out eventual mistakes before the ad is being printed would benefit the final print and avoid reprinting. This presupposes that the newspaper colour management system is correctly calibrated as well as the advertiser's devices.

## **UNIQUE LCD PROBLEMS AND POSSIBILITIES**

This part of the paper discuss desktop TFT-LCD problems and possibilities on the basis of the context of this paper, i.e. principally from the initial position of a newspaper premedia production flow.

### **LCDs compared to CRTs**

CRT has been used for a number of years in the graphic industry for visual matching, image processing and soft proofing, where correct colour reproduction is essential. The factors that have an impact on the colour reproduction on a CRT are well known, but the CRT technology is not optimal. Especially for newspaper production LCDs would be advantageous with its smaller volume and ergonomic advantages. Quite recently, the LCD technology has become so advanced that the LCD is a viable alternative for professional colour image work in the graphic industry, but colour reproduction for LCD panels is different from that of CRT display.

## **Checklist of important variables**

A list of factors influencing TFTLCD colour performance includes backlight and colour filter characteristics, quality of panel drive electronics, analogue and digital graphics adapter electronics, LCD array design, pixel/cell design and liquid crystal mode. This difference in technology between LCD and CRT monitors, results in different proceedings and specifications in parts of the calibration and characterisation process. Since the high-end LCD technology still is quite recent, some of these characteristics have been investigated, but some have not. While some trends of different characteristics are common to all LCDs, presently there are no standard characteristics, such as those exhibited by CRT monitors, [Wright, 00].

The main drawback that pleads against the use of LCD technology in colour management workflows is the inability of correct calibration, the colour variations depending on viewing angle and non-uniformity of colours. To calibrate a monitor correctly, adjustments such as luminance, contrast, temperature and RGB-channel must be controlled. Today, these settings are still not adjustable on most LCDs, which make the correct calibration impossible, even though a special calibration tool is used. The colour reproduced on a LCD depends on viewing angle and furthermore it is more legible at vertical than horizontal angles. Non-uniformity is not a specific LCD problem but can more commonly appear on larger sized monitors. These technical limitations would not be a problem for using the LCD for correct colour reproduction if only the user pays attention to these problems. This would require definite guidance for the LCD soft proofing operators. The LCD technology is actually not poorer than CRT technology, but different. Using LCDs for colour critical works are more related to attentive operators, than actual technical limitations.



For best colour reproduction on a LCD some factors should be considered:

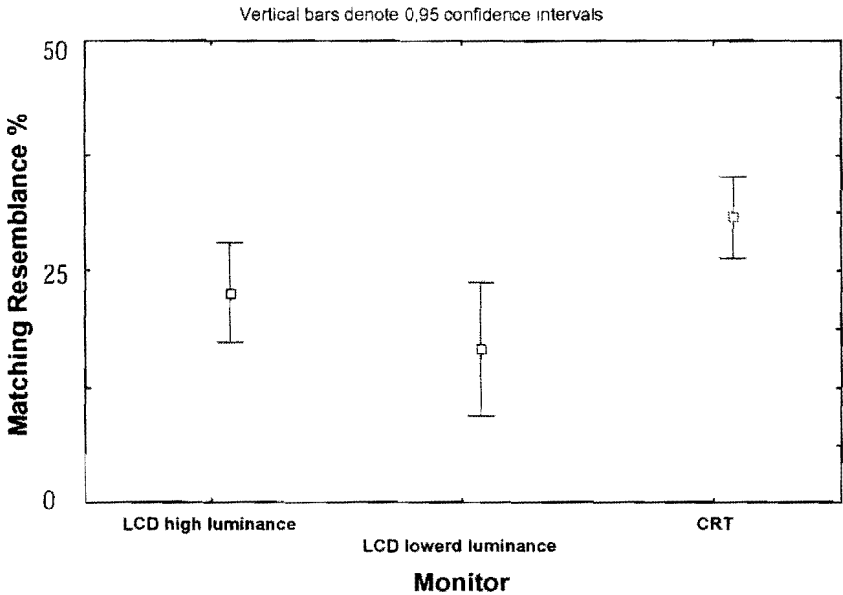
- As well as for CRTs some monitor brands are more suited for colour reproduction than others, and the same is true for LCDs. The monitor specifications will give this information.
- Using a LCD with digital connection (DVI-D) gives an image with better colour quality than reproduced on a CRT monitor. In analogical systems like CRTs the data signals are converted to analogy waves that form the electromagnetic beams in the cathode ray tubes. In LCDs this conversion needs to be done twice, digital to analogue in the video card and then back again to digital in the display. This makes the screened image poorer (less resolution and sharpness), especially when moving objects are displayed.
- Since each cell on an LCD is set to on or off individually and present LCDs are of high resolution, it is not surprising if a couple of pixels are broken. Usually, they do not brake during usage, but can be broken during manufacture.
- The same as mentioned about the above item can be said about uneven backlight. Both broken pixels and uneven backlight distribution should be checked while the LCD is purchased.

The benefits of desktop TFT-LCD technology compared to CRTs are greater colour gamut, higher contrast ratio, more stable colours (compared to the CRT which reproduces colour by three electron guns that have to be correctly adjusted), sharper image quality (because of the digital signal), ergonomic benefits such as no flicker, less volume, less electromagnetic fields to mention some advantages.

## DISCUSSION

In a recent psychophysical research of print quality, observers were asked to compare hard copies and soft copies displays on LCD and CRT, [Leckner, 02, 3]. Newsprint was one of the image qualities. The judgement of the observers showed that, images printed on newsprint compared to the soft copy image, were perceived almost equal regardless of what monitor (CRT or LCD) they were reproduced on, shown in Figure 3. This first study (which will be further investigated) suggests that LCDs serve as well as CRTs as soft proofing tool for newsprint

images, though the resemblance for both displays are lower for newsprint (lower quality paper) than for higher quality papers (e.g. coated paper), which probably are dependent on the architecture of the ICC-profiles as well as display technology. Present LCD technology is improving concerning important aspects for colour reproduction and it can already be considered to reproduce good enough quality for newsprints.



**Figure 3.** Matching resemblance between hard and soft copy for newsprint images. The results show that the resemblance is highest on the CRT monitor, but the LCD on full luminance showing similar resemblance to the printed hard copy image. When the luminance of the LCD is decreased to the luminance of the CRT (about 100 cd/m<sup>2</sup>) the resemblance decreases for low reflective paper as newsprint [Leckner, 02, 3].

The colour management equipment manufacture market has still not kept up with the development of LCDs, e.g. ICC-profile architecture and soft ware. They are also not adapted for the LCD technology. Even though this will not affect the colour management to a great extent, the reproduction of images on LCDs will probably benefit from correctly adapted profile architecture equipments, e.g. profile soft wares.

## FUTURE INVESTIGATIONS

In future work we will further investigate the ability of soft proofing newsprints on LCDs, by making extended psychophysical research of print quality involving the perceptibility of observers working professionally with ads-print production.

We will also look into a way of using digital receipt when sending and receiving colour images, in operations where preserved colours are of great importance e.g. the advertisement process.

## CONCLUSIONS

The colour reproduction of newspaper prints is comparatively good today. Using calibrated and characterised colour soft proof to a higher extent in the newspaper production flow than at present, would give greater control of the colour accuracy throughout the premedia production flow and result in a more stable colour reproduction. The use of soft proofs would have a minor influence on the time totally utilised in the production flow and is easily implemented, since the production is getting more and more digitalised and automated. Regular calibration routines and high-end equipment, as well as straight guidance for the operators in the production flow, especially when starting to use new equipment as LCDs and colour management software systems, is essential for receiving a stable and controlled colour workflow. Factors that are not instantly vitally to correct in the newspaper production flow, as for example correctly standardised ambient light, would if corrected increase the colour management. The colour control is especially important for the colours in the advertisements that are the most costly part for the newspaper companies, would benefit from being checked when received at the newspaper company, e.g. by digital measuring of the colours or grey balance strips included concealed in the advertisement file.

The newspaper industry should be able to use LCD in their production workflows with satisfactory results. The LCD technology for desktop TFT-LCD with digital connection suited for colour reproduction is good enough today, since the colour gamut, brightness and resolution are higher compared to CRT monitors. Still, the LCD technology is not optimally developed, and a few applications remain where CRTs are better suited for colour reproduction, such as for example, correct calibration, but such LCD displays are on their way to be introduced on the market. However, in a time critical production flow such as in

newspaper production with higher colour tolerance levels, the LCD technology is advantageous having greater monitor size and smaller volume and a number of ergonomic advantages. The factors that plead against the colour reproduction of LCDs is that larger sized monitors can show non-uniformity, calibration is difficult depending on manufacture, and the viewing angle can change the colour.

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